NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA
SURATHKAL

MINUTES

OF

TWENTY FIRST MEETING OF BOARD OF STUDIES

Date : **08.06.2012(Friday)**
Time : **02.00 PM**
Venue : **Board Room,**
N.I.T.K., Surathkal,
Post Srinivasnagar,
PIN - 575 025.

Minutes of the Twenty first combined Board of Studies (UG, PG, Research) Meeting held on 08th June, 2012 at 02.00 p.m. in the Board Room, NITK, Surathkal.

Members Present:

1. Dr. Sumam David	...	Chairman
2. Dr. K. C. Shet	...	Member
3. Dr. Lakshman N	...	Member
4. Dr. G. Umesh	...	Member
5. Dr. S. G. Mayya	...	Member
6. Dr. DVR Murthy	...	Member
7. Dr. M. K. Nagaraj	...	Member
8. Dr. A. Mahesha	...	Member
9. Dr. A. U. Ravishankar	...	Member
10. Dr. Harshavardhan	...	Member
11. Mr. A. R. Pais	...	representing Dept. of CSE
12. Dr. M. S. Bhat	...	representing Dept. of E&C
13. Dr. K. N. Shubhanga & Mrs. U. Vinutha	...	representing Dept. of E&E
14. Dr. G. Ram Mohan Reddy	...	Member
15. Dr. G.C. Mohan Kumar	...	Member
16. Dr. Chitharanjan Hegde	...	Member
17. Dr. S. M Hegde	...	Member
18. Dr. Udayashankar	...	Member
19. Dr. Shashikantha	...	Member
20. Dr. A. H. Sequeira	...	Member
21. Dr. Vidya Shetty	...	representing Dept. of Chemical Engg
22. Dr. Jagannath Nayak	...	Member
23. Dr. Subhash C. Yaragal	...	Member
24. Dr. Y. Suresh Kumar	...	Member
25. Dr. M. Govinda Raj	...	Member
26. Dr. V. Ramachandra	...	External Member
27. Prof. N. B. Ballal	...	External Member
28. Mr. K. Ravindranath	...	Secretary

Members Absent:

1. Dr. Gopal Mugeraya	...	Member
2. Dr. K. P. Halemane	...	Member
3. Dr. K. Chandrasekharan	...	Member
4. Dr. K. N. Lokesh	...	Member
5. Dr. Lillykutty Jacob	...	External member
6. Prof. K. B. R. Varma	...	External member

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Minutes of Twenty First BOS meeting held on 08.06.2012

The Chairman (BOS) and Dean (Academic) chaired the meeting and welcomed all the members to the **Twenty First BOS meeting** and introduced new BOS members.

The minutes of **Twentieth BOS** meeting was reviewed and approved as there were no comments received from the members.

ITEM No: 21-BOS - 1:
Modification in B.Tech Regulations based on Item No. 29 – Senate - E1 – 20 BOS-17
To be effective from B.Tech admissions2012-13.

Existing

3.1 The total course package for a B.Tech Degree Programme will typically consist of the following components.

(a) Basic Science Core Courses	BSC ≥ 20 Credits
(b) Engineering Science Core Courses	ESC ≥ 28 Credits
(c) Humanities and Social Science Core Courses	HSC ≥ 10 Credits
(d) Programme Core Courses	PC ≥ 60 Credits
(e) Elective Courses	
An Elective Course can be any of the following:Ele	
Programme Specific Electives	PSE ≥ 18 Credits
Open Electives	OE ≤ 24 Credits
(f) Departmental / Programme Major Project	PMP = 10 Credits
(g) Mandatory Learning Courses	MLC = 03 Credits

The Minimum Credit Requirement for the B.Tech Degree is 191 to 195.

Proposed

3.1 The total course package for a B.Tech Degree Programme will typically consist of the following components.

(a) Foundation Courses	FC	45 –55 Credits
A Foundation Course can be any of the following: Basic Science Core Courses (BSC), Engineering Science Core Courses (ESC), Humanities and Social Science Core Courses (HSC)		
(b) Programme Core Courses	PC	≥ 60 Credits
(c) Elective Courses	ELE	≥ 50 Credits
An Elective Course can be any of the following: ProgrammeSpecific Electives (PSE) Open Electives (OE)		
(d) Project (Mini Projects and Major Project)	MP	8 - 12 Credits
(e) Mandatory Learning Courses	MLC	5 - 6 Credits

The Minimum Credit Requirement for the B.Tech Degree is 170 to 180.

For Senate Approval

Project (MP)
Project work may consist of Major Project and Mini Projects (optional) offered by parent department. The Major Project is a course with 8 - 12 credits and can comprise of Part I and Part II, spread over 1 or 2 semesters of final year, preferably during 7th and 8th semesters (or as recommended by DUGC). DUGC may prescribe Mini Project as a requirement for the B. Tech Degree or in lieu of equivalent elective credits. The method of evaluation for major and minor projects shall be evolved by pertinent DUGC and appropriate double-letter grade is awarded which will be considered for SGPA and CGPA calculation

Mandatory Learning Courses:
These are courses that must be completed by the student at appropriate time. The 'S' grade is awarded for satisfactory completion of the course and 'N' grade is awarded for non-completion of the course. The 'S' and 'N' grades do not carry grade-points and hence not included in the SGPA, CGPA computations

Courses that come under this category are the following:

(a) ***Environmental Studies:***This is a 1 credit course, coordinated by Department of Civil Engineering and the student is required to complete this course during 1st / 2nd semester

(b) ***Professional Ethics and Human Values:*** This is a 1 credit course, coordinated by Department of Humanities, Social Sciences and Management and the student is required to complete this course during 1st / 2nd semester

(c) ***Seminar:*** The student will make presentations on topics of academic interest

(d) ***Practical Training:*** The student may complete the training before the beginning of the 7th semester (or as stipulated by the DUGC) and register for it in 7th Semester. The duration and the details shall be decided by the Faculty Advisor with approval from DUGC

(e) ***Professional Practice (optional):*** *It consists of special lectures arranges by the parent department and approved by DUGC.*

The BOS resolved to approve the modification in B.Tech regulations and recommended for Senate approval.

ITEM No: 21-BOS - 2:
Modification in B.Tech Regulations – Lower and upper limits for course credits in a semester
To be effective from B.Tech admissions2012-13.

For Senate Approval

The BOS resolved to approve reduction in the lower and upper limits of course credits registered in a semester by a full-time student of B.Tech program to 12 credits and 30 credits respectively.

ITEM No: 21-BOS - 3:
Revised Curriculum for First year B.Tech
To be effective from B.Tech admissions2012-13.

The BOS resolved to approve the revised curriculum for Foundation Courses and first year common courses and recommended for Senate approval.

The first semester of B.Tech program would be common, departments will have the option of introducing one branch specific course in the second semester to facilitate early induction of the students to the department. Office hours for discussions with students is to be included in the time table for each course.

The revised curriculum for Foundation Courses common to all B.Tech programs and first year common courses is enclosed as ***Annexure –I [P. No.14-21]***

For Senate Approval

ITEM No: 21-BOS - 4:
Modification of B.Tech Regulations – Change of Branch
To be effective from B.Tech admissions 2012-13.

Existing	Proposed
7. CHANGE OF BRANCH: 7.2 Normally, only those students will be eligible for consideration of a change of branch, after the second semester, who have – a) completed all the common credits required in the first two semesters of their studies, in their first attempt; b) obtained a SGPA of not less than 8.00 (7.00 for SC/ST) in both the FIRST as well as the SECOND semester;	**7. CHANGE OF BRANCH:** 7.2 Normally, only those students will be eligible for consideration of a change of branch, after the second semester, who have – a) completed all the common credits required in the first two semesters of their studies, in their first attempt; b) obtained a SGPA of not less than 8.00 (7.00 for SC/ST) in both the FIRST as well as the SECOND semester ***c) secured no failing grades in any of the courses***
7.3 Change of branch shall be strictly in order of merit of the applicants. For this purpose the CGPA obtained at the end of the second semester shall be considered. In case of a tie, the AIEEE rank of the applicants will be considered. The change of branch is permitted only to vacancies as per eligibility and category of admission.	7.3 Change of branch shall be strictly in order of merit of the applicants. For this purpose the ***CGPA obtained at the end of the second semester for common credits*** shall be considered. In case of a tie, the AIEEE rank of the applicants will be considered. The change of branch is permitted only to vacancies as per eligibility and category of admission.

The BOS resolved to approve the modification in the B.Tech Regulations for branch change and recommended for Senate approval.

For Senate Approval

M No: 21-BOS - 5:

vised Curriculum for B.Tech programs

be effective from B.Tech admissions 2012-13.

a) **Chemical Engineering (CH)**
The BOS resolved to approve the revised curriculum structure and contents for B.Tech program in Chemical Engineering. The details are enclosed as *Annexure- II [P.No.22-28]*

b) **Civil Engineering (CV)**
The BOS resolved to approve the revised curriculum structure and contents for B.Tech program in Civil Engineering. The details are enclosed as *Annexure-III [P.No.29-45]*

c) **Computer Engineering (CO)**
The BOS resolved to approve the revised curriculum structure and contents for B.Tech program in Computer Engineering. The details are enclosed as *Annexure-IV [P.No.46-62]*

d) **Electrical and Electronics Engineering (EE)**
The BOS resolved to approve the revised curriculum structure and contents for B.Tech program in Electrical and Electronics Engineering. The details are enclosed as *Annexure- V [P.No.63-82]*

e) **Electronics and Communication Engineering (EC)**
The BOS resolved to approve the revised curriculum structure and contents for B.Tech program in Electronics and Communication Engineering. The details are enclosed as *Annexure-VI [P.No.83-102]*

For Senate Approval

f) **Information Technology (IT)**
The BOS resolved to approve the revised curriculum structure and contents for B.Tech program in Information Technology. The details are enclosed as *Annexure-VII [P.No.103-113]*

g) **Mechanical Engineering (ME)**
The BOS resolved to approve the revised curriculum structure and contents for B.Tech program in Mechanical Engineering. The details are enclosed as *Annexure-VIII [P.No.114-130]*

h) **Metallurgical and Materials Engineering (MT)**
The BOS resolved to approve the revised curriculum structure and contents for B.Tech program in Metallurgical and Materials Engineering. The details are enclosed as *Annexure- IX [P.No.131-145]*

i) **Mining Engineering (MN)**
The BOS resolved to approve the revised curriculum structure and contents for B.Tech program in Mining Engineering. The details are enclosed as *Annexure-X [P.No.146-158]*

j) **Applied Mechanics & Hydraulics (AM)**
The BOS resolved to approve the revised curriculum structure and contents for undergraduate programs. The details are enclosed as ***Annexure-XI [P.No.159]***

k) **Physics (PH)**
The BOS resolved to approve the revised curriculum for I B.Tech Physics PH100(Theory) and PH101 (Lab) Courses. The details are enclosed as ***Annexure-XII [P.No.160-162]***

l) **Humanities, Social Sciences and Management (HU)**
The BOS resolved to approve the revised curriculum for Management Theory and Practice (HU 301) renamed as Principles of Management (HU302). The details are enclosed as ***Annexure- XIII [P.No.163]***

The DUGCs were requested to make corrections suggested by the BOS. The Chairman BOS was authorised to approve the corrected B.Tech curriculum submitted by the respective DUGCs and place them before the Senate.

Item No. 21- BOS -6
Revised Curriculum for M.Tech programs.
To be effective from M.Tech admissions 2012-13.

(a) **Computer Science and Engineering (CSE)**
The BOS resolved to approve the revised curriculum structure and contents for M.Tech program in Computer Science & Engineering. The details are enclosed as ***Annexure- XIV [P.No.164-171]***

(b) **Computer Science and Engineering (CSE-IS)**
The BOS resolved that at least 50% of Program Core should be different between two M.Tech programs. The DPGC of Department of Computer Science & Engineering was asked to revise and resubmit the curriculum of M.Tech Computer Science and Engineering - Information Security. The Chairman BOS was authorized to approve it and place it before the Senate. The details are enclosed as ***Annexure- XV[P.No.172-178]***

For Senate Approval

(c) **Information Technology (IT)**
The BOS resolved to approve the revised curriculum structure and contents for M.Tech program in Information Technology. The details are enclosed as ***Annexure-XVI [P.No.179-186]***

(d) **Industrial Biotechnology (IB)**
The BOS resolved to approve the revised curriculum structure and contents for M.Tech program in Industrial Biotechnology and inclusion of two new electives. The details are enclosed as ***Annexure-XVII [P.No.187-193]***

(e) **Materials Engineering (ML)**
The BOS resolved to approve the revised curriculum structure and contents for M.Tech program in Materials Engineering. The details are enclosed as ***Annexure-XVIII [P.No.194-198]***

(f) **Process Metallurgy(PM)**
The BOS resolved to approve the revised curriculum structure and contents for M.Tech program in Process Metallurgy. The details are enclosed as *Annexure- XIX[P.No.199-202]*

(g) **Nanotechnology (NT)**
The BOS resolved to approve the revised curriculum structure and contents for M.Tech program in Nanotechnology. The details are enclosed as *Annexure- XX[P.No.203-209]*

(h) **Systems Analysis and Computer Applications (SACA)**
The BOS resolved to approve the revised curriculum structure and contents for M.Tech program in Systems Analysis and Computer Applications (SACA). The details are enclosed as *Annexure-XXI [P.No.210-219]*

(i) **Communication Engineering (CE)**
The BOS resolved to approve the revised curriculum structure and contents for M.Tech program in Communication Engineering. The details are enclosed as *Annexure-XXII [P.No.220]*

(j) **VLSI Design (VL)**
The BOS resolved to approve the revised curriculum structure and contents for M.Tech program in VLSI Design. The details are enclosed as *Annexure- XXIII [P.221-235]*

The DPGC's were requested to make corrections suggested by the BOS. The Chairman, BOS was authorised to approve the same and place it before the Senate.

Item No. 21- BOS -7
Revised Curriculum for M.Sc programs
To be effective from M.Sc admissions 2012-13

(a) **Physics (PH)**
The BOS resolved to approve the revised curriculum structure and contents for M.Sc (Physics). The details are enclosed as *Annexure- XXIV [P.No.236-244]*

(b) **Chemistry (CY)**
The BOS resolved to approve the revised curriculum structure and contents for M.Sc (Chemistry). The details are enclosed as *Annexure-XXV [P.No.245-256]*

For Senate Approval

The DPGC's were requested to make corrections suggested by the BOS. The Chairman, BOS was authorised to approve the same and place it before the Senate.

Item No. 21- BOS -8 **Revised Curriculum for MBA programs** *To be effective from MBA admissions 2012-13* The BOS resolved that the total credit requirement for MBA program be reduced to 90 credits. The DPGC of Department of Humanities, Social Sciences and Management was asked to revise and resubmit the curriculum structure and contents of MBA program along with changes required in MBA regulations. ***(Annexure – XXVI, P. No.257-288)*** The Chairman, BOS was authorised to approve it and place it before the Senate.	*For Senate Approval*

Item No. 21 – BOS-9 **Revised Curriculum for Ph.D** *To be effective from Ph.D admissions 2012-13* (a) **Computer Science and Engineering (CSE)** The BOS resolved to approve the revised 900 level courses for Ph.D students in the Department of Computer Science and Engineering. The details are enclosed as ***Annexure-XXVII [P.No.289-291]*** (b) **Metallurgical and Materials Engineering** The BOS resolved to approve the revised 900 level courses for Ph.D students in the Department of Metallurgical and Materials Engineering. The details are enclosed as ***Annexure-XXVIII [P.No.292-294]***	*For Senate Approval*

Item No. 21- BOS -10 **Introduction of a course on Introduction to Research as an MLC for all Ph.D and M.Tech (Research) programs** *To be effective from admissions 2012-13* According to UGC Ph.D regulation 2009, all research scholars are to credit a course on Research Methodology which includes quantitative methods and Computer Applications. The BOS resolved to approve introduction of a mandatory learning course with 2 credits **Introduction to Research** in the program structure for all Ph.D and M.Tech (Research) programs. The course will be coordinated by Department of Humanities, Social Sciences and Management and will be supported by all other Departments. The details of the course are enclosed as ***Annexure- XXIX[P.No.295]***	*For Senate Approval*

Item No. 21- BOS -11 **Equivalent Subjects of 2011-UG Curriculum.** The BOS deferred the subject as the equivalent subject list submitted by DUGC of Department of IT was incomplete. The matter may be placed before the next BOS meeting.	*For reporting to Senate*

Item No. 21- BOS -12 **Relaxation of Elective credits-B.Tech Curriculum -2012.** (a) **Chemical Engineering(CH)- (Annexure XXX,P.No.296)** (b) **Metallurgical and Materials Engineering (Annexure XXXI, P.No.297)** The DUGC of the Department of Chemical Engineering and Metallurgical and Materials Engineering proposed relaxation in minimum elective credit requirement for electives in B.Tech Curriculum 2012 to $\geq$ 40 credits and $\geq$ 30 credits respectively. The BOS resolved to recommend minimum credit requirement for elective courses to $\geq$ 40 credits in B.Tech curriculum 2012.	*For Senate Approval*

Item No. 21- BOS -13 **Make-up exams.** The BOS resolved to approve the following recommendations with effect from B.Tech Curriculum 2012. 1. Only regular registrants of a given course during a given academic semester who have obtained FF grade in the course be permitted to appear for the make up examination. 2. Students who continue to have FF grade after the make up examination are required to re-register for the course whenever it is offered subsequently. *(Annexure – XXXII, P. No.298)*	*For Senate Approval*

Item No. 21- BOS -14 **Evaluate the need for Summer Course.** In B.Tech curriculum 2012, the total credit requirement is 170-180 and the average number of credits/semester is 21-23. Hence the students who have obtained FA grades will have free slots to re-register for these courses during the regular semester. Therefore the BOS resolves to recommend to the Board to cancel the provision to offer courses for such students during the summer term. *(Annexure – XXXIII, P. No.299)*	*For Senate Approval*

Item No. 21- BOS -15 **Masters Degree in Science and Management for enrollment to PhD admissions in the Department of Mining Engineering.** The BOS deferred the subject and the DRPC was asked to resubmit mentioning specific M.Sc disciplines of relevance to the Department of Mining Engineering.	*For reporting to Senate*

Item No. 21- BOS -16 **Modifications in Ph.D Regulations – Constitution of RPAC** *To be effective from Academic Year 2012-13* At present the RPAC consists of Guide(s), one Faculty from within Division and one from outside the Division selected by Dean (A) from the recommended panel. The BOS resolve to approve inclusion of one subject expert from the Institute nominated by the DRPC as member of RPAC.	***For Senate Approval***

Item No. 21- BOS -17
Modifications in Ph.D Regulations
To be effective from Academic year 2012-2013

Existing	Proposed
5.4.4 (a) Certificate from the Chairman DRPC that the presynopsis seminar has been completed satisfactorily	5.4.4 (a) Certificate from the RPAC that the presynopsis seminar has been completed satisfactorily

The BOS resolved to approve the modification in Ph.D curriculum.

For Senate Approval

Item No. 21- BOS -18 **Ph.D/M.Tech/M.Tech (Research)/M.Sc/MCA/MBA thesis format** *To be effective from Academic year 2012-2013* In order to reduce consumption of paper it is proposed that all project reports UG, PG as well as PhD thesis, synopsis and progress reports may be prepared by printing on both sides of paper (back to back). Page margin: odd numbered pages - Left 1.5", top 1.5", right 1", bottom 1"and for even numbered pages - Left 1", top 1.5", right 1.5" and bottom 1". The BOS resolved to approve the revised thesis format.	***For Senate Approval***

Reporting/Ratification Item:

Item No. 21- BOS -19
Introduction of new elective.

The BOS noted the introduction of elective ST 815 "Fracture Mechanics of Concrete" to be offered to M.Tech (Structural Engineering) students during January-May 2012.

Item No. 21- BOS -20
Inclusion as a Research Guide in the Department of Mining Engineering.
(Dr. K. Ramachander)

The BOS noted the inclusion of Dr. K. Ramachander as Research Guide in the Department of Mining Engineering.

The Secretary (BOS) proposed the vote of thanks to the chair and to the members.

(K. Ravindranath)
Secretary –BOS, NITK

(Dr. Sumam David S)
Chairman-BOS, NITK

***

Bachelor of Technology

List of Foundation Core Courses (FC) Common to All Undergraduate Programmes

Basic Science Core (BSC)		
MA110	Engineering Mathematics – I	(3-0-0) 3
MA111	Engineering Mathematics – II	(3-0-0) 3
PH110	Physics	(3-1-0) 4
PH111	Physics Laboratory	(0-0-2) 1
CY110	Chemistry	(3-0-0) 3
CY111	Chemistry Laboratory	(0-0-3) 2
Engineering Science Core (ESC)		
AM110	Engineering Mechanics	(3-0-0) 3
EE110	Elements of Electrical Engg.	(3-0-0) 3
EC110	Elements of Electronics & Communication Engg.	(3-0-0) 3
ME110	Elements of Mechanical Engineering	(3-0-0) 3
ME111	Engineering Graphics	(1-0-3) 3
CO110	Computer Programming	(3-1-0) 4
CO111	Computer Programming Lab	(0-0-2) 1
Humanities and Social Science Core (HSC)		
HU110	Professional Communication	(3-0-0) 3
HU300	Engineering Economics	(3-0-3)3
HU302	Principles of Management	(3-0-3)3
Mandatory Learning Courses (MLC)		
CV110	Environmental Studies	(1-0-0) 1
HU111	Professional Ethics and Human Values	(1-0-0) 1

First Year Bachelor of Technology

List of Core Courses Common to All Undergraduate Programmes

Basic Science Core (BSC)		
MA110	Engineering Mathematics – I	(3-0-0) 3
MA111	Engineering Mathematics – II	(3-0-0) 3
PH110	Physics	(3-1-0) 4
PH111	Physics Laboratory	(0-0-2) 1
CY110	Chemistry	(3-0-0) 3
CY111	Chemistry Laboratory	(0-0-3) 2
Engineering Science Core (ESC)		
AM110	Engineering Mechanics	(3-0-0) 3
EE110	Elements of Electrical Engg.	(3-0-0) 3
EC110	Elements of Electronics & Communication Engg.	(3-0-0) 3
ME110	Elements of Mechanical Engineering	(3-0-0) 3
ME111	Engineering Graphics	(1-0-3) 3
CO110	Computer Programming	(3-1-0) 4
CO111	Computer Programming Lab	(0-0-2) 1
Humanities and Social Science Core (HSC)		
HU110	Professional Communication	(3-0-0) 3
Mandatory Learning Courses (MLC)		
CV110	Environmental Studies	(1-0-0) 1
HU111	Professional Ethics and Human Values	(1-0-0) 1

Suggested Plan of Study:

GROUP – I (S1-S5)

Semester →	I	II
	(Chemistry Cycle)	(Physics Cycle)
1	MA110	MA111
2	CY110	PH110
3	HU110	CO110
4	AM110	ME110
5	EE110	EC110
6	ME111	PH111
7	CY111	CO111
8	CV110	HU111
9		Department Course (Optional)

GROUP – II (S6-S10)

Semester →	I	II
	(Physics Cycle)	(Chemistry Cycle)
1	MA110	MA111
2	PH110	CY110
3	CO110	HU110
4	ME110	AM110
5	EC110	EE110
6	PH111	ME111
7	CO111	CY111
8	HU111	CV110
9		Department Course (Optional)

PROPOSED COURSE CONTENTS OF I YEAR B.TECH
(2012 Curriculum)

CV110 ENVIRONMENTAL STUDIES (1-0-0) 1

Definition, scope and importance of Environmental Studies, Need for public awareness. Natural Resources Renewable and Non-renewable Resources. Natural resources and associated problems. Concept of an ecosystem: Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains and ecological pyramids, Biodiversity and Its Conservation, Environmental Pollution: Definition, Causes, effects and control measures. Pollution case studies. Disaster management, Social Issues and the Environment, Environmental ethics, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation, Consumerism and waste products, Acts related to Environment Protection, Isues involved in enforcement of environmental legislation, Human Population and the Environment, Field work equal to 5 lecture hours.

R. Rajagopalan, Environmental Studies, Oxford IBH Pub,2011.
Benny Joseph, Environmental Studies, McGraw Hill Pub,2008.
Erach Bharucha, Text Book for Environmental Studies, Pub., UGC,2004.
Masters, Gilbert M. Introduction to Environmental Engineering and Sciences, Prentice Hall India,2008.

HU111 PROFESSIONAL ETHICS AND HUMAN VALUES (1-0-0) 1

Professional Ethics:Engineering as a Profession, Aim of Engineering, Responsibilities of Engineers, Rights of Engineers, Impediments to Responsibilties , Honesty, Integrity, Reliablity, Risk, Safety and Liability, Global Issues.

Personal Ethics: Value of Self, others and Society, Compliance with Law, Social Norms, Service to Community, Engineer's Responsibilities to Economically Deprived Peoples and Environment, Corruption, Indian and Western Culture, Simple Living and High Thinking, Science and Spirituality.

Charles E. Harris et al., Engineering Ethics,Cengage Learning, 2009
Govindarajan M, Engineering Ethics:PHI 2004.
Fleddermann, Charles D. Engineering Ethics:Pearson Education 2004
Baura Gail D. Engineering Ethics:Academic Press 2006

AM110 ENGINEERING MECHANICS (3-0-0) 3

Fundamentals of force system, Concept of Rigid body and deformable bodies, Free body diagrams. Support Reactions-Determinate and Indeterminate structures. Analysis of Trusses, Frames and Machines. Centroid and Moment of Inertia of plane areas. Shear Force and Bending Moment Diagrams. Simple stress and strain, Hooke's Law, Mechanical properties of materials, Elastic Constants.

Merian, J.L, Kraige, L.G. Engineering Mechanics – Statics, 5th Edition, Wiley Publishers, New-Delhi, 2007.
Beer & Johnston, Mechanics for Engineers, 4th Edition, McGraw – Hill, New Delhi, 1987.
Timoshenko, S.P., Young, D.H., Rao, J.V. Engineering Machines,4th Edition, McGraw-Hill, Singapore, 1956.
Singer, F.L. Strength of Materials, Third Edition, Harper and Row Publishers, New York, 1980.
Hearn, E.J., Mechanics of Materials, Pergaman Press, England, 1972.
Beer and Johnston E. R. Mechanics of Materials, 3rd Edition, Tata McGraw Hill, New Delhi, 2007.

CO110 COMPUTER PROGRAMMING (3-1-0) 4

Concepts, definitions, taxonomy and history of Computer Programming, Operating systems and Program Execution basics. Problem solving and programming: strategies, programming paradigms,software development lifecycle. C programming language: C fundamentals, operators and expressions, Data input and output, Control statements, Functions, Arrays, Pointers, Dynamic memory allocations, Structure and unions, Files, Low- level Programming and Macros.

Joyce Farell, A guide to Programming Logic & Design, Course Technology, Thomson learning 2003
Brian W. Kernighan & Dennis M. Ritchie, The C Programming Language, Second edition, Printice Hall Inc.
Byron S. Gottfried, Program with C, second edition, Schaums Outline series.
Yashavanth Kanetkar, Let us C – BPB Publications. 2002
Balagurusamy, C Programming – TMH, 2002

CO111 COMPUTER PROGRAMMING LAB **(0-0-2) 1**

Introduction to fundamentals of DOS and Windows, C Programming exercise on simple statements, Control structures, Arrays, Matrices, Strings, Functions and Recursions, Structures and Unions, Bit Operations, Pointers, Dynamic Memory allocation, Files and Macros.

Brian W. Kernighan & Dennis M. Ritchie, The C Programming Language, Second edition, Printice Hall Inc.
Byron S. Gottfried, Program with C, second edition, Schaums Outline series.
Yashavant Kanetkar, Let us C BPB Publications.2002.
Balagurusamy, C Programming –TMH, 2002.

EC110 ELEMENTS OF ELECTRONICS & COMMUNICATION ENGINEERING **(3-0-0) 3**

RC & RL Circuits – low pass, high pass, transient analysis for pulse input; Diode: Principle, Characteristics, Applications (Rectifier, Clipping circuits) & Types (Zener Diode, LED, Photo diode); Transistor: Principle, Operation, Characteristics (CB,CE,CC), CE amplifier (load line analysis), Biasing, small signal model, Transistor as a switch; Digital Circuits: Basic Logic gates, Universal gates, Boolean Algebra, Combinational circuit (Half-Adder, Full-Adder, Decoder), Latch, Flip-Flop, Counters and Registers (brief description about ripple counter, SISO Register); Op-amps & its Applications: Terminal characteristics of Op-amp, Inverting and Non-inverting amplifier, Summing amplifier, Integrator, Introduction to ADC and DAC Systems: Linear power supply, SMPS, UPS, Principles of Communication Systems & Networks.

Albert Malvino, Electronic Principles, Tata McGraw Hill, 1995
Boylstead and Nashelsky, Electronic Devices and Circuits, PHI, 1998
George Kennedy & Bernard Davis, Electronic Communication System, Tata McGraw Hill, 1996
Wayne Tomasi, Electronic Communication Systems, Pearson Education, 2003
Ramakant A Gayakwad, OP-AMPS and Linear Integrated Circuits, Prentice Hall, 1999

EE110 ELEMENTS OF ELECTRICAL ENGINEERING **(3-0-0) 3**

Review of circuit elements, voltage sources, current sources, source transformation, mesh current and node voltage analysis of circuits. Network reduction techniques. Concept of the magnetic circuit. AC analysis of single phase systems, wave forms, phasor representation, the j-operator, concepts of real and reactive power and power factor. Extension of AC analysis to symmetrical 3-phase systems, phase sequence, measurement of three phase power under balanced condition. Introduction to transformers, equivalent circuits, phasor diagram, regulation and efficiency. Electro-mechanical energy conversion, three phase induction motors.

Fitzgerald, D.E. Higginbotham, A. Grabel, Basic Electrical Engineering, 5th Edition, McGraw-Hill, 2009.
William H. Hayt Jr., Jack E. Kemmerly, Steven M.Durbin, Engineering Circuit Analysis, 6th Edition,TMH, 2002
Olle I. Elgerd, Basic Electric Power Engineering, Addison-Wesley, 1977.
Edward Hughes, Electrical Technology, 7th Edition, Longman, 1995.

ME110 ELEMENTS OF MECHNICAL ENGINEERING (3-0-0) 3

Module -1: Introduction to Mechanical Engineering, Emerging trends & its role, Mechanics in Mechanical Engineering

Module -2: Materials and Stresses: Mechanical design concept, Types of drives, Friction and wear

Module 3: Prime movers, Introduction to refrigeration , certifugal pumps and compressors. Sourses of energies; conventional and renewable

Module 4 ; Manufacturing Processes :Basic processes like machining, casting, forging etc. welding , brazing and soldering. Manufacturing Systems.

Module 5: Introduction to Mechatronics, electro-mechanical elements, working principles, construction and their applications (Sensors & Actuators.)

J. Wickert, An Introduction to Mechanical Engineering, Cengage learaning, 2nd edn, 2006

Gopalkrishna K.R., Mechanical Engineering Sciences. Subhas Publications, 2001.

Roy and Choudhary, Elements of Mechanical Engineering Media Promoters and Publishers, 1975

ME111 ENGINEERING GRAPHICS (1-0-3) 3

Orthographics Projections of points, Straight lines, Planes, Solids (auxiliary plane method and Change of position method). isometric projections.

Gopalkrishna K R, Engineering Graphics (Ist angle projection) Subhas Publication,2005.

Bhat N D., Engineering Drawing. Charotar Publication 2006

CY110 CHEMISTRY (3-0-0) 3

Electrochemical Cells: Nernst equation, electrochemical series, types of electrodes, Polarization, Decomposition potential, Overvoltage, factors effecting electroplating, Electroless plating – PCB preparation. Corrosion: Types, Theory and factors affecting, Corrosion control, Galvanic series, Measurement of corrosion rate. Water Technology: Hardness of water, Boiler troubles, Internal and external treatments, Desalination. Energy: Fuels, Classification, Calorific value and its determination, Coal and its analysis, Petroleum, Catalytic cracking, Diesel and petrol knocking, Reforming of gasoline, Synthetic petrol, Power alcohol, Biodiesel, Hydrogen as a source of energy.High Polymers: Addition, Condensation and Coordination polymerization, Copolymerisation, Molecular weights and their determinations, Methods of polymerization, T_g & T_m and factors affecting them, Teflon, PMMA, UF; Elastomers - Compounding, SBR and Silicone rubbers, Conducting, biodegradable, Liquid crystal polymers. Semiconductor Chemistry: Preparation of pure semiconductors, Doping techniques. Chemistry of Nano-materials - Nano-carbons, ZnO, TiO_2.

B. R. Puri, Sharma, L. R. and Madan S Pathania, Principles of Physical Chemistry, Vishal Publishing Co., 41st Edn. 2004.

Jain, P. C. and Monika Jain, Engineering Chemistry, Dhanpat Rai & Sons, Delhi, Revised 14th Edn. 2004.

Kuriacose, J. C. and Rajaram, J., Engineering Chemistry, Volume I/II, Tata McGraw-Hill Publishing Co. Ltd. New Delhi, 2000.

Gowariker et al., Polymer Science and Technology, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.

Rao, C. N. R., Chemistry of Nanomaterials, Volume I and II, Wiley Publication, 2004.

CY111 CHEMISTRY LABORATORY (0-0-3) 2

Volumetric estimations involving metal-ion, redox, self and precipitation type indicators - analysis of water (hardness and chlorides), ores (haematite and pyrolusite); Instrumental methods of analysis - potentiometry, colorimetry, conductometry, refractometry and viscometry; Analysis of polymers, metals, alloys, and related engineering materials.

Engineering Chemistry Lab Manual, written by Faculty, Dept of Chemistry, NITK, Surathkal.

Furnis et al (ed.), Pearson, Vogel's Text book of 'Quantitative Chemical Analysis', Pearson, 2006

PH100 PHYSICS **(3-1-0) 4**

Special theory of relativity. Elements of Quantum Mechanics: Particle properties of waves : Photoelectric effect and Compton effect. Wavelike properties of particles : de Broglie hypothesis, Davisson-Germer experiment, Wave packets, phase and group velocities, uncertainty principle. Schrodinger equations – time dependent and independent and application of Schrodinger's equation to case of free particle, particle in an infinite potential well, particle in a finite potential well, tunneling with examples (only qualitative treatment). Physics of Solids : Ohms' law, Classical free electron theory. Statistical Physics: MB, FD and BE Distribution functions Semiconductors. Electrical conductivity in intrinsic and extrinsic semiconductors, effect of temperature on electrical conductivity, Hall effect, experimental determination of carrier concentration. PN junction. Dielectric Materials : Electrical polarization mechanisms, expression for dielectric constant of monatomic gases, qualitative ideas for dielectric constant of polyatomic molecules, internal fields in solids, dielectric constant of elemental solids (Claussius Mosotti equation only). Ferroelectric and Piezoelectric materials, Piezoelectric effect.

Arthur Beiser, Concepts of Modern Physics (Sixth Edition) Tata Mc Graw – Hill Publication, 1998
Kenneth.S. Krane, Modern Physics (Second Edition) Wiley International Edition,1998
A. J. Dekkar, Electrical Engineering Materials, Prentice Hall of India Ltd., 1990.
B.G Streetman, Solid State Electronic Devices, Prentice Hall of India Ltd.,1981.

PH101 PHYSICS LABORATATORY **(0-0-2) 1**

Experiments on Zener Diode Characteristics, Series Resonance, Helmhotz Resonator, Photoelectric effect, Transistor Characteristics, Hall Effect. Air-Wedge/Newton's Ring Experiment.

Arthur Beiser, Concepts of Modern Physics (Sixth Edition) Tata McGraw Hill publication, New Delhi (1998)
Kenneth.S. Krane, Modern Physics (Second Edition) Wiley International Edition (1998).
Practical Work book for I/II sem B.Tech Students
Chauhan & Singh, A Text book of Advanced Practical Physics

MA110 ENGINEERING MATHEMATICS - I **(3-0-0) 3**

Infinite series, Convergence and Divergence. Power Series, Fourier series, Half range expansions, Successive Differentiation, Polar curves, Angle between radius vector and tangent. Curvature. Mean value theorems. Functions of several variables, Partial differentiation. Taylor's theorem for a function of two variables. Extreme values. Errors and Approximations. Reduction formulas for integration, Curve tracing. Applications.

Shanti Narayan: Differntial Calculus, Shyam Lal Charitable Trust, Delhi,1990
Shanti Narayan: Integral Calculus, S. Chand & Co., Delhi, 1989
C.B. Thomas and Finney: Calculus and Analytical Geometry, Pearson 2010
R. Courant and F. John: Introduction to Calculus, Vols. I & II, Springer Verlag (Indian Edn) 1989.

MA111 ENGINEERING MATHEMATICS - II **(3-0-0) 3**

Vector Calculus, Vector differentiation and vector integration, Line, Surface and Volume integrals. Green's, Gauss Divergence and Stoke's Theorems. Multiple integrals. Jacobians. Beta and Gamma Functions, Ordinary differential equations. Partial differential equations. One dimensional heat conduction equation and wave equation. Derivation and solution.

Murray R. Spiegel , Vector Analysis , Schaum Pub,1959.
Erwin Kreyszig, Advanced Engg. Mathematic., Wiley Eastern,2011.
E. D. Rainville and P. E. Bedient , A Short Course in differential equations, 6th Edn, McMillan Pub,1981
Shanti Narayan, Integral Calculus, Sultan Chand& Co., Delhi, 1989
R. Courant and F.John, Introduction to Calculus, Vols. I & II, Springer Verlag (Indian Edn),1989

HU110 PROFESSIONAL COMMUNICATION (3-0-0) 3

Organization Communication : Attempts to acquaint students with the process and requirements of Communication in organization. It includes the Objectives of Communcation, Channels of Communication, Barriers in Communication, Cross Cultural Communication.

Written Communication : Focuses on improving the Writing Skills. A Review of Grammar, Tranformation of Sentences; Reading Comprehension; Precis Writing; Skills to Express ideas through various kinds of Essays; Business Letters, Application Letters, Email and Internet; Report Writing, CVs/Resumes.

Oral Communication : Aims at improving the Oral Communication Skills, Public Speaking Skills, Features of Effctive Speech-Verbal and Non-Verbal, Presentation Skills, Audio and Visual Aids; Group Discussion, Mock Interviews and Meetings.

Meenakshi Raman and Sangeeta Sharma, Technical Communication; Principles and Practice, Oxford University Press, 2004

Mattukutty M. Monippally, Business Comunication Strategies, Tata Mcgraw-Hill Publishing Co. Ltd, 2001

Shirley Taylor, Model Businees Letters, E-Mails and other Business Docuements (VI Edition), Pearson Education /Prentice Hall, 2012

Michael Swan, Practical English Usage, Oxford University Press, 2005

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA SURATHKAL
Department of Chemical Engineering (CH)

Bachelor of Technology in Chemical Engineering.
Foundation Courses

Basic Science Core (BSC)		
MA110	Engg.Mathematics – I	(3-0-0) 3
PH110	Physics	(3-1-0)4
PH111	Physics Lab	(0-0-2) 1
MA111	Engg.Mathematics – II	(3-0-0) 3
CY110	Chemistry	(3-0-0) 3
CY111	Chemistry Lab	(0-0-3) 2
CY205	Organic Chemistry	(3-0-0) 3
CY255	Technical Analysis Lab	(0-0-4) 2
CY305	Inorganic & Physical Chemistry	(3-0-0) 3
	Total Credit under BSc	**24**
Engineering Science Core (ESC)		(3-0-0) 3
EE110	Elements of Electrical Engineering	(3-0-0)3
ME110	Elements of Mechanical Engineering	(3-1-0)4
CO110	Computer Programming	(0-0-2) 1
CO111	Computer Programming Lab	(3-0-0) 3
EC110	Elements of Electronics Engg.	(3-0-0) 3
AM110	Engineering Mechanics	(1-0-3) 3
ME111	Engineering Graphics	(0-0-2) 1
ME200	Workshop	**21**
	Total Credit under ESc	
Humanities and Social Science Core (HSC)		(3-0-0) 3
HU100	Professional Communication	(3-0-0) 3
HU300	Engineering Economics	(3-0-0) 3
HU302	Principles of Management	**9**
	Total Credit under HSc	
Programme Core (PC)		(2-2-0) 4
CH200	Process Calculations	(2-2-0) 4
CH201	Transport Phenomena	(3-1-0) 4
CH202	Particulate Technology	(3-1-0) 4
CH250	Momentum Transfer	(3-1-0) 4
CH251	Chemical Engg. Thermodynamics	(3-1-0) 4
CH252	Mass Transfer – I	(3-1-0) 4
CH300	Heat Transfer	(2-1-0) 3
CH301	Chemical Reaction Engg .– I	(3-1-0) 4
CH302	Mass Transfer – II	(0-0-3) 2
CH303	Fluid & Fluid Particle Systems lab	(2-1-0) 3
CH350	Chemical Reaction Engineering – II	
CH351	Process Dynamics & Control	(3-1-0) 4
CH352	Simultaneous Heat & Mass Transfer	(2-1-0) 3
CH353	Heat Transfer Operations Lab	(0-0-3) 2
CH400	Chemical Process Industries	(3-0-0) 3
CH401	Process Design of Chemical Equipments	(2-0-3) 4
CH402	Mass Transfer Operations Lab	(0-0-3) 2
CH450	C.R.E. & Process Control Lab	(0-0-3) 2
	Total Credit under Pc	**60**
Elective (Ele)		
CH211	Process Instrumentation	(3-0-0) 3
CH261	Energy Technology	(3-0-0) 3
CH311	Petroleum Engineering	(3-0-0) 3
CH312	Biochemical Engineering	(3-0-0) 3
CH361	Process Modeling & Simulation	(3-1-0) 4
CH362	Separation Processes	(3-1-0) 4
CH363	Fertilizer Technology	(3-0-0) 3
CH364	Risk and Safety Management in Process Industries	(3-0-0) 3
CH411	Fermentation Technology	(3-0-0) 3
CH412	Pollution Control & Safety in Process Industries	(3-0-0) 3
Programme Major Project (PMP)		
CH449	Major Project - I	(0-0-3) 2
CH499	Major Project – II	(0-0-9) 6
Mandatory Learning Courses (MLC)		
CY 110	Environmental Studies	(1-0-0) 1
HU111	Professional Ethics and Human Value	(1-0-0) 1
CH440	Practical Training	1
CH 490	Seminar	(0-0-3) 2
Open Electives (OE)		
CH211	Process Instrumentation	(3-0-0) 3
CH261	Energy Technology	(3-0-0) 3
CH311	Petroleum Engineering	(3-0-0) 3
CH465	Air Pollution Control and Design of Equipments	(3-0-0) 3

Suggested Plan of Study

Semester →	III	IV	V	VI	VII	VIII
1	CH200	CH250	CH300	CH350	CH 400	*CH450*
2	CH201	CH251	CH301	CH351	CH401	*CH499*
3	CH202	CH252	CH302	CH352	CH402	*Elective*
4	CY 205	CY255	CH303	CH353	CH449	*Elective*
5	ME 200	*Elective*	CY305	HU300	CH440	*Elective*
6	*Elective*	*Elective*	HU302	*Elective*	CH490	*Elective*
7	*Elective*	*Elective*	*Elective*	*Elective*	*Elective*	*Elective*
8	*Elective*	*Elective*	*Elective*	*Elective*	*Elective*	*Elective*

Degree Requirements:

Category of Courses	Minimum Credits to be Earned
Foundation Courses	
Basic Science Core (BSC)	24
Engineering Science Core (ESC)	21
Humanities and Social Sciences Core (HSC)	09
Programme Core (PC)	60
Elective (Ele)	50
Programme Major Project (MP)	08
Mandatory Learning Courses (MLC)	05
Total	**177**

:H200 Process Calculations (2-2-0) 4

ıtroduction to Engineering Calculations. Physical and chemical properties of compounds and Mixtures. echniques of problem solving. Concepts of unsteady state processes and material balance equation. Steady tate Material Balances. Material balances involving Recycle by pass and purge calculations. Multiphase ystems. Single component phase Equilibrium. Solutions of Solids in Liquids. Humidity charts and their uses. nergy and Energy balances.

).M.Himmelblau, Basic Principles and calculations in Chemical Engg 5th Edition, Prentice Hall of India. 1992
ł.M.Felder, R.W.Rlusseau, Elementary Principles of chemical processes 2nd Edition. John Wiley & Sons Inc. 986

:H201 Transport Phenomena (2-2-0) 4

;hell balances for momentum, energy and mass transfer. Introduction to general transport equations for nomentum, energy and mass transfer in cartesian - cylindrical and spherical coordinates - simple solutions in ɔne dimension. Simplification of general equations with time and spatial coordinates for momentum, energy, nass transport, boundary layer concepts of momentum energy and mass transport. Macroscopic balances or isothermal systems, nonisothermal systems and multi componant systems.

Robert S. Brodkey and Harey C. Hershey - Transport Phenomena - A Unified Approach, McGraw Hill Book Co., 1988.
R.B.Bird, W.E.Stewart and E.W.Lightfoot - Transport Phenomena, John Wiley & Topan, 1960.
Beek W.J. and Mutzall K.M.K., - Transport Phenomena, John Willey and Sons Ltd., 1975.

CH202 Particulate Technology (3-1-0) 4

Particle Size Analysis. Industrial Screening. Storage and Conveyance of Solids. Size Reduction. Size Enlargement. Classification. Centrifugal Separation. Gas cleaning. Solid - Liquid Separation. Thickening. Froth Flotation. Magnetic separation. Electrical separation. Sorting (Separation of solids). Mixing and Agitation.

Richardson J.F and Coulson J.M, Chemical Engineering (SI Units) Vol 2; 1978.
McCabe W.L. and Smith J.C., Unit Operations in Chemical Engineering, McGraw Hill, New York, 5th edition.

CH211 Process Instrumentation (3-0-0)3

Introduction: Temperature measurement, Pressure measurement, Flow measurement, Level measurements Viscosity measurement, Moisture and humidity measurements. Conductivity meter- pH meter, Analytical instruments – Liquid chromatography – HPLC – Mass spectroscopy - Computer aided analysis – process instruments and automatic analysis.

Instrumentation, Measurement and Analysis, B.C.Nakra and K.Chaudhry, Tata McGrow Hill Co., New Delhi, 1985.
Encyclopadia of Instrumentation, Liptak B.G.,Vol.I, BG and supplement Chelton Book Co., New York, 1969.
Instrumental Methods of Analysis, Willard, Merru, Dean and Settle, C.B.S. publication, New Delhi, 1986 (Chapters 17, 18, 19, 30 & 31).
Mechanical and Industrial Measurements, R.K.Jain, Khanna Publishers, New Delhi, 1982.

CH250 Momentum Transfer (3-1-0) 4

Properties of fluids. Fluid statics. Introduction to fluid flow. Basic equations of fluid flow. Laminar Flow. Turbulent flow. Fluid flow around immersed bodies - Boundary layer and friction drag. Motion of particles through fluids. Fluidization principles. Dimensional analysis Similitude. Mixing of liquids. Compressible flow. Flow measurement. Fluid transportation machinery

McCabe and Smith, Unit operations in Chemical Engineering, McGraw - Hill 5th Edition. 1993
Coulson and Richardson, Chemical Engineering Volume I ELBS, Pargamon 3rd Edition. 1977

CH251 Chemical Engg. Thermodynamics (3-1-0) 4

Fundamental Concepts and Definitions. PVT relationships. First law of Thermodynamics. Application of law to different processes in closed systems. Second Law of Thermodynamics. Physical meaning of entropy. T-S diagrams. Relations among thermodynamic properties. Thermodynamic functions in terms of measurable properties. Construction of thermodynamic charts. Third Law of Thermodynamics. Thermodynamics of flow processes. Application of first law to flow processes. Power and Refrigeration Cycles. Single Component Systems. Multicomponent Systems. Phase Equilibria.

Smith, J.M, and H.C. Van Ness -Introduction to Chemical Engineering Thermodynamics, 4th edition, McGraw - Hill.

Hougen, A., K.M. Watson and R.A. Ragatz - Chemical Process Principles, Vol. 2 (Thermodynamics), Asia Publishing House, 1960.

Rao Y.V.C. - Introduction to Chemical Engineering Thermodynamics, Willey Eastern, 1994.

CH252 Mass Transfer – I (3-1-0) 4

Introduction to Mass Transfer operations. Introduction to advanced separation techniques. Steady and unsteady state operations, stage wise and continuous contact operations. Diffusion Mass Transfer. Concept of Mass Transfer Coeficient. Theories of Mass transfer. Flow past solids - Analogies. Interphase Mass Transfer. Absorption and Desorption. Adsorption.

R.E. Treybal - Mass Transfer Operations. 2nd Edition, McGraw Hill, 1968.

W.L. McCabe and J.C. Smith - Unit Operations of Chemical Engineering. McGraw Hill, 1976.

CH261 Energy Technology (3-0-0)3

Energy Scenario in India -Conventional/non-conventional renewable non renewable sources. Principles of efficient use of fuels, energy conservation and auditing. Solid liquid and Gaseous fuels. Combustion, Furnaces. Draught and chimney height. Nuclear Energy - Classification and Components. Unconventional fuels, renewable energy sources.

Sharma S.P.and Chander Mohan -Fuels and Combustions- Tata McGraw Hill Book Co., 1982.

Shaha A.K. - Combustion Engineering and Fuel Technology, Oxford Press.

Gilchrist J.D. - Fuels, Furnaces and Refractors, Pergamon Press, 1977.

Ronald F. Probstein and Hicks R.E. - Synthetic Fuels - McGraw Hill Book Co., 1982.

Manon L Smith and Keri W Stinson - Fuels and Combustion - McGraw Hill Book Co., 1952.

CH300 Heat Transfer (3-1-0) 4

Steady state conduction. Transient conduction. Insulation - critical thickness of insulation. Heat transfer with heat generation. Heat Transfer by convection. Heat Transfer with packed and fluidized beds. Heat Transfer in Jacketted vessels. Cryogenic heat transfer. Heat transfer in extended surfaces.

Heat transfer with change of phase. Boiling Heat transfer. Radiation.

J.M.Coulson and J.F.Richardson - Chemical Enginering, Vol.1, 3rd ed., Pergamon and ELBS, 1977.

Krieth - Fundamentals of Heat Transfer, 4th Edition, Harper & Law, 1986.

CH301 Chemical Reaction Engineering – I (2-1-0) 3

Chemical Reaction Equilibrium. Kinetics of Homogeneous Reactions. Single Homogeneous Reactor Design. Multiple Reactor Systems. Multiple Reaction Systems.

Levenspiel, O. - Chemical Reaction Engineering, 3rd edition, Wiley Eastern Limited.

Scott Fogler; H. - Elements of Chemical Reaction Engineering, 3rd edition, Prentice Hall of India.

H302 Mass Transfer – II (3-1-0) 4

oncepts of Vapour - Liquid equilibria. Multi component systems. Principles of distillation. Continuous ectification. Method of McCabe and Thiele. Liquid-Liquid Extraction, leaching.

.E.Treybal - Mass Transfer Operations. 2nd Edition, McGraw Hill (1968).

V.L.McCabe and J.C.Smith - Unit Operations of Chemical Engineering, McGraw Hill (1976).

adger and Banchero - Introduction to Chemical Engineering.

H303 Fluid & Fluid Particle Systems Lab (0-0-3) 2

xperiments based on Momentum Transfer and Particulate Technology.

:H311 Petroleum Engineering (3-0-0)3

ntroduction. Composition and evaluation of properties of crude oil and refinery products.

tefining of petroleum. Types of pipe still furnaces used in refineries and their design consideration.

:racking processes. Rebuilding processes. Product treatment processes.

lobert A. Meyers, Hand Book of Petroleum Refining Processes, McGraw Hill Book Co., 1986.

Bhasker Rao B.K,. Modern Petroleum Refining Processes, Oxford & IBM Publishing Co., 1984.

:H312 Biochemical Engineering (3-0-0) 3

ntroduction - Principles of microbiology. The kinetics of enzyme catalysed reactions. Metabolic Pathways and :nergetic of the cell. Kinetics of substrate Utilisation. Biological reactors-applications. And design. :ermentation Technology.

'.E.Bailey, D.F.Ollis - Biochemical Engineering Fundamentals, McGraw Hill, NY, 1977

:H350 Chemical Reaction Engineering – II (2-1-0) 3

Non-ideal Flow Reactors. Non-isothermal Homogeneous Reactions. Non-catalytic heterogeneous Reaction Kinetics. Catalytic Heterogeneous Reaction Kinetics.

Smith, J.M. - Chemical Engineering Kinetics, 2nd edition, McGraw Hill, 1970.

Levenspiel, O. - Chemical Reaction Engineering, 3rd edition, Wiley Eastern.

Scott Fogler, H. - Elements of Chemical Reaction Engineering, 3rd edition, Prentice Hall of India.

CH351 Process Dynamics & Control (3-1-0) 4

Introduction. Dynamic Behaviour of Lumped Parameter Systems. Transient analysis of control systems. Frequency response analysis. Advanced control strategies - Feed forward control, cascade control, inferential control, ratio control, adaptive control, selective control, smith predictor dead time compensator, interaction and decoupling in multi input - multi output control system.

Process Systems Analysis and Control - D.R.Coughanowr, McGraw Hill, Second Edition, 1991.

Process Dynamics and Control, D.W.Seborg, T.F. Edger, D.A.Millichamp, John Wiley & Sons, 198Badger and Banchero - Introduction to Chemical Engineering.

CH352 Simultaneous Heat & Mass Transfer (2-1-0) 3

Evaporation -Concept and applications. Humidification and Dehumidification. Crystallisation. Drying Operations.

J.M.Coulson and J.F.Richardson - Chemical Enginering, Vol.1, 3rd ed., Pergamon and ELBS, 1977.

W.L.McCabe and J.C.Smith - Unit Operations of Chemical Engineering, McGraw Hill (1976).

CH353 Heat Transfer Operations Lab. (0-0-3) 2

Experiments based on Heat Transfer course.

CH361 Process Modeling & Simulation (3-1-0) 4

Introduction. Numerical solutions of Mathematical equations. Lumped Parameter models: steady state and unsteady state. Distributed Parameter models: Steady state and unsteady state. Unsteady state distributed parameter models (one-dimension).

Computational Methods in Process Simulations, W.F. Ramirez, Butterworth Publishers, 1989.

Modelling and Simulation in Chemical Engineering, Boger E. Franks, John Wiley & Sons, 1972.

CH362 Separation Processes (3-1-0) 4

Adsorption separations. Membrane separation processes. Surfactant based separations. External field induced separations. Supercritical fluid extraction.

Hand Book of Separation Process Technology, R.W. Rousseau, 1987, John Wiley and Sons.

Hand Book of Industrial Membrane Technology, M.C.Porter, 1990, Noyes Publication, Park Ridge, New Jersey.

CH363 Fertilizer Technology (3-0-0) 3

Introduction. Production, transmission and storage of ammonia through various processes and raw materials; ammonia salts; nitric acid and nitrates. Production of Urea through various Processes. Phosphatic Fertilizers. Potash fertilizers. Compound fertilizers.

Fertilizer Manual, No. 13 - Development and Transfer of Technology series, United Nations Industrial Development Organisation, 1980.

CH364 Risk and Safety Management in Process Industries (3-0-0) 3

The concept of risk and safety management. Major disasters in chemical process industries. Hazard identification methods and risk quantification techniques. Fire and explosions. Hazards peculiar to various industries Safety education and training, safety management, legal aspects of industrial safety, safety audit. Concept of preparation of on-site and off-site emergency plan.

F.P.Lees - Loss Prevention in Process Industries, 2nd ed. 1996, Butterworth-Heinemann.

W. Handley - Industrial Safety Handbook, 2nd ed. 1977, McGraw Hill.

CH400 Chemical Process Industries (3-0-0) 3

Chlor-alkali industries. Sulphur industries. Nitrogen industries. Phosphate industries. Potash industries. Manufacture of soaps, detergents and glycerine. Manufacture of paper pulp, paper and paperboard. Manufacture of industrial alcohol, acetone and butanol. Petroleum Refining. Petrochemicals. Synthetic fibres.

C.E.Dryden - Edited and Revised by M.Gopala Rao - Outlines of Chemical Technology, Edition 2, Affiliated East West Press Pvt. Ltd., New Delhi, 1973,

Austin G. T. - Shreves Chemical Process Industries, McGraw Hill Book Co., 5th Edition, 1986.

CH401 Process Design of Chemical Equipment (2-0-3)4

Detailed Chemical Engineering Process Design of the following equipments is to be carried out. Mechanical aspects of the design are not included here. Heat Exchangers; Packed and Tray towers for Absorption and distillation. Design of equipments mentioned above using simulation software.

Donald Q Kern - Process Heat Transfer, McGraw Hill Book CO, 1950.

J.M.Coulson and J.F.Richardson - Chemical Engineering, Vol.6, Design, Second Edition, Pergaman Press, 1993.

Robert H. Perry and Don Green - Chemical Engineers' Hand Book, 6th Edition, McGraw Hill Book Co.

Douglas J.M., Conceptual design of Chemical Processes McGraw Hill, New York, 1988.

W.D. Seider, J.D. Seader and R.L. Daniel, Product and Process Design Principles, Wiley, 2004.

CH402 Mass Transfer Operations Lab (0-0-3) 2
Experiments based on Mass Transfer I & II.

CH411 Fermentation Technology (3-0-0) 3
Introduction, fermentors-principles and design, Manufacture of alcohol, pencillin, vitamins and other products.

Fermentation Technology, Whitaker.
Biochemical Engineering Fundamentals, J .E .Bailey and D. F. Ollis, 1997, McGraw Hill.

CH412 Pollution Control & Safety in Process Industries (3-0-0) 3
Importance of environment for human kind, flora and fauna, Types of pollution damages due to environmental pollution (industrial gas, liquid and solid effluents). Legislations to environmental pollution problems. Indian standards waste recycling. Noise pollution and its control. Waste water treatment. Air Pollution. Pollution control of effluents from different industries. Scientific and Engineering aspects of safety in industry.

S.P.Mahajan - Pollution Control in Process Industries - Tata McGraw Hill, 1990.
C.S. Rao - Environmental Pollution Control Engineering, Wiley Eastern, 1992.

CH465 Air Pollution Control and Design of Equipments (3-0-0) 3
Introduction. Air pollution laws and standards. Meteorological aspects of air pollutant dispersion, the Gaussian plume model, design of stacks and chimneys Air pollution control methods and design of equipments- control of gaseous emissions, Air pollution control in specific industries

Martin Crawford - Pollution control theory, , 1976, McGraw Hill, NY.
Joe Ledbetter - Air Pollution Part A&B, 1972,Marcel Dekker, NY.
N.Cheremissinoff - Air Pollution Control, Design Hand Book, Part I and II, 1977,Marcel Dekker, NY.

CH440 Practical Training 1
This course is a one credit course. A student may complete the training before the beginning of 7th semester (or as stipulated by DUGC) and register for it in 7th semester. The duration and details shall be decided by the faculty advisor, with approval from DUGC.

CH449 Major Project - I (0-0-3) 2
The Students jointly or individually will be assigned an experimental or theoretical problem, to be carried out under the supervision of a guide. The project has to be completed in the VII & VIII semester. The students should complete the preliminary literature survey and experimental set up in the VII semester. Their work will be reviewed and evaluated.

CH450 C.R.E. & Process Control Lab (0-0-3) 2
Experiments based on Reaction Engg. I & II and Process Control courses.

CH490 Seminar (0-0-3) 2
This course is two credit course to be completed during 7th semester. The student will make presentations on topics of academic interest.

CH499 Major Project – II (0-0-9) 6
Extension and completion of Major project -I started in the previous semester (CH449).

CH 263 Mineral Dressing Lab. (0-0-3) 2
Experiments based on Mineral dressing

COURSE STRUCTURE - UG

Department of Civil Engineering (CV)
Bachelor of Technology in Civil Engineering

Basic Science Core (BSC)

MA110	Engineering Mathematics - I	(3-0-0)3
PH110	Physics	(3-1-0)4
PH111	Physics Lab	(0-0-2) 1
MA111	Engineering Mathematics - II	(3-0-0)3
CY110	Chemistry	(3-0-0)3
CY111	Chemistry Lab	(0-0-3) 2

Engineering Science Core (ESC)

EC110	Elements of Electronics and Communication Engineering	(3-0-0)3
AM110	Engineering Mechanics	(3-0-0)3
ME110	Elements of Mechanical Engineering	(3-0-0)3
ME111	Engineering Graphics	(1-0-3) 3
ME200	Workshop	(0-0-2) 1
EE110	Elements of Electrical Engg.	(3-0-0)3
CO110	Computer Programming	(3-1-0)4
CO111	Computer Programming Lab	(0-0-2) 1

Humanities and Social Science Core (HSC)

HU110	Professional Communication	(3-0-0)3
HU300	Engineering Economics	(3-0-0) 3
HU301	Principles Management	(3-0-0) 3

Programme Core (PC)

AM200	Mechanics of Materials	(3-0-0)3
AM216	Strength of Materials Lab	(0-0-3) 2
AM250	Mechanics of Fluids	(3-0-0)3
AM300	Water Resources Engineering	(3-0-0) 3
AM316	Hydraulics Lab	(0-0-3) 2
CV200	Civil Engineering Materials and construction	(3-0-0) 3
CV201	Elements of Surveying	(3-0-0)3
CV202	Engineering Geology	(3-0-0)3
CV216	Civil Engg. Materials Lab	(0-0-3) 2
CV217	Surveying Practice	(0-0-3) 2
CV250	Structural Analysis-I	(3-0-0)3
CV251	Design of RCC structures	(3-0-0)3
CV252	Soil Mechanics	(3-0-0)3
CV266	Geology Lab	(0-0-3) 2
CV267	Soil Mechanics Lab	(0-0-3) 2
CV300	Structural Analysis-II	(3-0-0)3
CV301	Highway and Traffic Engineering	(3-0-0) 3
CV316	Building Design And Drawing	(1-0-3) 3
CV350	Environmental Engineering	(3-0-0)3
CV351	Design of steel Structures	(2-1-0) 3
CV366	Environmental Engg. Lab	(0-0-3) 2
CV367	Highway Materials and Concrete testing	(0-0-3) 2

Programme Specific Electives (PSE)

CV253	Architecture and Town Planning	(3-0-0) 3
CV322	Concrete Technology	(3-0-0) 3
CV371	Railways, Tunnels, Harbours and Airports	(3-0-0) 3
CV372	Design of PSC Structures	(3-0-0) 3
CV385	Geoinformatics	(3-0-0) 3
CV386	Rock Mechanics	(3-0-0) 3
CV387	Applied Geology	(3-0-0) 3
CV388	Advanced Surveying	(3-0-2) 4
CV401	Bridge Engineering	(3-0-0) 3
CV421	Transportation Project Planning and Evaluation	(3-0-0) 3
CV422	Advanced Design of Structures-I	(3-0-0) 3
CV423	Design of Foundations, Earth and Earth Retaining Structures	(3-0-0) 3
CV424	Advanced Environmental Engineering	(3-0-0) 3
CV425	Computer Aided Design and Applications in Civil Engineering	(2-0-3) 4
CV438	Structural Dynamics and Wind Engg.	(3-0-0) 3
CV471	Advanced Design of Structures - II	(3-0-0)3
CV472	Ground Improvement Techniques	(3-0-0) 3
CV473	FEM Applications in Civil Engg	(3-0-0) 3
CV474	Elements of Earthquake Engg	(3-0-0) 3
CV475	Oil and Natural Gas Exploration	(3-0-0)3
CV476	Disaster Management and Mitigation	(3-0-0)3
CV485	Air Pollution and Noise Pollution	(3-0-0) 3
CV486	Environmental Impact Assessment	(3-0-0) 3
CV487	Construction and Project Management	(3-0-0) 3
AM371	Open Channel Flow and Sediment transport	(3-0-0)3
AM372	Civil Engineering Systems	(3-0-0) 3
AM400	Geographic Information Systems	(3-0-0) 3
AM401	Satellite Digital Image Analysis	(3-0-0) 3
AM402	Principles of Geo-informatics	(3-0-0) 3
AM421	Design & Drawing of Hydraulic Structures	(1-0-3) 3
AM422	Fundamentals of Coastal Engg	(3-0-0) 3
AM423	Basics of Offshore Engg	(3-0-0) 3
AM424	Coastal Erosion and its Mitigation	(3-0-0) 3
AM435	Performance Appraisal of Large Projects	(3-0-0) 3
AM436	Disaster Management	(3-0-0) 3
AM437	Decision Making Under Risk and Uncertainty	(3-0-0) 3
AM438	Rural Infrastructure Development	(3-0-0) 3
AM439	Inverse Modelling	(3-0-0) 3

Suggested Plan of Study:

Semester	III	IV	V	VI	VII	VIII
1	CV200	CV250	CV300	CV350	CV400	CV499
2	CV201	CV251	CV301	CV351	CV417	*Elective*
3	CV202	CV252	CV 316	CV366	CV440	*Elective*
4	CV216	CV266	AM300	CV367	CV449	*Elective*
5	AM200	CV267	AM316	HU300	*Elective*	*Elective*
6	AM216	AM250	HU301	CV 390	*Elective*	*Elective*
7	ME200	CV217	*Elective*	*Elective*	*Elective*	
8	*Elective*	*Elective*	*Elective*	*Elective*	*Elective*	
9	*Elective*	*Elective*	*Elective*			

Degree Requirements:

Category of Courses	Minimum Credits to be Earned
Basic Science Core (BSC)	16
Engineering Science Core (ESC)	21
Humanities and Social Science Core (HSC)	09
Programme Core (PC)	64
Electives Programme Specific Elective (PSE) Open Elective (OE)	50
Programme Major Project (PMP)	10-12
Mandatory Learning Courses (MLC)	05
Total	175

Department of Applied Mechanics and Hydraulics

AM100 ENGINEERING MECHANICS (3-0-0) 3

Fundamentals of force system, Concept of Rigid body and deformable bodies, Free body diagrams. Support Reactions-Determinate and Indeterminate structures. Analysis of Trusses, Frames and Machines. Centroid and Moment of Inertia of plane areas. Shear Force and Bending Moment Diagrams. Simple stress and strain, Hooke's Law, Mechanical properties of materials, Elastic Constants.

Merian, J.L, Kraige, L.G. Engineering Mechanics - Statics, 5th Edition, Wiley Publishers, New-Delhi, 2007.
Beer & Johnston, Mechanics for Engineers, 4th Edition, McGraw - Hill, New Delhi, 1987.
Timoshenko, S.P., Young, D.H., Rao, J.V. Engineering Machines,4th Edition, McGraw-Hill, Singapore, 1956.
Singer, F.L. Strength of Materials, Third Edition, Harper and Row Publishers, New York, 1980. Hearn, E.J., Mechanics of Materials, Pergaman Press, England, 1972.
Beer and Johnston E. R. Mechanics of Materials, 3rd Edition, Tata McGraw Hill, New Delhi, 2007.

AM200 MECHANICS OF MATERIALS (3-0-0) 3 PREREQ: AM100

Simple flexure theory, Bending stress and shearing stress distribution across sections. Deflection of beams, Macaulay's method for deflection of statically determinate beams. Compound stresses - analytical method, graphical method - Mohr's circle of stresses., Torsion, Transmission of power through hollow and solid shafts. Beams of uniform strength, Springs, Combined bending and torsion, Strain energy, Theories of failure, Columns & struts, Thick and thin pressure vessels.

Singer, F.L. Strength of Materials, 3rd Edition, Harper and Row Publishers, New York, 1980.
Hearn, E.J., Mechanics of Materials, Pergaman Press, England, 1972.
Beer and Johnston E. R. Mechanics of Materials, 3rd Edition, Tata McGraw Hill, New-Delhi, 2007.

AM 201 MECHANICS OF SOLIDS (2-1-0) 3 PREREQ: AM100

Simple flexure theory, Bending stress and shearing stress distribution across sections Macaulay's method for deflection of statically determinate beams. Compound stresses - Analytical Method, Graphical Method - Mohr's Circle. Torsion, Transmission of Power through hollow and solid shafts. Beams of Uniform strength, Springs, combined bending and Torsion, Strain energy. Thick and Thin pressure vessels

Singer, F.L. Strength of Materials, 3rd Edition, Harper and Row Publishers, New York, 1980. Hearn, E.J., Mechanics of Materials, Pergaman Press, England, 1972.
Beer and Johnston E. R. Mechanics of Materials, 3rd Edition, Tata McGraw Hill, New-Delhi, 2007.

AM 216 STRENGTH OF MATERIALS LAB (0-0-3) 2

Tension test on mild steel and cast iron, Compression test on mild steel and cast iron, Torsion test on mild steel rod, Rockwell and Brinell hardness tests, Impact test (Charpy and Izod) on mild steel, Bending test on mild steel rod and wood, Shear test on mild steel plate and rod, tests on leaf and helical spring. Demonstration on fatigue test.

Hearn, E.J., Mechanics of Materials, Pergaman Press, England, 1972.
Beer and Johnston E. R. Mechanics of Materials, 3rd Edition, Tata McGraw Hill, New-Delhi, 2007.

AM217 MECHANICS OF SOLIDS LAB (0-0-2) 1

Tension tests on mild steel and cast iron, Compression tests on mild steel and cast iron, Shear tests, Bending test on mild steel, Torsion test, Hardness test and Impact test, (Tests on Springs). Demonstration on fatigue test.

Hearn, E.J., Mechanics of Materials, Pergaman Press, England, 1972.
Beer and Johnston E. R. Mechanics of Materials, 3rd Edition, Tata McGraw Hill, New-Delhi, 2007.

AM250 MECHANICS OF FLUIDS (3-0-0) 3

Properties and classification of fluids. Basic equation of fluid statics. Manometers. Buoyant force. Kinematics of fluid flow. Continuity equation. Bernoulli's equation. Momentum equation. Flow measurements: Brief introduction. Dimensional analysis. Model law. Basics of pipe flow. Hagen-Poiseuille equation. Darcy-Weisbach equation. Moody's diagram. Uniform flow in open channels.

Modi, P.N and Seth, S.M., Hydraulics and Fluid Mechanics, Standard Book House, Delhi, 2010.
Streete. V.L and Wylie. E.B., Fluid Mechanics, McGraw Hill Book Company, New York, 1997.
Ven Te Chow, 1959. Open Channel Hydraulics, McGraw Hill, New York.

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AM300 WATER RESOURCE ENGINEERING (3-0-0) 3 PREREQ: AM250

Hydrology: Hydrologic cycle, Water budget, Catchment. Precipitation: types, measurement, intensity, duration, temporal and spatial analysis. Infiltration, soil moisture, evaporation, transpiration, Groundwater. Runoff: components, factors, hydrographs, unit hydrograph, flood estimation. Irrigation: objectives, methods, irrigation water requirements. Components of irrigation system and design principles. Water Power Engineering: Basic principles, types of schemes

Subramanya K, Engineering Hydrology, Tata McGraw Hill, 3rd Edition, 2008.
Garg S. K, Irrigation Engineering and Hydraulic Structures, Khanna Publishers, 2008.
Ven Te Chow, LW Mays and DR Maidment., Applied Hydrology, McGraw Hill, 1988.

AM316 HYDRAULICS LAB (0-0-3) 2 PREREQ: AM250

Calibration of V notch, Rectangular Notch; Venturimeter, Orifice meter, Water meter. Friction factor of pipes. Impact of jet on vanes. Tests on centrifugal pump, reciprocating pump, Pelton wheel turbine, Francis turbine. Hydraulics jump, Syphons, Demonstration experiments (pressure gauge, Pitot tube, Kaplan turbine)

Modi, P.N and Seth, S.M., Hydraulics and Fluid Mechanics, Standard Book House, Delhi, 2010

AM317 FLUID MECHANICS AND MACHINERY LAB (0-0-2) 1 PREREQ: ME202

Calibration of V notch, Venturimeter, Orifice meter, Water meter. Friction factor of pipes. Impact of jet on vanes. Tests on centrifugal pump, reciprocating pump, Pelton wheel turbine, Francis turbine. Demonstration experiments (pressure gauge, Pitot tube, Kaplan turbine) *Modi, P.N and Seth, S.M., Hydraulics and Fluid Mechanics, Standard Book House,*

AM371 OPEN CHANNEL FLOW AND SEDIMENT TRANSPORT (3-0-0) 3 PREREQ: AM250

Steady GVF, SVF, RVF. Unsteady flow: basic equations, velocity of flood wave discharge, flood routing. Bulk properties of sediments, various related theories such as competent velocity concepts, lift concept, critical tractive force concept, Shield's analysis, regimes of flow, bed forms, resistance to flow, bed and suspended load transport, reservoir sedimentation, agredation and degradation of rivers, local scour, sediment samplers.

Subramanya. K, Open channel flow, Tata McGraw Hill,3rd Edition, 2010.
Graf,W. H. Hydraulics of sediment transport, McGraw Hill, 1984. Garde and
Rangaraju, Sediment transport, Wiley Eastern, 2nd Edition,1985 Chow, V. T.
open channel flow

AM372 CIVIL ENGINEERING SYSTEMS (3-0-0) 3

Introduction to systems approach, simple and complex system, unique features of complex system. Unconstrained optimization, concave & convex functions, constrained optimization - KT conditions, Lagrangian multiplier method. Introduction to LP, Simplex method, Two phase method, Duality in LP, Introduction to DP, Network model, Allocation model. Some typical case studies.

Rao. S.S., Engineering Optimization, Wiley-IEEE, 3rd Edition, 1996.
Taha, H..A,Operation Research, Prentice Hall, 6th Edition, 1997.
Panik M. .J., Classical optimization foundation, North Holland Pub. Co., 1976.

AM380 MINI PROJECT – I (0-0-3) 2

Experimental work either in the field or in the laboratory or design tasks of relatively smaller magnitude compared to Major Project work and in line with the guidelines formulated by the DUGC (AM).

AM381 MINI PROJECT – II (0-0-3) 2

Experimental work either in the field or in the laboratory or design tasks of relatively smaller magnitude compared to Major Project work and in line with the guidelines formulated by the DUGC (AM).

AM 400 GEOGRAPHIC INFORMATION SYSTEM (3-0-0) 3

Components of GIS, functions , Coordinate Systems, Raster and vector-based GIS and data structures, Spatial data sources Geo-relational Vector data model, Object based vector data model, raster data model, data input, geometric Transformation, Spatial data editing, Attribute data input and management, vector data analysis, Raster data analysis., GIS Modeling and Decision support system, Applications of GIS in several domains

Kang-tsung Chang Introduction to Geographic Information Systems 4 th edition Tata McGraw Hill Burrough & McDonnell, Principles of Geographical Information Systems, Oxford University Press Yang, Snyder & Tobler, Map projection Transformation principles and applications, Taylor and Francis

AM 401 SATELLITE DIGITAL IMAGE ANALYSIS (3-0-0) 3

Introduction to Remote sensing and Digital image Processing, Remote sensing data collection Alternatives, Hardware and software issues, Image Quality assessment , Electromagnetic Energy Radiation Principles and radiometric correction, Geometric correction, Image Enhancement , Pattern Recognition, Information extraction from MSS and Hyperspectral data, Change detection studies. Jensen J.R Remote Sensing of the Environment An Earth Resource Perspective Second Edition , Dorling Kindersley India Pvt Ltd.

Jensen J.R Introduction to Digital Image Processing: A remote sensing Perspective. Prentice-Hall,2005.

Lillesand, T.M., R.W. Kiefer, and J.W. Chipman. Remote Sensing and Image Interpretation. 5th Edition. John Wiley and Sons. 2004.

AM 402 PRINCIPLES OF GEOINFORMATICS (3-0-0) 3

The electromagnetic spectrum and atmospheric considerations, Spectral Characteristics ,Sensors and platforms : Visible and infrared sensors, Radar technology, Data Products , Visual Interpretation , GIS, GPS , Applications.

Lillesand, T.M., R.W. Kiefer, and J.W. Chipman. 2004. Remote Sensing and Image Interpretation. 5th Edition. John Wiley and Sons.

Sabins, F.J. Jr. 1996. Remote Sensing: Principles and Interpretation. Third Edition. W.H. Freeman and Company, New

Kang-tsung Chang Introduction to Geographic Information Systems 4th edition Tata McGraw Hill k. Ahmed El-Rabbany " Introduction to GPS" Artech House

AM 403 GEOGRAPHIC POSITIONING SYSTEMS (3-0-0) 3

Introduction to GPS, GPS details, GPS Errors and Biases , Datum, Coordinate Systems and Map Projections , GPS Positioning Modes, Ambiguity-Resolution Techniques, GPS Data and Correction Services,GPS standard Formats, GPS integration, GPS applications, Other Satellite Navigation Systems *Ahmed El- Rabbany " Introduction to GPS" Artech House Rao, K.N. R Fundamentals of Satellite Communications PHI, 2004*

AM421 DESIGN & DRAWING OF HYDRAULIC STRUCTURES (1-0-3) 3 PREREQ: AM 300

Introduction to Lacey's regime theory, Khosla's theory, Bligh's creep theory, Hydraulic design and drawing of following structures: i. Earthen dam; ii. Gravity dam (OS); iii. Gravity dam (NOS); iv. Surplus weir; v. Canal drop; vi. Canal regulator; vii. Tank sluice with tower head; viii. Direct sluice; ix. Aquaduct. *Punmia,BC and Lal,PBB. Irrigation& Water Power Engineering, Standard Book House, 2nd Edition,1990.*

Michel, WH. Manual of Irrigation Engineering, Hubbard Press,1997.

C.S. Murthy, Water Resources Engineering:Principles and Practices, New Age International,1997.

AM422 FUNDAMENTALS OF COASTAL ENGINEERING (3-0-0) 3 PREREQ : AM250

Basic Wave Hydrodynamics, Linear Wave Theory, Wave Phenomena,Generation of Wind Waves, Wave Spectrum, Wave Forecasting, Basics of Wave Structure Interaction, Coastal Processes - Littoral Drift, Coastal Erosion and Protection (Hard and Soft Options), Design Principles of Breakwaters.

Shore Protection Manual, U.S.Army Corps of Engineers, Coastal Engineering Research Center,1984. US Army Corps of Engineers, 'Shore protection manual(SPM)", Vol. 1 &2, Coastal Engg Res. Centre, US Govt. Printing Office , Washington D.C. USA, 1984.

US Army Corps of Engineers, 'Coastal Engg. Manual (CEM)", Parts 1 to 6, Coastal Engg Res. Centre, Washington D.C. USA., 2006.

Ippen A.T., Estuary & Coastline Hydrodynamics, McGraw Hill, New York, USA, 1996.

AM423 BASICS OF OFFSHORE ENGINEERING (3-0-0) 3 PREREQ AM 250

Ocean Waves, Currents, Winds, Ice and Mud loading, Basics of Offshore Structures - Jacket, Tower, Gravity platforms, Hybrid Structures and factors governing their selection, Linear wave theory, Morison equation. Linear dynamic analysis, Pile foundations, Bearings capacity of footings, Corrosion and under water Welding.

US Army Corps of Engineers, 'Shore protection manual(SPM)", Vol. 1& 2, Coastal Engg Res. Centre, US Govt Printing Office , Washington D.C. USA., 1984.

US Army Corps of Engineers, 'Coastal Engg. Manual (CEM)", Parts 1 to 6, Coastal Engg Res. Centre, Washington D.C., USA, 2006.

Weigel R.L.,Recommended practice for Planning, Designing, & Construction of Fixed Offshore Structures - Oceonographical Engg., Prentice Hall, 1969.

Pilarckzyk K. W. and Zeidler R. B., "Offshore breakwaters and Shoreline Evolution Control", A. A. Balkema Publishers, Rotterdam, The Netherlands,1996.

AM424 COASTAL EROSION & ITS MITIGATION (3-0-0) 3 PREREQ : AM250

Origin of Coasts, Sediment Transport and Budgeting, Coastal Erosion and Mitigation: A Global Scenario and Indian Perspective, Coastal Processes, Planning and Design of Coastal Protection Works, Soft and Hard Options, Innovative Technologies, Remote Sensing, Geographical Information System and Artificial Neural Network in Coastal Engineering, Performance of Coastal Protection Works in India,

Coastal Zone Regulation, Integrated Coastal Zone Management, Coastal Pollution and Environmental Impact Assessment.

Bruun, P., Port Engineering, Vol. I

Shore Protection Manual, U.S.Army Corps of Engineers, Coastal Engineering Research Center, U.S.Govt. Printing office, Washington D.C., Vol. 1 & 2. 1984.

Ippen A.T., Estuary and Coast line Hydrodynamics McGraw Hill, 1966

AM 435 PERFORMANCE APPRAISAL OF LARGE PROJECTS (3-0-0) 3

Introduction to performance appraisal, unique features of large projects, technical parameters, economical parameters, social parameters, environmental parameters, Evolving normalized index for performance appraisal, comparative analysis of different methods. Decision making under risk and uncertainty, Theory of errors, sensitivity analysis - Brief introduction, Specific case studies *Taha, HA,Operation Research, Prentice Hall, 6th Edition, 1997. Luce, RD and Raiffa,H. Games and Decisions, Dover, New York, 1989.*

Lorry W. Canter, Handbook of Environmenal Impact Assessment, Blackwell Science Ltd, Oxford, UK,1999.

Gupta, BI and Gupta A. Construction Management Machinery and Accounts. Standard Publishers,2005.

AM 436 DISASTER MANAGEMENT (3-0-0) 3

Types of Disasters, its Dimensions, Impact of Disasters, Forecasting, Role of Remote Sensing and Geographical Information System in Disaster Management, Vulnerability, Disaster Reduction Strategies, Multi Hazard Mapping, Financial Management, Losses from Global Disasters and Expenses in Reconstruction and Retrofitting of Structures, Role of NGO, Government Bodies and Public, Social and Economic Development of Disaster Prone areas.

Emergency Planning *Ghosh, G.K. Disaster Management, APH Publishing Co., New Delhi, 2006.*

Ghosh, S.G. Natural disaster management: New technologies and opportunities, ICFAI University Press, New Delhi,2008.

Institute of Engineers, World Congress on Natural Disaster Mitigation, Vol I & II, 2004.

AM 437 DECISION MAKING UNDER RISK AND UNCERTAINTY (3-0-0) 3

Decision making process, elements of leadership, planning and strategic management, Management of public organization. Decision making using Risk Theories, Different models of decision making under uncertainty. Sensitivity analysis and uncertainty analysis in distributed parameter systems.

Taha, HA,Operation Research, Prentice Hall, 6th Edition, 1997. Joseph L. Masij, Essential of Management, McGraw Hill, 1996.

AM 438 RURAL INFRASTRUCTURE DEVELOPMENT (3-0-0) 3

Integrated rural development, rural growth and economy, need for rural infrastructure, cooperative movement. Rural water supply schemes- Surface water and groundwater systems, components and design principles, economic analysis. Rural sanitation- requirements, methods, design features. Rural roads and communication facilities.

Twort, AC, DD Ratanayaka and MJ Brandt. Water Supply, AIWA Pub., 5th edition, New York,2000.
GS Birdi and JS Birdie , Water Supply and Sanitary Engineering, Dhanpat Rai & Sons, New Delhi, 1998.

AM 439 INVERSE MODELING (3-0-0) 3

Lumped and distributed systems, introduction to inverse modeling, conventional parameter estimation procedures, OLS, WLS and Gauss Newton Algorithm for parameter estimation, Parameter perturbation, Sensitivity analysis, Role of sensitivity analysis in parameter identifiability, uniqueness and stability. Linear error statistics, uncertainty analysis in inverse modeling, Role of redundancy in data, handling of noisy and bad data in inverse modelling, Role of spatial and temporal data in parameter uncertainty, Grouping of parameters, effect of zonation in distributed models.

Taha, HA,Operation Research, Prentice Hall, 6th Edition, 1997.
J.N.Kapur , Mathematical modeling, New Age International, 2003.
M.R. Ball , Mathematics in social & life sciences. John Wiley, 2nd edition, 1985.
Dym CL , Principle of mathematical modeling, Elsevier,2nd edition, 2004.

AM 445 FUNDAMENTALS OF FINITE ELEMENT METHOD (3-0-0) 3

Direct approach. Basic structural elements. Plane elasticity problems. Galerkin weighted residual approach. Element properties. Linear and quadratic elements. Lagrange and Hermite shape functions. Isoparametric elements. Numerical integration using Newton-Cotes quadratures and Gauss-Legender quadratures.

L.T. Segerlind, Applied Finite Element Analysis, John-Wiley, 2nd edition,1984. J.N.Reddy, An Introduction to the Finite Element Method, McGraw-Hill,2nd edition,1993.

AM 455 ENGINEERING OPTIMIZATION (3-0-0) 3

Optimization, Formulation of linear Optimization problems, Linear Programming model,Graphical method, Simplex method, Finding a feasible basis - Big M and two phase Simplex method, Duality in Linear Programme. Primal-dual relationship. Sensitivity analysis. Network analysis: Transportation problem. Dynamic Programming (DP); Non-linear Programming-unconstrained and constrained optimization, Lagrange multipliers and Kuhn - Tucker conditions.

F.S.Hiller and G.J.Liberman, Introduction to Operations Research.
Ravindran ,D. T.Philips and J.J.Solberg , Operations Research - Principles and Practice.
Hadly.G, Linear Programming(LP)
S.S.Rao, Engineering Optimisation

AM 473 WATER RESOURCES EXCESS MANAGEMENT (3-0-0) 3 PREREQ : AM 300

Excess rainfall, Direct runoff, Peak flow estimation, Frequency and Return Period, Risk, Design storm, Design Storm Hydrograph. Flow routing. Drainage of urban areas, System components and Design principles, Storm water management.

Ven Te Chow, LW Mays and DR Maidment., Applied Hydrology, McGraw Hill, 1988.
American Society of Civil Engineers Task Committee on Hydrology Handbook, Hydrology Handbook, 2nd edition, ASCE Manuals & Reports on Engg. Practice No.28, 1996
Mays. L.W. Water Resources Handbook,McGraw Hill, 2007.

AM 474 COMPUTATIONAL METHODS IN HYDROLOGY (3-0-0) 3 PREREQ : AM 300

Introduction, Hydrometeorological measurements, Hydrological models, catchment simulation. Continuity, momentum and energy equations, differential equations in hydrology. Finite difference technique, Finite element method, Galerkin method, steady and transient problems. Model application, flow routing, wave motion, unsaturated /saturated ground water flow. *Maidment, D. Hand Book of Hydrology, McGraw Hill, 1st edition, 1993.*

Huyakorn and Pinder, Computational methods in subsurface flow, Academic Press, New York, 1983. Zienkiewiz O.C. and Morgan, K., Finite elements and approximation, John Wiley,2006.

AM 475 GROUND WATER ENGINEERING (3-0-0) 3 PREREQ : AM 300

Fundamentals of ground water flow, Mechanics of well flow, Image well theory, Well design, Well characteristics, Production tests and maintenance. Pollution of aquifers: salt water intrusion, Aquifer remediation and management, Groundwater recharge, Rainwater harvesting, Ground water rights. *Todd D.K, Ground water hydrology, 3rd edition, Wiley,2008. Walton, W.C., Ground water resource evaluation. McGraw Hill, 1970. Raghunath, H.M., Ground Water, New Age International, 3rd edition, 1998. Karanth, K. Groundwater Assessment and Management, Tata McGraw Hill, 2007.*

Department of Civil Engineering

CV200 CIVIL ENGINEERING MATERIALS AND CONSTRUCTION (3-0-0) 3

Traditional materials : stone, brick, tiles-roofing and flooring, steel, timber, lime, cement, their manufacture, properties and codal requirements. Mortar, cement concrete, properties, specifications and tests for quality control. Reinforced concrete, fibre reinforced concrete and ferrocement applications. Paints, enamels, varnishes, tar, bitumen, asphalt, properties and use. Modern materials: plastics, rubber, polymer, fibre reinforced plastics, manufacture, properties and use. Introduction to composites and smart materials.

Building Construction: Foundations; Stone Masonry - Random rubble and Ashlar,; Brick Masonry -Rules for bonding, stretcher and header bonds and English Bond for 1 and 1 V brick thickness,; Doors and Windows; RCC Stairs and design of a dog-legged stair; Pitched Roofs and Simple Trusses; RC Constructions - Lintels and sunshades, beams and one-way and two-way slabs.

S.K. Duggal, Building Materials, Oxford & IBH publishing Co. Ltd., New Delhi 2000 M.S. Shetty, Cement Technology, Theory and Practice, S.C. Chand & Co. Ltd., 2002
B.C.Punmia, Building Construction

CV201 ELEMENTS OF SURVEYING (3-0-0) 3

Introduction to Surveying, Chain Surveying, Compass Surveying, Errors, Accuracy and precision. Introduction to plane table surveying. Levelling, contouring, Theodolite traverse. Introduction to tacheometric surveying and Trigonometric leveling. Horizontal curves. Introduction to vertical curves. Electronic distance measurements - Introduction. Minor Instruments, Digital Theodolite and total Station.

P.C. Punmia,Surveying Vol. I and II -STD
K. R. Arora,Surveying Vol-I &II- STD Book, New Delhi.
S.K. Roy,Fundamentals of surveying -Prentice - Hall of India, New Delhi.

CV202 ENGINEERING GEOLOGY (3-0-0) 3

General Geology, Physical Geology, Mineralogy, Petrology. Study of Igneous, Sedimentary, Metamorphic rocks, Physico - mechanical properties of rocks.

Structural geology : Study of folds, faults, Joints, unconformities: resource engg., remote sensing applications, Hydrogeology : Aquifers, geophysical exploration, selection of dam sites, tunnels, land slide control measures, environmental geology.

Parbin Singh, Engineering and General Geology, Katson Pub., Delhi, Sixth edition 2001. Blyth.
F.G.H & De Freitas M. H.,Engineering Geology, ELBS, 7th edition, 1984 D.V.Reddy,
Engineering Geology for Civil Engineers, Oxford IBH Publishers,1995,1997.

CV203 MINING GEOLOGY (3-0-0) 3

Physical Geology; Interior of the earth, Geological processes, Geological hazards. Mineralogy; physical properties, Quartz, Silicates, carbonate minerals, petrology; study of Igneous, Sedimentary, Metamorphic rocks. Stratigraphy; principles, geological time scale, Dharwars, Gondwana, tertiary systems. Paleontology; fossils and their uses, fossil fuels; coal and petroleum geology.

Parbin Singh, Engineering and General Geology, Katson Pub. Delhi, 6th edition 2001 Mukerjee P.K. A text book of Geology, World Press Pvt. Ltd. 11th edition, 1990

CV216 CIVIL ENGINEERING MATERIALS LAB (0-0-3) 2

Sampling and testing of materials as per BIS specifications and codal requirements. Cement, fine and coarse aggregates, bricks, roofing and flooring tiles.

V.V. Sastry & M.L.Gambhir, Laboratory Manual of Concrete Testing (Part - I), Dhanpat Rai & Sons, New Delhi 1992.
Relevant BIS codes for testing of materials.

13/21

CV217 SURVEYING PRACTICE (0-0-3) 2

Chain, Compass, Plane table leveling theodolite and tacheometric surveying curves.

CV218 MINING GEOLOGY LAB. (0-0-3) 2

Mineralogy; Megascopic study of minerals, Microscopic study of minerals, Petrology; Megascopic study of rocks, Microscopic study of rocks.

Paleontology; Identification and description of fossils

Crystallography ; Study of crystals through crystal models

Simmons & Schuden guide, Rocks and Minerals

Cornelius S. Hurlbut. Jr. Dana's manual of Mineralogy, John Wiley and Sons, 1985

CV250 STRUCTURAL ANALYSIS – I (3-0-0) 3

Conditions of equilibrium, degrees of freedom, determinate and indeterminate structures, Linear and nonlinear structural systems. Deflection of beams : Moment area method and conjugate beam method, the first theorem of Castigliano, Betti's law, Clark Maxwell's Theorem of reciprocal deflection, strain energy method and unit load method. Redundant Structures : The second theorem of Castigliano, Consistent deformation method, slope deflection method. Rolling loads and influence lines : Statically determinate beams and bridge trusses, series of loads and uniformly distributed loads, criteria for maximum and absolute maximum moments and shears. Three hinged arches, influence lines, Cables and suspension bridges, suspension bridge with three hinged stiffening girders and influence line diagrams.

Norris and Wilber, Elementary structural analysis. C.K. Wang, Statically indeterminate structures

CV251 DESIGN OF RCC STRUCTURES (3-0-0) 3

Strength properties and behaviour of concrete and reinforcing steel. Basic principles of working stress design. Limit state design concepts. Designing of members subjected to flexure, shear, torsion, axial forces and combinations, uniaxial and biaxial bending of columns. Design of simply supported and continuous beams and slabs; two way slabs, isolated and combined footings. Computation of deflection and crack width.

Ashok K Jain, Reinforced Limit State Design, Nem Chand & Bros. Roorkee, 1998. Unnikrishna Pillai and Devadas Menon, Reinforced Concrete Design, Tata- McGrawhill, 1997.

CV252 SOIL MECHANICS (3-0-0) 3

Soil formation, Three phase system, Index properties of soils, Soil classification, Hydraulics of soils, Stress distribution in soils, Soil compaction, One dimensional consolidation, Effective stress and pore water pressure, Shear strength of soils.

T.W.Lambe and R.V.Whitman, Soil Mechanics, John Wiley and Sons, Inc, Newyork. V.N.S.Murthy, Soil Mechanics and Foundation Engineering, Dhanpat Roy and Sons, New-Delhi. Relevant IS Codes(Latest editions).

CV253 ARCHITECTURE, CONSTRUCTION AND TOWN PLANNING (3-0-0) 3

Town Planning and Architecture: An overview of ancient human settlements; Indus Valley, Manasurā's classification of villages, Dantaka Village, Slums, Housing Bye-laws, Neighbourhood units, objectives and principles of town planning, Master-Plan, Zoning, Aesthetics and Principles of Architectural Composition.

S.C.Rangawala, Principles of Town Planning Sir.

Banister Fletcher, Comparative Architecture

Talbot Hamlin, Forms and Functions of Twentieth century Architecture; Vol II

CV254 ADVANCED MINING GEOLOGY LAB (0-0-3) 2

Structural Geology : Interpretation of Geological and Structural geological maps. Solving Dip and Strike, borehole problems. Megascopic and Microscopic Study of ore minerals, ore reserve estimation. Geophysical exploration.

Gurappa. K.M,. Structural geology manual.

CV266 GEOLOGY LAB (0-0-3) 2

Mineralogy : Identification and description of important rock-forming and ore minerals.
Petrology : Identification and description of Igneous, Sedimentary, Metamorphic rocks.
Structural Geology : Interpretation of geological and Structural geological maps, Solving Dip and strike problems.

K.M. Gurappa, Structural geology Manual
B.S. Sathya Narayanaswamy Engineering Geology Laboratory Manual, Eurasia pub.

CV267 SOIL MECHANICS LAB (0-0-3) 2

Identification of soils, Index properties of soils, Soil permeability, Light compaction test, Coefficient of consolidation, Direct shear test, Unconfined comp. Test, Triaxial comp. Test and Vane shear test, CBR test.

T.W.Lambe, Soil Testing for Engineers, John Wiley and Sons, Inc, Newyork. SP36
Part 1 and Part 2 (Latest editions).

CV268 ADVANCED MINING GEOLOGY (3-0-0) 3

Structural Geology ; Dip and Strike, study of folds, faults, Joints, unconformities, Economic Geology; Magmatic, Hydrothermal, Sedimentary, Metamorphic deposits, oxidation and supergene enrichment, study of Gold, Iron, copper, lead, Zinc Chromite, manganese, bauxite, mica, asbestos, magnetite, borytes deposits.
Exploration Geology ; Principles, Stage of mineral exploration, Geological, Geophysical, geochemical and remote sensing methods of exploration. Applied Geology; Sampling, guides for locating ore deposits, geological mapping, Hydrogeology.

Arogya Swamy, Courses in Mining Geology, Oxford & IBH, 1988
Bateman A.M., Economic mineral deposits, John Wiley & Sons
Billings, Structural Geology

CV300 STRUCTURAL ANALYSIS – II (3-0-0) 3

Analysis of statically indeterminate Structures, Moment distribution Method, Kani's Method, Matrix method: introduction to flexibility and stiffness methods, two hinged arches, influence lines for indeterminate beams and arches, analysis of multistorey frames by approximate methods, substitute frame, portal and cantilever methods, plastic analysis of simple beams and portal frames.

S.P. Timoshenko, Theory of structures
M.B. Kanchi, Matrix method of structural analysis

CV301 HIGHWAY AND TRAFFIC ENGINEERING (3-0-0) 3

Introduction: Initial recommendations for highway planning in India, saturation system, Third 20 year road development plan and fundamentals of transportation systems, planning on trip generation, distribution, assignment and modal split

Traffic Engineering: Vehicular and road user characteristics, traffic studies, junctions and signals, traffic control devices

Highway alignment and geometric design: Highway alignment, cross-sectional elements, horizontal alignment and vertical alignment *Highway design and construction:* design of flexible and rigid pavements, WBM and bituminous concrete roads and highway maintenance

S.K. Khanna and C.E.G. Justo, Highway Engineering, Nemchand Bros., Roorkee L.R.
Kadiyali, Traffic and Transport Planning, Khanna Publishers, New Delhi

CV316 BUILDING DESIGN AND DRAWING (1-0-3) 3

Foundations; Doors and Windows; Stairs - proportioning and designing of different types of staircases for residential and commercial buildings; Different types of roofs and trusses. Functional design of buildings: To draw the line diagram, plan elevation and section and line sketches of different types of buildings (school, hospital, hostel, residential, office etc.).

Introduction to AutoCAD. *Shah and Kale, Principles of Building Drawing Sharma and Kaul, Text of building construction B.C. Punmia, Building construction*

CV321 APPLIED SOIL ENGINEERING (3-0-0) 3 PREREQ: CV 253

Soil exploration, Earth pressure and its determination, Bearing capacity - Theoretical methods and Insitu tests, Stability of slopes by various approaches, Load carrying capacity of single and group of piles. Ground improvement methods. Introduction to soil dynamics.

B.M. Das, Principles of Geotechnical Engineering, The PWS Series in Civil Engg.

V.N.S. Murthy, Soil Mechanics and Foundation Engineering, Dhanpat Rai & Sons, New Delhi.

CV322 CONCRETE TECHNOLOGY (3-0-0) 3

Concrete making materials - Manufacture of Cements, types of cements and aggregates, properties and testing, Water, admixtures. Fresh concrete, workability, Compaction, Curing. Strength of Concrete, elasticity, shrinkage and creep. Durability of Concrete. Testing of hardened concrete, destructive and non destructive testing methods, Concrete mix design, Quality Control and acceptance Criteria. Special Concretes, Concrete chemicals.

A.M. Neville, Properties of Concrete, The English Language Book Society and Pitman Publishing Co. London, U.K.

M.S. Shetty, Concrete Technology - Theory and Practice, S. Chand & Co. Ltd., New Delhi.

CV350 ENVIRONMENTAL ENGINEERING (3-0-0) 3

Essentials of water and wastewater engineering systems, quantities, sources, water distribution systems, planning and analysis. Wastewater collection. House drainage. Water and wastewater characteristics. Drinking water standards. Unit operations and processes of water and wastewater treatment. Design of treatment units.

Fair & Geyer, Water Supply and Waste water disposal, John Wiley Publications

B.C. Punmia & Ashok Jain, Water supply Engineering & Wastewater Engineering, Arihant Publications

CV351 DESIGN OF STEEL STRUCTURES (2-1-0) 3

General principles of elastic method of design of steel structures. Bolted and welded connections, Tension and compression members, laterally supported and unsupported beams, unsymmetrical bending, built up beams, plate girders, members subjected to axial force and uniaxial and biaxial moments. Introduction to the limit state design philosophy of steel structures.

A.S. Arya and J.L. Ajmani, Design of steel structures, Nem Chand Bros, Roorkee.

Ramachandra, Vol I & II, Design of steel structures, Standard Book House, New Delhi.

S.K. Duggal, Design of Steel Structures, Tata McGraw Hill, Publishing Co. Ltd., New Delhi.

CV366 ENVIRONMENTAL ENGINEERING LAB (0-0-3) 2

pH, colour, turbidity; Solids - suspended, dissolved, settleable and volatile; Dissolved oxygen, BOD, COD; Determination of fluorides and iron; hardness, chlorides; Nitrite-Nitrogen and Ammonical-nitrogen; Available chlorine in bleaching powder, residual chlorine in water and chlorine demand; Bacteriological quality of water-presumptive test, confirmation test and determination of MPN; Jar test

CV367 HIGHWAY MATERIALS AND CONCRETE TESTING LAB (0-0-3) 2

Tests on highway materials, aggregates and bituminous materials. Tests on fresh concrete - workability tests, tests on hardened concrete, strength tests - destructive and non destructive testing, tests on R.C. beams and columns.

S.K. Khanna and C.E.G. Justo, Highway materials Testing - Nem Chand Bros, Rookee V.V.

Sastry andM.L. Gambir, Laboratory manual on concrete testing (Part II).

CV371 RAILWAYS, TUNNELS, HARBOURS AND AIRPORTS (3-0-0) 3

Railways: Rail gauges; coning; adzing; railway track components, functions, requirements, and width of formation; creep; tractive resistance; geometric design; points and crossings; stations and yards; signaling and interlocking.

Docks & Harbors: Types of harbors, tides, wind and waves, breakwaters, docks, quays, Transit sheds, warehouses, navigational aids

Tunnels: Introduction to tunneling, tunneling through soils, soft and hard rocks, tunnel ventilation

Airports: Introduction to airport planning and development, Airport design standards, airport planning *S.P. Arora & S.C. Saxena, A text Book of Railway Engineering Srinivasan, Docks, Harbors and Tunnels.*

S.K. Khanna, M.G. Arora and S.S. Jain, Airport Planning and Design

CV372 DESIGN OF P.S.C. STRUCTURES (3-0-0) 3 PREREQ: CV 252, CV 300

Materials- Pre and post tensioning methods-Losses of prestress-Stresses in concrete due to prestress and loads-Prediction of long term and short term deflections-Limit state of collapse in flexure and shear-Limit state of serviceability-Transmission length-Anchorage zone stresses-Design of endblock-Design of pre and post tensioned beams-Analysis of continuous beams-Concordant cable profiles-Analysis of composite beams-Determination of stress distribution in a composite sections. *N. Krishna Raju, Prestressed concrete, Tata-McGraw Hill, NewDelhi.*

T. Y. Lin and N. H. Burns, Design of prestressed concrete structures, John Wiley and Sons, NewYork.

CV385 GEOINFORMATICS (3-0-0) 3

Introduction to geinformatics : Principles of Remote sensing Satellites and Sensors, Aerial photography, elements of photo-grammetry, Satellite data products, Visual interpretation, Digital interpretations. Introduction to GIS principles, Generation of thematic maps, Georeferencing, Digitization, overlay analyses, Map projections : Global positioning system: Application of RS and GIS in mining; Geological mapping, geomorphological mapping, oil and mineral exploration,Ground water and surface water potential mapping, Natural hazard and disaster (Earthquakes,volcanic eruptions, Land slides, Avalanches, flood, drought etc.) Zone mapping, Forecasting, estimaton of losses and management, monitoring ocean productivity and coastal zone management, computer applications in mining. *Lillesand, Thomas and Kiefer, Remote Sensing and image interpretation, John Wiley and Sons. Burrough and Mc Dennell, principles of Geographical information systems, Oxford University Press.*

CV386 ROCK MECHANICS (3-0-0) 3

Introduction to rock mechanics, Engineering classification of rocks, Engineering properties of intact rocks, Determination of insitu properties - shear strength, deformation, insitu stress, strength of jointed rocks, application to rock slopes, rock blasting, ground improvement techniques in rocks and bearing capacity.

Jaegar and Cook, Foundation of rock masses.

Goodman, Introduction to rock mechanics, Wiley international

CV387 APPLIED GEOLOGY (3-0-0) 3 PREREQ: CV202

Introduction, interior of the earth, Geological process, Geological hazards, Natural resources; Minerals, rocks, water, soil; Engineering properties of rocks, Structural geology, stratigraphy, Hydrogeology; artificial recharge structures, rain water harvesting, ground water exploration, geophysical exploration, Remote sensing and GIS applications. Economic Geology, process of formation of mineral deposits, ore genesis, ore dressing, Indian mineral deposits, Environmental geology, Application of geology in Civil Engg. projects like Dams, tunnels, bridges etc.,

Blyth, F.G.H & De Freitas M.H., Engineering Geology, ELBS, 7th Edition, 1984.

Robert F. Legget, Geology and Engineering, Mcgraw Hill

CV388 ADVANCED SURVEYING (3-0-2) 4 PREREQ CV201

Introduction to tacheometric surveying, tacheometric levelling and errors in tacheometric levelling; Fundamentals of geodetic surveying; theory of errors and triangulation adjustments; Electronic distance measurement; Hydrographic surveying including three-point problems; photogrammetric surveying including aerial photogrammetry; fundamentals on the use of digital theodolites and total stations.

B.C. Punmia, Surveying Vol. 2 and 3

T.P. Kanetkar & Kulkarni, Surveying and leveling Vol. 2

S.K. Roy, Fundamentals of surveying

David Clark, Plane and geodetic surveying Vol.2

CV389 ADVANCED STRUCTURAL ANALYSIS (3-0-0) 3

Matrix method of structural analysis : flexibility and stiffness formulation - Direct stiffness method. Analysis of Beams of non-uniform cross section. Unsymmetrical bending of beams. Analysis of beams curved in plan. Introduction to analysis of shell roofs.

Genaro, Advanced Structural Analysis.

G.S. Ramaswamy, Design and Construction of shell roofs.

CV390 SEMINAR 1

CV400 ESTIMATION, COSTING AND SPECIFICATIONS (3-0-0) 3

Methods of estimating, measurements, taking out quantities, typical estimates for buildings, and Civil Engineering works, Specifications for all types of building items. Analysis of rates, data for various building items, Earthwork calculations. Introduction to Departmental procedures, tender, contracts, arbitration, valuation of buildings.

B.N. Dutta, Estimating and Costing in Civil Engineering Theory and Practice. M. Chakroborti, Estimating, Costing & Specifications in Civil Engineering. S.C. Rangawala - Valuation of Real Properties, Charotar Publishing House.

CV401 BRIDGE ENGINEERING (3-0-0) 3 PREREQ: CV252

Bridge site investigation and planning, bridge hydrology, Standards of loading for highway and railway bridges, Culverts, bridge superstructures, Design of R.C.C. beam and slab bridges, load distribution methods, Bearings, Design of bridge substructures and foundations, Design principles of prestressed concrete, steel and composite bridges, Introduction to cable stayed and suspension bridges, flyovers, temporary and movable bridges, construction and maintenance of bridges and flyovers.

D.J. Victor, Essentials of Bridge Engineering, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi. N. Krishna Raju, Design of Bridges, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

CV417 STRUCTURAL DESIGN AND DRAWING (1-0-3) 3 PREREQ: CV252, CV351

R.C. design- R.C. staircases, retaining walls - Cantilever and Counterfort type, Water tank- rectangular and circular tanks, underground and resting on ground. Framed structures. Steel design - Connections : Column splices, column bases, beam - columns, Steel purlins and roof trusses, connection between roof truss and supporting column, bracing systems.

N. Krishna Raju, Structural Design and Drawing - R.C. and Steel, University Press, Hyderabad. D. Krishna Murthy, Structural Design and Drawing, Vol II & III, C.B.S. Publishing Co., New Delhi.

CV421 TRANSPORTATION PROJECT PLANNING & EVALUATION (3-0-0) 3

CV422 ADVANCED DESIGN OF STRUCTURES – I (3-0-0) 3 PREREQ: CV252

Design of R.C. flat slabs, continuous beams and portal frames, redistribution of moments. Yield line analysis of slabs, Deep beams, Curved beams, Elevated water tanks and supporting structures, Chimneys, Silos and Bunkers.

N. Krishna Raju, Advanced Reinforced Concrete Design, C.B.S. Publishers and Distributors, Delhi. P.C. Varghese, Advanced Reinforced Concrete Design, Prentice - Hall of India, Pvt. Ltd., New Delhi.

CV423 DESIGN OF FOUNDATIONS, EARTH AND EARTH RETAINING STRUCTURES

(3-0-0) 3 PREREQ: CV253, CV321

Loads for foundation design, Depth of foundation, proportioning of footings, Geotechnical and structural design of isolated, combined and raft foundations. Analysis of pile groups. Design of piles and pile cap. Design of cantilever, counterfort and soil reinforced retaining walls. *Swami Saran, Design of Substructures, Oxford and IBH Publishers. J.E. Bowles, Analysis & Design of Foundations, Mc Graw Hill. Relevant IS Codes.*

CV424 ADVANCED ENVIRONMENTAL ENGINEERING (3-0-0) 3 PREREQ: CV350

Water pollution control: Effluent standards. Disposal of wastewater. Stream sanitation. Water quality indices; Solid waste management: Characteristics, treatment disposal; Air Pollution Control: Sources and Characteristics, effects, Control; Noise Pollution Control, measurement & analysis; Hazardous solid waste: Classified wastes, Disposal of hospital wastes; EIA: Introduction, case studies *Metcalf & Eddy, Waste Water Engineering Treatment, Disposal & Reuse, Tata Mcgraw Hill Publishers Sincero & Sincero, Environmental Engineering, Prentice Hall Inc.*

CV425 COMPUTER AIDED DESIGN & APPLICATIONS IN CIVIL ENGINEERING (2-0-3) 4

Object oriented programming, Application programs to solve problems in structural analysis, surveying, soil mechanics, transportation engineering and numerical analysis. Design of structural elements and programming concepts. Programs for the design of beams, slabs and columns by Limit state theory.

E. Balaguruswamy, Object oriented programming in C++, Mc Graw Hill Publishers V.L.Shah, Computer aided design in reinforced concrete, Structures publishers.

CV438 STRUCTURAL DYNAMICS AND WIND ENGG. (3-0-0) 3

Vibration of SDOF systems - Free and Forced vibrations, effect of damping, response spectrum, MDOF systems - Natural frequencies and modes, Eigen value problem, mode superposition method, Wind effects - Mean Wind speed, turbulence, spectrum of turbulence, Aerodynamic instabilities, Aerodynamic damping, Along - wind and Across - wind responses.

Cloush and Penzien, Dynamics of Structures, McGraw Hill, New York.
J.W. Simth, Vibration of Structures, Chapman and Hall Ltd., New York.
Scanlan and Sachi, Wind Engineering

CV440 PRACTICAL TRAINING / EDUCATIONAL TOUR 2

This course is a 2 credit course. A student may complete the training or educational tour before the beginning of 7th semester (or as stipulated by DUGC) and register for it in 7th Semester. The duration and the details shall be decided by the faculty advisor, with approval from DUGC.

CV 449 B. TECH. PROJECT –I 2

CV471 ADVANCED DESIGN OF STRUCTURES – II (3-0-0) 3 PREREQ: CV252

R.C. domes and shell roofs, membrane and beam method of analysis, Multistoried building systems; Grid floors, Composite steel and in-situ concrete beams & slabs. Communication and transmission line steel towers.

P. Dayaratnam, Design of Reinforced concrete structures, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
P. Dayaratnam, Design of Steel Structures, A.H. Wheeler & Co. Ltd. Allahabad.
N. Krishna Raju, Advanced Reinforced concrete Design, C.B.S. Publishers and Distributors, New Delhi.

CV472 GROUND IMPROVEMENT TECHNIQUES (3-0-0) 3 PREREQ; CV253, CV321

Need and Objectives, Mechanical Modification-Compaction control, Vibro flotation, Hydraulic modification - Dewatering methods, Electro-Osmosis, Vertical drains, Physical and chemical modification - grouting, shortcreting, ground freezing. Modification by inclusions and Confinement. Stone columns, lime columns, Sand drains and Compaction piles.

M.R. Hausmann (1990) Engineering Principles of Ground Modifications, McGraw Hill Publishing Co.
Purushotham Raj, Ground Improvement Techniques, Laxmi Publications, New Delhi.

CV473 FEM APPLICATIONS IN CIVIL ENGG. (3-0-0) 3

Types of elements - Boundary value and initial value problems - Approximate methods - Principles and steps in Finite Element Analysis - Generalized and natural co-ordinates - Direct stiffness approach-Analysis of 2D Trusses, beams, and Plane frames. Introduction to continuum problems - Triangular elements for plane stress problems - Numerical Integration.

T.R. Chandrupatla & Ashok D. Belegundu , Introduction to Finite Elements in Engg. - Prentice Hall. O. C. Zienkiewicz and K Morgan, Finite Elements & Approximation, John Wiley & Sons.

CV474 ELEMENTS OF EARTHQUAKE ENGINEERING (3-0-0) 3

Engineering seismology - Plate tectonics, Earthquake mechanism, Seismic zoning map of India, seismic waves, earthquake magnitude and intensity, seismic vulnerability, hazard and risk, Introduction to the theory of vibrations - simple SDOF systems, response spectra, Performance of structures, Lessons from past earthquakes, causes of failure and damage, Aseismic design of structures - Philosophy & Principles of earthquake resistant design, building forms and architectural design concepts, Introduction to seismic codes, Calculation of equivalent static earthquake forces, restoration and retrofitting of existing structures.

A.K.Chopra, Dynamics of Structures, Prentice Hall, 2002 IITKanpur, Earthquake Tips, www.nicee.org

CV475 OIL AND NATURAL GAS EXPLORATION (3-0-0) 3

Geology of oil and Natural gas fields: Introduction to petroleum, Economic Importance, Geological factors, Reservoir Sedimentology and Sequence Stratigraphy of oil and natural, Structural Geology and Basin Development, oil and natural gas deposit distribution in India, Gas hydrated deposits in India and in the world.

Exploration of oil and natural gas deposits: Remote Sensing, GIS, GPS, geological, geophysical and geochemical methods of exploration of oil and natural gas deposits.

Reservoir Engineering; Drilling and Production Engineering (drilling Methods of oil and natural gas wells, drilling technologies for deep water areas); Refining Engineering.

Safety and Environmental Engineering: Safety norms and regulations; environmental norms and regulations; safety auditing; environmental auditing; carbon credits; preparation of EIA reports; principles of developing green belt around petroleum installations to minimize carbon foot prints.

A. I. Levorsen, 1967, Geology of petroleum, W. H. Freeman

Selley, R C, 1998, Elements of Petroleum Geology, Acadamic Press.

Reddy D V, 2010, Engineering Geology, Vikas Publishers.

Lyons W C, Plisga G J, 2005, Standard Handbook of Petroleum and Natural Gas Engineering, Gulf Professional Publishing.

Azar J J, Samuel G R, 2007, Drilling Engineering. Pennwell Corporatin.

Robert Stoneley, 1995, Introduction to Petroleum Exploration, Oxford University Press.

Edwin S. Robinson and Cahit Coruh, 1988, Basic Exploration Geophysics, John Wiley and Sons.

CV485 AIR POLLUTION AND NOISE POLLUTION (3-0-0) 3

Natural and man made air pollution, sources, effects, control. Noise pollution - sources, measurement, mitigation.

Wark Kenneth and Warner C.F., Air Pollution its Origin and Control, Harper and Row, Publ. Sincero A.P. and Sincero G.A. Environmental Engineering. Prentice Hall.

CV486 ENVIRONMENTAL IMPACT ASSESSMENT (3-0-0) 3

Introduction of EIA - Environmental impact Statement (EIS) and Environmental Impact Analysis (EIA) - Meaning and objective of EIA; Environmental Impact Prediction - Planning and Management of Impact Studies - ISO 14000 Series - Environmental monitoring and mitigation measures.

Canter, R.L., Environmental Impact Assessment, McGraw Hill Inc.,

John G. Rau and David C. Wooten (Ed)., Environmental Impact Analysis Handbook, McGraw Hill Book, 1980.

Peter Wathern (Ed)., Environmental Impact Assessment, Theory and Practice, Unwin Hyman Ltd., London, 1988.

Munn, R.E., (Ed)., Environmental Impact Assessment, Principles and Procedures, Published on behalf of Scope, Unwin Brothers Ltd., Surrey, London, 1979.

CV487 CONSTRUCTION AND PROJECT MANAGEMENT (3-0-0) 3

Introduction: project forms, management objectives and functions; organizational chart of a construction company; manager's duties and responsibilities; public relations; Leadership and team - work; ethics, morale, delegation and accountability. Man and Machine: Man-power planning, training, recruitment, motivation, welfare measures and safety laws; machinery for Civil Engg., earth movers and hauling costs, factors affecting purchase, rent, and lease of equipment, and cost-benefit estimation. Planning, scheduling and Project Management: Planning stages, construction schedules project specification, monitoring and evaluation; Bar-chart, CPM, PERT, network- formulation and time computation.

Departmental Procedures: specifications, tendering, contracting and arbitration

Lionel Stebling, Project and Quality Management

P.P. Dharwadkar, Management in Construction Industry, Oxford IBH, New Delhi

J.O.Brien, Construction Management, Mcgraw Hill

J.M.Antill & R.W. Woodhead, Critical Path Methods in Construction, Wiley

B.C. Punmia & K.K.Khandelwal, Project Planning and control with PERT and CPM

PWD Codes A and D

CV 488 GROUND WATER DEVELOPMENT AND MANAGEMENT (3-0-0) 3

Hydrological cycle, Hydrological properties of rocks, Distribution of ground water, Ground water movement-Darcy's law, Flow nets. Aquifer parameters, Parameter estimation, pump test and recovery test-Thei's, Theim's, Jacob's equations. Ground water exploration-Geophysical techniques RS, GIS, GPS, Construction of wells, Springs. Ground water recharge, Rain Water harvesting, Water conservation techniques. Ground water quality, Ground water pollution, Environmental issues. Ground water buget, Ground water management. Ground water legislation

Todd D. K, Ground water hydrology, 3rd edition, Wiely, 2008.
Walton, W. C., Ground water resource evaluation. McGraw Hill, 1970.
Raghunath, H. M, Ground water, New Age International, 3rd edition, 1998.
Karanth, K. Groundwater Assessment and Management, Tata McGraw Hill, 2007.

CV 489 RETROFITTING AND REHABILITATION OF STRUCTURES (3-0-0) 3

Introduction, Causes of Deterioration, Deterioration process, Planning, Investigation and diagnosis, Assessment of distress structures, Assessment procedure for evaluation of structures and demolition procedures, Testing techniques, Interpretation of results, Repair and renovation techniques, Repair materials, Surface coatings, Protection, Seismic retrofitting.

Allen, R.T.L. and Edwards, S.C., 'The repair of concrete structures'
Key, T., 'Assessment and renovation of concrete structures'
Emmons, P.H., 'Concrete repair and maintenance illustrated'

CV490 SEMINAR (0-0-2) 1

This course is a 1 credit course to be completed during 7th / 8th semester. The student will make presentations on topics of academic interest.

CV 449 B. TECH. PROJECT –II 8

Department of Computer Science & Engineering (CO)

Bachelor of Technology in Computer Engineering

Basic Science Core (BSC)

MA110	Engineering Mathematics – I	(3-0-0) 3
PH110	Physics	(3-1-0) 4
PH111	Physics Lab	(0-0-2) 1
MA111	Engineering Mathematics – II	(3-0-0) 3
CY110	Chemistry	(3-0-0) 3
CY111	Chemistry Lab	(0-0-3) 2
MA201	Concrete Mathematics	(3-0-0) 3

Engineering Science Core (ESC)

EE110	Elements of Electrical Engg.	(3-0-0) 3
ME110	Elements of Mechanical Engg.	(3-0-0) 3
CO110	Computer Programming	(3-1-0) 4
CO111	Computer Programming Lab	(0-0-2) 1
EC110	Elements of Electronics Communication Engg.	(3-0-0) 3
AM110	Engineering Mechanics	(3-0-0) 3
ME111	Engineering Graphics	(1-0-3) 3

Humanities and Social Science Core (HSC)

HU100	Professional Communication	(3-0-0) 3
HU300	Engineering Economics	(3-0-0) 3
HU302	Principles of Management	(3-0-0) 3

Program Core (PC)

CO200	Computer Organization & Architecture	(3-1-0) 4
CO201	Theory of Computation	(3-1-0) 4
CO202	Design of Digital Systems	(3-1-0) 4
CO203	Data Structures and Algorithms	(3-1-0) 4
CO204	Design of Digital Systems Lab	(0-0-3) 2
CO205	Data Structures and Algorithms Lab	(0-0-3) 2
CO250	Data Communication	(3-1-0) 4
CO251	Software Engineering	(3-1-0) 4
CO252	Operating Systems	(3-1-0) 4
CO253	Design & Analysis of Algorithms	(3-1-0) 4
CO254	Operating Systems Lab	(0-0-3) 2
CO255	Software Engineering Lab	(0-0-3) 2
CO300	Computer Networks	(3-1-0) 4
CO301	Database Management Systems	(3-1-0) 4
CO302	Computer Networks Lab	(0-0-3) 2
CO303	Database Management Systems Lab	(0-0-3) 2
CO350	Compiler Design	(3-1-0) 4
CO351	Compiler Design Lab	(0-0-3) 2
CO352	Computer Graphics Mini Project	(1-0-2) 2

Department Specific Elective (PSE) Courses

CO260	Principles of Programming Language	(3-0-0) 3
CO261	Information Systems	(3-0-0) 3
CO262	System Programming	(3-0-0) 3
CO263	Object Oriented Programming	(1-0-3) 3
CO310	Microprocessor Systems	(3-0-0) 3
CO311	Unix Network Programming	(3-0-0) 3
CO312	Computer Graphics & Multimedia	(3-0-0) 3
CO313	Number Theory & Cryptography	(3-0-0) 3
CO314	Simulation & Modeling	(3-0-0) 3
CO315	Object Oriented Systems	(3-0-0) 3
CO316	Computer Architecture Lab	(1-0-3) 3
CO360	Advanced Data Structures	(3-0-0) 3
CO361	Logic for Computer Science	(3-0-0) 3
CO362	Information Security	(3-0-0) 3
CO363	Web Engineering	(3-0-0) 3
CO364	Soft Computing	(3-0-0) 3
CO365	Advanced Computer Networks	(3-0-0) 3
CO366	Formal Methods	(3-0-0) 3
CO367	Distributed Computing	(3-0-0) 3
CO368	Internet Technology & Applications	(1-0-3) 3
CO410	Artificial Intelligence & Expert Systems	(3-0-0) 3
CO411	Advances in Compiler Design	(3-0-0) 3
CO412	Distributed Database System	(3-0-0) 3
CO413	Game Theory	(3-0-0) 3
CO414	Digital Image Processing	(3-0-0) 3
CO415	Optimization Techniques in Computing	(3-0-0) 3
CO416	Wireless Networks	(3-0-0) 3
CO417	Software Project Management	(3-0-0) 3
CO418	Green Computing	(3-0-0) 3
CO419	Distributed Computing Lab	(0-0-3) 2
CO420	Soft Computing Lab	(0-0-3) 2
CO421	Software Testing	(1-0-3) 3
CO460	High Performance Computing	(3-0-0) 3
CO461	Data Warehousing and Data Mining	(3-0-0) 3
CO462	Network Management	(3-0-0) 3
CO463	Cloud Computing	(3-0-0) 3
CO464	Network Security	(3-0-0) 3
CO465	Distributed Algorithms	(3-0-0) 3
CO466	Information Retrieval	(3-0-0) 3
CO467	Software Quality Assurance	(3-0-0) 3
CO468	Computer Vision	(3-0-0) 3
CO469	Mobile Computing	(3-0-0) 3
CO470	Service Oriented Computing	(3-0-0) 3
CO471	Parallel Programming	(1-0-3) 3

Open Elective (OE)

CO280	Object Oriented Programming Concepts	(3-0-0) 3
CO310	Microprocessor Systems	(3-0-0) 3
CO330	Problem Solving Techniques in Computers	(3-0-0) 3
CO362	Information Security	(3-0-0) 3
CO364	Soft Computing	(3-0-0) 3
CO380	Internet technologies	(3-0-0) 3
CO410	Artificial Intelligence & Expert Systems	(3-0-0) 3
CO417	Software Project Management	(3-0-0) 3
CO480	Management Information Systems	(3-0-0) 3
CO481	Decision Support Systems	(3-0-0) 3

Programme Major Project (PMP)

CO449	Major Project - I	(0-0-6) 4
CO499	Major Project – II	(0-0-9) 6

Mandatory Learning Courses (MLC)

CY110	Environmental Studies	(1-0-0) 1
HU311	Professional Ethics and Human Values	(1-0-0) 1
CO390	Seminar	(0-0-3) 2
CO440	Practical Training/Educational Tour	(0-0-3) 2

Suggested Plan of Study:

Semester →	III	IV	V	VI	VII	VIII
1	CO200	CO250	CO300	CO350	*Elective*	*Elective*
2	CO201	CO251	CO301	CO351	*Elective*	*Elective*
3	CO202	CO252	CO302	CO352	*Elective*	*Elective*
4	CO203	CO253	CO303	HU301	*Elective*	*Elective*
5	CO204	CO254	HU300	*Elective*	*Elective*	*Elective*
6	CO205	CO255	*Elective*	*Elective*	*Elective*	CO499
7	MA201	*Elective*	*Elective*	*Elective*	CO440	
8				CO390	CO449	

Degree Requirements:

Category of Courses		Minimum Credits to be Earned
Basic Science Core (BSC)		19
Engineering Science Core (ESC)		20
Humanities and Social Science Core (HSC)		09
Program Core (PC)		60
Electives		50
Program Specific Elective (PSE)	Open Elective (OE)	
≥ 38	0-12 credits	
Programme Major Project (PMP)		10
Mandatory Learning Courses (MLC)		06
Total		174

Department of Computer Science & Engineering

CO100 COMPUTER PROGRAMMING (3-1-0) 4

Concepts, definitions, taxonomy and history of Computer Programming, Operating systems and Program Execution basics. Problem solving and programming: strategies, programming paradigms, software development lifecycle. C programming language: C fundamentals, operators and expressions, Data input and output, Control statements, Functions, Arrays, Pointers, Dynamic memory allocations, Structure and unions, Files, Low- level Programming and Macros.

Brian W. Kernighan & Dennis M. Ritchie, The C Programming Language, Second edition, PHI.
Byron S. Gottfried, Program with C, second edition, Schaums Outline series.
Yashavanth Kanetkar, Let us C – BPB Publications. 2002

CO101 COMPUTER PROGRAMMING LAB (0-0-2) 1

Introduction to fundamentals of DOS and Windows, C Programming exercise on simple statements, Control structures, Arrays, Matrices, Strings, Functions and Recursions, Structures and Unions, Bit Operations, Pointers, Dynamic Memory allocation, Files and Macros.

Brian W. Kernighan & Dennis M. Ritchie, The C Programming Language, Second edition, PHI.
Byron S. Gottfried, Program with C, second edition, Schaums Outline series.
Yashavant Kanetkar, Let us C- - BPB Publications.2002

CO200 COMPUTER ORGANISATION AND ARCHITECTURE (3-1-0) 4

Logical organization of computers; Processor basics, CPU organization, Data Representation, Instruction Sets, Data path design, Fixed Point arithmetic, ALU design, Control design: Basic concepts, Micro programmed Control & hardwired; Introduction to parallel processing: Principles of pipeline and vector processing. Multiprocessor architectures and programming.

J.P.Hayes Computer Architecture and organization III Edition, McGraw Hill, 1998.
Hwang and Briggs, Computer Architecture and parallel processing, McGraw Hill, 1985.
David A. Patterson & John L. Hennessy, Computer Organization and design, Morgan Kaufmann Publ., 3rd edition.

CO201 THEORY OF COMPUTATION (3-1-0) 4

Formal Languages and Automata Theory: Generative grammar, Chomsky hierarchy, Finite state Automata: Definition, Concept of Non-determinism, Equivalence of deterministic and Nondeterministic Automata; Relation between CFL and Type3 grammars; Pumping Lemma for CFL; Closure properties. Push down Automata: Definition, Equivalence between NPDA and context free grammars, Pumping Lemma for C.F.L's, Decision problems, Closure properties. Turing machines: Definition, extension to Turing machines: Multi-track, Multi-tape, and Non determinism. TM as an acceptor, TM as a computing device; Relation between TM and type-0-grammars. Universal Turing Machine, Concept of computability, Undecidable problems. Recursive function theory: Primitive recursive functions, general recursive function, relation between general recursive functions and Turing machines, Church's thesis, P, NP, NP- Hard & NP- Complete problems.

J.E.Hopcroft and J.D.Ullman, Introduction to automata, Languages and computation, Addison Wesley.
H.E.Lewis and C.H. Papadimitiou, Elements of the Theory of Computation, Prentice-Hall of India, 1981.
Derickwood, Theory of Computation, John Wiley & Sons.

CO202 DESIGN OF DIGITAL SYSTEMS (3-1-0) 4

Switching algebra and logic circuits; combinational and sequential circuits and their algorithmic synthesis; Computer aided synthesis and optimization (introduction); Hardware modeling using VHDL; Logic optimization: two level, multi level, circuits; Introduction to VLSI design: MOS devices, system level design; Introduction to VLSI testing: fault models, testing combination and sequential circuits.

Alan B.Marcovitz, Intro. To Logic Design, TMH, 2002.
Giovanni De Micheli, Synthesis and Optimization of Digital circuits, 2000
Zvi Kolavi, Switching and finite automata theory, Tata McGraw Hil 2000

CO203 DATA STRUCTURES AND ALGORITHMS (3-1-0) 4

Algorithm analysis and design techniques. Basic data structures –Stack, Queue and List –their sequential and linked representations, variations, operations with algorithms on these; Trees and graphs and sets - variations, operations and representation methods. Algorithms for Searching & Sorting. Data structures and algorithms for external storage.

Alfred V Aho, John E Hoperoft, Jeffrey D. Ullman. Data structures and Algorithms- Addison Wesley.2003
Horowitz and Sahni , Data Structures and Algorithms using C/C++, 2003
Mark Allen Weiss, Algorithms Data structures and problem solving with C++, Addison Wesley

CO204 DESIGN OF DIGITAL SYSTEMS LAB (0-0-3) 2

Design of basic gates, adders, subtractors, encoders, decoders, shifters: up, down, up-down, counters, flip flops, code conversion, multiplexers (All using behavioral modeling). Introduction to structural modeling: Adders, subtractors, multiplexors, counters, multiplier (array multiplier), Design of FSM: Moore machine, Melay machine.

J. Bhasker, VHDL primer, 3rd edition, Addison Wesley Longmen Singapore Pvt. Ltd.
Douglas Perry, VHDL by McGraw Hill International, 1998.
Peter Ashenden, The Designer Guide to VHDL by 1998

CO205 DATA STRUCTURES AND ALGORITHMS LAB (0-0-3) 2

Implementation of array operations: Stacks, Queues, Circular Queues, Multiple stacks and queues. Implementation of linked lists: stacks, queues, polynomial operations. Doubly linked lists. Tree traversal: AVL tree implementation, application of trees. Hash Table. Searching and sorting.

Alfred V Aho, John E Hoperoft, Jeffrey D. Ullman. Data structures and Algorithms- Addison Wesley.2003
Horowitz and Sahni , Data Structures and Algorithms using C/C++, 2003
Mark Allen Weiss, Algorithms Data structures and problem solving with C++, Addison Wesley

CO250 DATA COMMUNICATION (3-1-0) 4

Evolution of Data Communication and Networks; Transmission fundamentals: Signals, media, encoding and modulation, multiplexing, devices, error detection and correction, Data link control and protocols, data transmission over networks - switching techniques and LAN.

William Stallings, Data and Computer Communications and Networking, 2nd Edition, TMH, 2002.
Behrouz A Forouzan, Data Communications and Networking, 2nd edition, TMH, 2002
Leon, Garcia and Widjaja - Communication Networks, TMH 2002.

CO251 SOFTWARE ENGINEERING (3-1-0) 4

Introduction to software engineering, Software development life cycle & various models, requirements engineering, software specification, software metrics, software design, Object Oriented software engineering, Software testing & various testing mechanisms, Software verification and validation, Verifying performances, Verifying reliability, Software cost estimation models, Software development tools including CASE Tools, Software Project management.

R.S. Pressman, Software Engineering, McGrawHill, 2002
Pankaj Jalote, An Integrated Approach to software Engineering, Narosa Pub., 2002

CO252 OPERATING SYSTEMS (3-1-0) 4

Introduction to O.S, File Systems, CPU scheduling, Memory management, Disk Scheduling algorithms, virtual memory concept, Deadlocks, Concurrent processes, Performance Evaluation, Operating system Security, Case Studies - The UNIX operating system

Silberschartz & Galvin, Operating System Concepts, Addison Wesley, Fifth Edition, 1997.
Melin Milenkovic, Operating Systems: Concepts and Design, McGraw Hill, New York, 2000.
Sumitaba Das, Unix concept and applications

CO253 DESIGN AND ANALYSIS OF ALGORITHMS (3-1-0) 4

Models of computation, various performance measures, General techniques of algorithm design, Analysis of different algorithms for sorting and selection, Data structures for efficient manipulation of sets and partition, Efficient Graph algorithms based on Depth first search, Strassen's matrix multiplication algorithm, Efficient algorithms for matrix inversion and LUP decomposition, Modular arithmetic, NP-complete problems and approximation algorithms.

Aho, Hopcroft and Ullman the design and analysis of Computer Algorithms, Addison Weseley.
Horowitz and Sahni, Fundamentals of Computer Algorithms, Galgotia Publications, 2000.
Knuth D.E., The Art of Computer Programming, Vol. I: Fundamental Algorithms, Addison Wesley.2000

CO254 OPERATING SYSTEMS LAB (0-0-3) 2

Linux and/or other OS based exercises to practice/simulate: scheduling, memory management algorithms; concurrent programming; use of threads and processes; kernel reconfiguration, device drivers and systems administration of different operating systems, Writing utilities and OS performance tuning

Silberschartz & Galvin, Operating System Concepts, Addison Wesley, Fifth Edition, 1997.
Melin Milenkovic, Operating Systems: Concepts and Design, McGraw Hill, New York, 2000.
Sumitaba Das, Unix concept and applications

CO255 SOFTWARE ENGINEERING LAB (0-0-3) 2

Mini project to be designed to give exposure to the latest developments in Software Engineering and to understand the use of Project Management skills; use of CASE tools.

R.S. Pressman, Software Engineering, McGrawHill, 2002
Pankaj Jalote, An Integrated Approach to software Engineering, Narosa Pub., 2002

CO260 PRINCIPLES OF PROGRAMMING LANGUAGE (3-0-0) 3

Imperative Programming Paradigm: Syntax, Semanaties, and Pragmatics. Basic Constructs, Data abstraction. Procedural abstraction: Names, bindings, scope, parameter passing methods, interface. Functional Programming Languages: implementation, case study. Logic Programming Languages: implementation, case study.

Ravi Sethi. Programming Languages: Concepts and Constructs. Addison Wesley 1996.
Benjamin C Pierce. Types and Programming Languages, MIT Press, 2002
Michael L Scott ,Programming Language Pragmatics. Elsevier. 2004.

CO261 INFORMATION SYSTEMS (3-0-0) 3

Information System Design and Development - phases; System analysis methods - Data, Process, Network and Object modeling; System design approaches / methods - architectures and processes, input and output, prototyping; system implementation, safety & security, maintenance.

Jeffrey.L.Whitten, Lonnie.D.Bentley, System analysis and design methods 4th edition, TMH, 2002
James.A.Senn, Analysis and Design of Information System, 2nd edition, McGraw Hill, 2002

CO262 SYSTEMS PROGRAMMING (3-0-0) 3

Introduction to system software, Desirable characteristics of systems programs, Introduction to Assemblers, loaders and text editor, Study of detailed machine language structure and PDP-11 Input/ Output operations in PDP-11; subroutines and coroutines; concurrent I/O; supervisor mode. Macro facilities in PDP-11, Macro facilities in PDP-11, Design of an assembler, Linkers and loaders, Design of a simple text editor.

Schneider, Principles of Computer Organization, Wiley International Edition
Mac Ewan, Introduction to Computer Systems through PDP-11 & Pascal, McGraw Hill
D.M. Dhamdhere, Introduction to system software, Tata McGraw Hill, New Delhi, 2002.

CO263 OBJECT ORIENTED PROGRAMMING (1-0-3) 3

Principles of Object oriented programming, OO Paradigms, Basic Principles, Applications of OO programming using Java.

Brac J Cox, Object Oriented Programming: An evolutionary approach – Addison Wesley Publishing Company
Patrick Naughton and Herbert Schildt, Obsorne, The Complete Reference Java2.
Ira Pohl, "Object oriented programming using C++", Pearson Education Asia, 2003

CO280 OBJECT ORIENTED PROGRAMMING CONCEPTS (3-0-0) 3

Principles of Object oriented programming, OO Paradigms, Basic Principles, Applications of OO programming using Java.

Brac J Cox, Object Oriented Programming : An evolutionary approach – Addison Wesley Publishing Company.
Patrick Naughton and Herbert Schildt, Obsorne, The Complete Reference Java2.
Ira Pohl, "Object oriented programming using C++", Pearson Education Asia, 2003.

CO300 COMPUTER NETWORKS (3-1-0) 4

Introduction, Layered Architecture of Computer Networks, OSI and TCP/IP architectures & layers with protocols, Internetworking & routing, Network management current trends

Behrouz A. Forouzan, Data Communications & Networks, third edition, Tata McGraw Hill.
James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, 6/E, Pearson Publication.
Andrew. S. Tannenbaum, Computer Networks, Prentice Hall of India, 2nd Edn, 2002.

CO301 DATABASE MANAGEMENT SYSTEMS (3-1-0) 4

Introduction; E-R Models, Relational Models, Relational Algebra & Calculus, SQL Queries, programming and triggers, Data Storage, File Handling, Security, Parallel & distributed data, Internet database, Data Mining, Object Database systems, Real Time Database systems,

R. Ramaksrishnan & Johannes G, Database Management System, McGraw Hill Publishers.
J.O. Ullman , Principles of Database systems, Galgotia Publishers
Stamper & Price, Database Design and Management-An Applied Approach, McGraw Hill Publications.

CO302 COMPUTER NETWORKS LAB (0-0-3) 2

Exercises comprising simulation of various protocols and performance study; TCP/IP Level Programming, Routing Algorithms and internetworking.

Kris Jamsa, Ken Cope, Internet Programming, Galgotia.
Fred Halsall, Data Communications, Computer networking on OSI, Addison Wesley Publishing Co., 2nd Edition, 2002.
Behrouz A. Forouzan, Data Communications & Networks, third edition, Tata McGraw Hill.

CO303 DATABASE MANAGEMENT SYSTEMS LAB (0-0-3)2

Assignment in Design and Implementation of Database systems or packages for applications such as office automation, hotel management, hospital management; deployment of Forms, Reports Normalization, Query Processing Algorithms in the above application project; Distributed data base management & other related exercises

R. Ramaksrishnan & Johannes G, Database Management System, McGraw Hill Publishers.

J.O. Ullman , Principles of Database systems, Galgotia Publishers

Stamper & Price, Database Design and Management-An Applied Approach, McGraw Hill Publications.

CO310 MICROPROCESSOR SYSTEMS (3-0-0) 3

Microprocessor Architecture, 8086, Instruction set, Subroutines, Programming examples, Software development with Interrupts; Intel 80286, 80386; Programmable peripheral devices, 8255, 8253,8259, 8257, Motorola 68000 Processors, 68020, 68030; Mother boards, I/o bus, I/o channel, BIOS,DOS, PC bus, Multibus I & II, VME, CRT Controller, Floppy disc Controller, Hard disc Controller, CDROM Drive, Serial Communication Controller, Pen drive, Mouse drive.

Doughlas V. Hall, Microprocessors & Interfacing

Barry B. Brey, "The Intel Microprocessors: Architecture, Programming & Interfacing" PHI, 6th Edition, 2003.

Lice & Gibson, "Microcomputer System 8086 / 8088" PHI, 2nd Edition.

CO311 UNIX NETWROK PROGRAMMING (3-0-0) 3

Introduction to Unix. TCP & UDP, TCP Sockets, UDP sockets, Name and address conversion, I/O functions, Non Blocking I/O, Daemon Process, Raw sockets.

Brian W.Kernighan, The Unix Programming Environment, Pearson Education 2003

Jeff Horwitz, Unix System Management-Primer Plus, Sams / Pearson Education, 2003

W. Richard Stevens, Bill Fenner, Andrew M. Rudoff, Unix Network Programming: The Sockets Networking Api, Volume 1, Addison-Wesley Professional, 2004

CO312 COMPUTER GRAPHICS & MULIMEDIA (3-0-0) 3

Introduction to computer graphics: basic raster graphics algorithms for drawing 2D primitives, 2D transformations, window-to-viewport transformation, input devices and interactive techniques. 3D graphic: viewing in 3D, projections, basics of solid modeling, 3D transformations. Multimedia building blocks: audio - basic sound concepts, music, speech, MIDI versus digital audio, audio file formats, sound for the web, images and graphics- basic concepts, computer image processing. Video and animation - basic concepts, animation techniques, animation for the web.

Foley J. D., Van Dam A., Feiner S. K., & Hughes J. F., Computer Graphics Principles and Practice, Second Edition, Addison Wesley

Hearn D. & Baker P.M, Computer Graphics, Prentice Hall India

Koegel Buford J. F., Multimedia System, Addison Wesley

CO313 NUMBER THEORY & CRYPTOGRAPHY (3-0-0) 3

Elementary number theory, Finite fields, Arithmetic and algebraic algorithms, Secret key and public key cryptography, Pseudo random bit generators, Block and stream ciphers, Hash functions and message digests, Public key encryption, Probabilistic encryption, Authentication, Digital signatures, Zero knowledge interactive protocols, Elliptic curve cryptosystems, Formal verification, Hard problems, Randomness and Pseudo randomness and Testing.

Koblitz, N. Course on Number Theory and Cryptography, Springer Verlag, 1986

Menezes, A, et.al. Handbook of Applied Cryptography, CRC Press, 1996

Ivan Niven, Herbert S. Zukerman, Hugh L.Montgomery, An Introduction to the Theory of Numbers.

CO314 SIMULATION AND MODELING (3-0-0) 3

Introduction to Modeling and simulation concepts. Levels of simulation for digital, analog & mixed mode circuits. IC CAD Overview. Device Simulation. Electrical simulation techniques. Relaxation based simulation techniques. Gate level simulation, Switch level timing simulation. Mixed mode interface, simulation and implementation, analog multi-level simulation. Discrete time models, Event driven simulation, Logic simulation, timing verification in ICs, setup and hold times for clocked devices.

R. Saleh, S. Jou & A.R.Newton, Mixed mode simulation and analog multilevel simulation, Kluwer Academic Pub. 1994.

V.Litovski & M. Zwolinski, VLSI circuit simulation & Optimization, Chapman & Hall, 1997.

J Baker, Li & Boyce, CMOS Circuit Design & Simulation, PHI, 2000.

CO315 OBJECT ORIENTED SYSTEMS (3-0-0) 3

Introduction to object technology and applications; object oriented decomposition vs. structured decomposition in software development, concepts and applications of object oriented analysis and design, object oriented databases, application development using programming language JAVA

Grady Booch, Object Oriented Analysis and design and applications

James Rumbaugh, O. O. Modeling. 2005, Thomson Education.

Booch, G., Rumbaugh, J. and Jacobson, I. (1999). The Unified Modeling Language user guide. Addison Wesley Longman, Inc. Reading, MA. USA.

CO316 COMPUTER ARCHITECTURE LAB (1-0-3) 3

This lab will be based on assembly programming on of RISC processor simulator SPIM.

J.P.Hayes Computer Architecture and organization III Edition, McGraw Hill, 1998.

Hwang and Briggs, Computer Architecture and parallel processing, McGraw Hill, 1985.

David A. Patterson & John L. Hennessy, Computer Organization and design, Morgan Kaufmann Publ.,3rd edition.

CO330 PROBLEM SOLVING TECHNIQUES IN COMPUTERS (3-0-0) 3

Basic problem solving strategies, problem simplification and decomposition techniques, algorithmic solutions and their correctness, recursion, simulation, decision trees, graphs and networks, computer organization and programming constructs and basic operating system and debugging tools.

Delores M. Etter. Engineering Problem Solving with C, 3rd Edition, Prentice Hall, 2005.

Jeri R. Hanly and Elliot B. Koffman, Problem Solving and Program Design in C, Pearson Education, Inc., ISBN: 0-321-21055-7,

D.S. Malik , Thomson, C++ Programming: From Problem Analysis to Program Design, Third Edition, Course Technology, 2007

CO350 COMPILER DESIGN (3-1-0) 4

Introduction to compiler design, Lexical analyzer, Regular expressions and finite automata, Introduction to context free grammars, BNF notation, Parsing Techniques: Top-down parsing and Bottom-up parsing, Error recover strategies for different parsing techniques, Intermediate code generation, symbol table, Runtime storage allocation, Code Optimization, Code generation.

Alfred V. AHO, Ravi Sethi & Jeffrey D. Ullman, Compilers; Principles, Techniques & Tools, Addison-Wesley Publication, 2001.

William A. Barrett et.al, compiler Construction, Theory and Practice, Galgotia 2000

Holub A.I., Compiler Design in C, Prentice Hall India.2000

CO351 COMPILER DESIGN LAB (0-0-3) 2

The laboratory course would consist of building a mini compiler (possibly subsets of Standard Compilers like PASCAL or other languages) and executing Simple problems to demonstrate the Compiler capabilities. LEX & YACC of Unix to be used.

Alfred V. AHO, Ravi Sethi & Jeffrey D. Ullman, Compilers; Principles, Techniques & Tools, Addison-Wesley Publication, 2001.

William A. Barrett et.al, compiler Construction, Theory and Practice, Galgotia 2000

Holub A.I., Compiler Design in C, Prentice Hall India.2000

CO352 COMPUTER GRAPHICS MINI-PROJECT (1-0-2) 2

2D and 3D conversion, Transformation and curves. Implementation of 2D packages which support graphics editor with classical input techniques, transformation and animation.

Van Dam, Foley, Feimer, Hugher, Computer Graphics Principles and Practice in C-, Addison Wesley

Hearn D. & Baker P.M, Computer Graphics, Prentice Hall India

Koegel Buford J. F., Multimedia System, Addison Wesley

CO360 ADVANCED DATA STRUCTURES (3-0-0) 3

Data structures and its operations, trees, Heaps, Advanced Graph Algorithms and application, Internet Algorithms, Compression algorithms, search engine algorithms, spiders and crawlers, Integer and polynomial Arithmetic, modular Arithmetic, NP-Completeness and approximation algorithms.

Thomas Cormen, Charles E Leiserson and Ronald D River, Introduction to Algorithms, PHI, 2001.

Mark Allen Weiss, Algorithms, Data Structures and Problem Solving with C++, Addison Wesley, 2002.

Fundamentals of data structures in C++, by E. Horowitz, S. Sahni, and D. Mehta, Second Edition, Silicon Press, 2007.

CO361 LOGIC FOR COMPUTER SCIENCE (3-0-0) 3

Propositional logic, syntax of propositional logic, main connective, semantics of propositional logic, truth tables and tautologies, tableaus, soundness theorem ,finished sets, completeness theorem,. Predicate logic, syntax of predicate logic, free and bound variables, semantics of predicate logic,, graphs, tableaus, soundness theorem, finished sets, completeness theorem, equivalence relations, order relations, set theory. Linear time Temporal Logic(LTL), syntax of LTL, semantics of LTL, Buchi Automata, Buchi recognizable languages and their properties, Automata theoretic methods, Vardi-Wolper Construction, Satisfiability problem of LTLI, Model checking problem of LTL. Software Verification: Tools used for software verification. SPIN and SMV. Introduction to both tools. Method of verification by the tools.

Jerome Keisler H. Joel Robbin, Mathematical Logic and Computability, McGraw-Hill International Editions, 1996.

Papadimitriou, C. H., Computational Complexity, Addison Wesley, 1994

Gallier, J. H., Logic for Computer Science: Foundations of Automatic Theorem Proving,, Harper and Row, 1986.

CO362 INFORMATION SECURITY (3-0-0) 3

Basic concepts, access control, Protection, Secure coding, Cryptography, Network security, Firewalls, Confining untrusted code, Security on the Internet and the World Wide Web, Attack Techniques, Case studies.

Matt Bishop, Computer Security, Arts & Science, Pearson Education, 2003.

Pceprzyk et.al., Fundamentals of Computer Security, Allied Publishers, 2004.

Derek Atkins and 9 others, Internet Security, Techmedia 2nd edition, 1997.

CO363 WEB ENGINEERING (3-0-0) 3

Requirements specification and analysis, Web-based systems development methodologies and techniques, Migration of legacy systems to Web environments, Web-based real-time applications development, Testing, verification and validation, Quality assessment, control and assurance, Configuration and project management, "Web metrics"- generating metrics for estimation of development efforts, Performance specification and evaluation, Update and maintenance, Development models, teams, staffing, Integration with legacy systems, Human and cultural aspects, User-centric development, user modeling and user involvement and feedback, End-user application development.

Journal of Web Engineering, Rinton Press, IEEE & ACM Publications.

Cato & John, User Centered web design, Pearson Education, 2001.

Kappel, G., Proll, B. Reich, S. & Retschitzegger, W. Web Engineering, 1s ed. Wiley & Sons.

CO364 SOFT COMPUTING (3-0-0) 3

Introduction to learning systems -Feed forward Neural Networks - Multilayer Perceptron propagation algorithm and its variants - Improving generalizatio. Recurrent Neural Networks - Hopfield net - Boltzmann machine and Mean field learning –combinational optimization problems using recurrent Neural Networks. Unsupervised Neural Networks. Competitive learning - Self organizing maps - Growing cell structures Principal component analysis. Basics of fuzzy sets. Genetic algorithms: Population based search techniques, evolutionary strategies, mathematical foundations of genetic algorithms, search operators, genetic algorithms in function and combinational optimization, hybrid algorithms, application to pattern recognition

S. Haykin, Neural Networks : A comprehensive foundation, Pearson, 1999

J. M. Zurada, Introduction to artificial neural networks, Jaico publishing, 1997.

B. Yajnanarayana, Artificial Neural Networks, PHI, 1991

CO365 ADVANCED COMPUTER NETWORKS (3-0-0) 3

In Depth review of network and transport layer protocols, Congestion control algorithms and QOS, network virtualization, overlays sensor network, mesh network.

Richard Stevens, TCP/IP Illustrated, Volume 1: The Protocols PHI, 2001.

Behrouz Forouzan, TCP/IP Protocol Suite, 3/e, McGraw Hill

Larry L. Peterson, Bruce S. DavieComputer Networks: A Systems Approach, Elsevier

CO366 FORMAL METHODS (3-0-0) 3

Formal Methods in Computing Specification; Formal Description Techniques in Communication Software Systems; Formal Methods in Object Orientation and Software Engineering, Proof Methods and Techniques, Temporal and Model Logic

Jan Ven Lecuwen—Formal Model and Semantics, Elsevier-MIT Press, 1992

Arindama Singh—Logic for Computer Science, PHI, IEEE, 2003

Programming Perl. Larry Wall, Tom Christensen, and Randal Schwartz.1996. O'Reilly & Associates, Inc.

CO367 DISTRIBUTED COMPUTING (3-0-0) 3

Introduction Distributed Systems and applications, Message Passing mechanisms IPC and RPC, Distributed Operating Systems – resources/process/thread management, Distributed File Systems and Services, Shared data, Synchronization Transaction and Concurrency Control, Distributed databases, Name service, Timing & Coordination, Replication, Security and Fault Tolerance.

Pradeep Sinha, Distributed Operating Systems- Concepts and Design, PHI, 2000

George Couloris, Jean Dollimore & Time Kindberg,Distributed Systems:Concepts & design, 2nd ed, Addision Wesley 2003.

A.S. Tanenbaum and M.V. Steen, Distributed Systems – Principles and Paradigms, PHI.2003

V. Rajaraman, C. Siva Ram Murthy, Parallel, Computers Architecutre & Programming, PHI.

CO368 INTERNET TECHNOLOGY AND APPLICATIONS (1-0-3) 3

Internet & Web Technology, Infrastructure and tools for Internet Commerce /E-Commerce Current Trends in E-Commerce applications development, Enterprise level E-Commerce: SCM, CRM, EDI, B2Bi, ERP.

Henury Chan et al. E-commerce-Fundamental and applications, John Wiley & Sons, 2002

G. Winfield Treese and Lawrence C.S. Designing Systems for Internet Commerce, Pearson Edison, LPE, 2002.

Thomas Powell, The Complete Reference to HTML, Osborne/McGraw-Hill

CO380 INTERNET TECHNOLOGY (3-0-0) 3

Internet & Web Technology, Infrastructure and tools for Internet Commerce /E-Commerce Current Trends in E-Commerce applications development, Enterprise level E-Commerce: SCM, CRM, EDI, B2Bi, ERP.

Henury Chan et al. E-commerce-Fundamental and applications, John Wiley & Sons, 2002

G. Winfield Treese and Lawrence C.S. Designing Systems for Internet Commerce, Pearson Edison, LPE, 2002.

Thomas Powell, The Complete Reference to HTML, McGraw-Hill

CO390 SEMINAR (0-0-3) 2

This course is a 2 credit course to be completed during 7th / 8th semester. Students will have to choose a topic in CSE's current trends or industry practices, prepare a write up, present it along with a suitable demonstration. Evaluation will be based on the relevance of topic, communication skills, and the reporting / documenting procedure.

CO410 ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS (3-0-0) 3

Architecture of AI & KBCS Systems, Design Issues and AI techniques, Introduction & Design of Expert Systems various applications, Introduction to fuzzy logic systems, Natural Language processing, Heuristic Search techniques, knowledge based systems.

Nilson, Artificial Intelligence: A new synthesis, 2001.

Edwin wise, Hands on AI with Java, McGraw Hill, 2004.

George Lugar, "AI-Structures and Strategies for Complex Problem Solving", 4/e, 2002, Pearson Educations

CO411 ADVANCES IN COMPILIER DESIGN (3-0-0) 3

Review of compiler fundamentals - lexical analysis, parsing, semantic analysis, error recovery and intermediate code generation; Runtime storage management; Code generation; Code improvement - peephole optimization, dependence analysis and redundancy elimination, loop optimization, procedural and inter-procedural optimization, instruction scheduling, optimization for memory hierarchy; Compilation for high performance architecture; Portability and retargetability; Selected topics from compilers for imperative, object-oriented and mark-up languages, parallel and distributed programming and concurrency.

Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, Compilers: Principles, Techniques and Tools, Addison-Wesley.

Michael L. Scott, Programming Language Pragmatics, Elsevier.

Andrew W. Appel, Modern Compiler Implementation in C/Java, Cambridge University Press.

CO412 DISTRIBUTED DATABASE SYSTEM (3-0-0) 3

Distributed database architecture, distributed database design, distributed query processing, query decomposition and optimization of distributed queries, distributed transaction management and concurrency control, distributed DBMS reliability, distributed database operating systems, Distributed multi database systems, Client/Server database systems, Peer-to-Peer Systems,
Location-based Applications, Parallel DBMS.

Principles of Distributed Database Systems, M.T. Ozsu and P. Valduriez, Prentice-Hall, 2nd Ed. 1999.
Ceri and Pelagatti, Distributed Database Principles and Systems, McGraw Hill. 2000
D. Bell and J. Grimson, Distributed Database Systems, Addison-Wesley, 1992.

CO413 GAME THEORY (3-0-0) 3

Introduction to game theory and strategic thinking, Ideas such as dominance, backward induction, Nash equilibrium, evolutionary stability, commitment, credibility, asymmetric information, adverse selection, and signaling, Applications.

D. Fudenberg and J. Tirole, Game Theory, MIT Press, 1991.
Martin J. Osborne. An Introduction to Game Theory. Oxford University Press. Indian Edition, 2003.
Roger B. Myerson. Game Theory: Analysis of Conflict. Harvard University Press, 1991.
Y. Narahari, Dinesh Garg, Ramasuri Narayanam, Hastagiri Prakash. Game Theoretic Problems in Network Economics and Mechanism Design Solutions. Springer, London, 2009.

CO414 DIGITAL IMAGE PROCESSING (3-0-0) 3

Digital data sources-satellite and Aerial photographs, Sources of error, Image rectification and restoration, Image enhancement, multi image manipulation, Principal component analysis, Image classification, supervised, unsupervised, and other advanced classification techniques. Accuracy assessment, Analysis of hyperspectral data.

Jensen, J.R. Introductory Digital Image Processing: A remote sensing Perspective, Prentice Hall
Lillesand, Thomas & Kiefer, Remote sensing and Image Interpretation, 6th edition John Wiley & Sons
Rafael C Gonzalez, Richard E Woods 2nd Edition, Digital Image Processing - Pearson Education 2003.

CO415 OPTIMIZATION TECHNIQUES IN COMPUTING (3-0-0) 3

Basic OR techniques, requirements, networks, design, role and methods, databases, compilers, optimization and performance in web computing, internet application, performance measurement tools, case studies.

Kanth, Introduction to computer system performance evaluation, McGraw Hill, 1992
David K smith, Network Optimization in Practice, ellise, Horrwood publications, 1982
Hiller and Lieberman, Introduction to Operation Research (Seventh Edition) Tata McGrawHill Publishing Company Ltd

CO416 WIRELESS NETWORKS (3-0-0) 3

Wireless Communications, Wireless Networks , Mobile Networking : Mobile IP, Mobile Networking, mobility in a higher layer , micro mobility , Ad Hoc Networks , Ad Hoc Routing , Wireless Protocols - Wireless TCP , Data Board casting , Mobile Data Management, Location Dependency/Awareness, Disconnected/Weak-connected Operations ,Adaptation, Mobile Applications/Services, User Interface Issues , Security Issues , Satellite Networks , New Topics.

William Stallings, Wireless Communications and Networks, , Prentice Hall, second edition, 2005.
Vijay Garg, Wireless Communications & Networking, Morgan Kaufmann, June 2007. .
Theodore S. Rappaport, Wireless Communications: Principles and Practice

CO417 SOFTWARE PROJECT MANAGEMENT (3-0-0) 3

Data Collection and Analysis in software engineering, Product Metrics, Quality Metrics, Management Metrics, Conventional Software Management, Life cycle Phases, Iterative process planning,, Modern Project Profiles, Next generation cost models.

K. Conway, Software Project Management: From Concept to Development, IDG Books, 2001

I. Jacobson.G.Booch and J.Rumbaugh, The Unified Software Development Process, Addison Wesley, 1999.

Norman E- Fentar and Share Lawrence Pflieger, Software Metrics, International Thomson Computer Press 1997.

CO418 GREEN COMPUTING (3-0-0) 3

Green Computing Fundamentals: Energy- efficient, power efficient and thermal aware computing and communication Newton's cooling model and basic thermodynamics and sustainability. Middleware Support for green computing: Power states Power states Voltage and frequency scaling ACPI support for Linux and, Voltage and frequency scaling, ACPI support for Linux and Windows, compiler optimization, virtualization and server consolidation. Tools for monitoring: Sensor networks, cooling equipment and their behavior. HPC computing: Hadoop, Map-Reduce, Dynamic thermal-aware scheduling, Resource Management in Virtualized Environment. Green Mobile, embedded computing and networking: Optimizing for minimizing battery consumption, Safe and Sustainable Cyber-physical systems (Medical devices). Management Frameworks Standards and metrics for green computing

K. Kant, Data center evolution – a tutorial on state of the art issues and challenges, Elsevier Computer Networks, 53(2009)2939-2965

L. Barraso and Holzl, Case for Energy Proportional Computing, IEEE Computer Dec 2007

CO419 DISTRIBUTED COMPUTING LAB (0-0-3) 2

Implementation of concurrent echo client-server application, concurrent day-time client-server application. Configure following options on server socket and tests them: SO_KEEPALIVE, SO_LINGER, SO_SNDBUF, SO_RCVBUF, TCP_NODELAY. Incrementing a counter in shared memory. Create CORBA based server-client application. Design XML Schema and XML instance document. WSDL based: Implement Arithmetic Service that implements add, and subtract operations / Java based: Implement Trigonometric Service that implements sin, and cos operations. Configuring reliability and security options. Monitor SOAP request and response packets. Analyze parts of it and compare them with the operations (java functions) headers.

M.L.Liu Addison Wiselly, Distributed Computing : Concepts & Applications

Nicolai M. Josuttis , SOA in Practice: The Art of Distributed System Design Prentice Hall Publication

Pradeep K. Sinha, Distributed Operating Systems: Concepts and Design

CO420 SOFT COMPUTING LAB (0-0-3) 2

MATLAB Fuzzy Logic Toolbox: Implement fuzzy set operations, implement fuzzy relational operations, design and implement fuzzy temperature controller, design and implement Fuzzy Traffic light controller, write and illustrate the concept of Fuzzy C – means Clustering, design a self executable fuzzy logic controller. MATLAB Neural Network Toolbox: Write programs to test the learning rules of Hebb, Perceptron, Delta, and Widrow Hoff in MATLAB learning rule. To implement the Back propagation algorithm, write and test a program for the linear separability of the input domain, write and implement a Hopfield algorithm, write a program for pattern recognition, design a self executable neural classifier.

Jyh, Chuen-Tsai, Eiji Mizutani "Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning", Prentice Hall. 1997

Chin –Teng Lin and C.S. George Lee - "Neural Fuzzy Systems" – A neuro fuzzy synergism to intelligent systems Prentice Hall International. 1996

Yanqing Zhang and Abraham Kandel - "Compensatory Genetic Fuzzy Neural Networks and Their Applications" World Scientific. 1998

CO421 SOFTWARE TESTING (1-0-3) 3

Software testing concepts & principles, Testing Strategies, Testability and Related Issues, Methods for developing the strategy, Life Cycle Testing, Installation Phase Testing and Various Phases of Testing; Tools and Techniques for Software Testing, Testing Object Oriented Software.

Glenford J. Myers, The Art of Software Testing, John Wiley & Sons, 1979.

Boris Beizer, Black Testing: Techniques for Functional Testing of Software and Systems, John Wiley & Sons, 1995

William Perry, Software Testing : Effective Methods for Software Testing, John Wiley, 1995

Cem Kaner, Jack Falk, Hung Quoc Nguyen, Testing Computer Software, 2nd Ed, Intl. Thomson Computer Press.

CO440 PRACTICAL TRAINING (0-0-3) 2

The Student has to undergo a training programme or any equivalent programme fixed by the institution /department. This will be done during the third or fourth year. A report will be submitted by the student. Evaluation is based on the seminar and report.

CO449 MAJOR PROJECT- I (0-0-6) 4

The Student has to select a project work based on a topic of interest. Periodically the implementation will be evaluated by the guide. This work, started in VII semester continues through eighth semester, at the end of which, the student will be evaluated internally and externally.

CO460 HIGH PERFORMANCE COMPUTING (3-0-0) 3

High performance computing architecture, cluster components, monitoring tools, Shared memory processing, performance issues, virtualization Grid Computing, GPGPU technology with NVIDIA's Cuda programming, High performance computing, Architecture of cluster-based systems, Shared-memory processing, Grids, Performance Issues and Tecchniques,

David j. Kuck, "High Performance Computing", Oxford Univ Pr, 1996

Gary W. Sabot, "High Performance Computing ", Addison-Wesley, 1995

David B. Kirk, Wen-mei W. HwuProgramming Massively Parallel Processors: A Hands-on Approach (Applications of GPU Computing Series) Elsevier-2010

CO461 DATA WAREHOUSING & DATA MINING (3-0-0) 3

Data Warehousing: Data warehousing components and building data warehouse. Data Mining – Objectives, examples, data mining process, Data mining techniques, Generalization, Data mining knowledge representation.

Raph Kimball, Data Warehouse Toolkit, John Wiley & Sons Publications

Michael. J. Berry, Gordon Linoff, :Data Mining Techniques: Marketing, Sales, Customer support. John Wiley & Sons.

CO462 NETWORK MANAGEMENT (3-0-0) 3

Network management standards and models, network management protocols, SNMP. Management information base (MIB), Network Configuring Proto (NETCONF), Heterogeneous Network and network security management, Network Management tools and applications.

M. Subramanian, Network Management: Principles and Practice, Addison- Wesley, 2000

J. Burke, Network Management Concepts and Practice, A Hands-On Approach, Pearson Education,2000.

William Stallings, SNMP, SNMPv2, SNMPv3, AND RMON 1 and 2, Addison Wesley, Third Edition, 1999.

CO463 CLOUD COMPUTING (3-0-0) 3

Introduction to Cloud Computing, Infrastructure as a Service (IaaS),Virtualization, Platform as a Service (PaaS),Software as a Service (SaaS),Cloud issues and challenges, Current techniques for large data processing (Google GFS, BigTable, and Map-Reduce),Cloud resource management, Energy efficiency in data centers, Cloud simulation and Semantic cloud

Antohy T Velte, Cloud Computing: A Practical Approach, McGraw Hill,

J. Lin and C. Dyer, Data-Intensive Text Processing with MapReduce, ,Morgan and Claypool, 2010

T. Velte, A. Velte, R. Elsenpeter, Cloud Computing, A Practical Approach, McGraw-Hill, 2009.

CO464 NETWORK SECURITY (3-0-0) 3

Introduction - Attacks, services and mechanisms - Classical encryption techniques - DES -Block cipher - Design principles and modes of operation. Encryption Algorithms - Hash functions - Triple DES - RC5 - Key management – Public key cryptography - RSA algorithm - Digital signatures and authentication protocols. System Security - Backups - Integrity management - Protecting against programmed threats, viruses and worms - Physical security - Personnel security. Network Security - Protection against eavesdropping - Security for modems - IP security -Web security - Electronic mail security - Authentication applications. Security Tools - Firewalls - Wrappers - Proxies - Discovering a break-in - Denial of service attacks and solutions - Cryptographic security tools: Kerberos, PGP, SSH, SRP, OPIE.

William Stallings, "Cryptography and Network Security – Principles and Practice", II Edition, Pearson Education, 2000,

Steve Burnett, Stephene Paine, "RSA Security's official guide to cryptography", RSA Pren, Tata McGraw Hill Edition, 2001

E. Nemeth, G. Snyder, s. Seebass, T.R. Hein, "UNIX System Administration Handbook", III Edition, Pearson Education, Asia, 2001

CO465 DISTRIBUTED ALGORITHMS (3-0-0) 3

Role of Distributed Algorithms in designing applications, Synchronous algorithms, asynchronous network algorithms, distributed algorithms for memory management and web computing.

Nancy & Lynch, Distributed Algorithms, Harcour Asia, 2001.

Distributed Computing: Fundamentals, Simulations, and Advanced Topics 2 Ed., *Hagit Attiya and Jennifer Welch. Wiley 2004 (ISBN 0-471-45324-2).*

Gerard Tel. Introduction to Distributed Algorithms. Cambridge University Press, Cambridge, UK. 2ndedition, 2000.

CO466 INFORMATION RETRIEVAL (3-0-0) 3

Introduction to Information Retrieval: unstructured and semi-structured text. Inverted index and Boolean queries. Text Indexing, Storage and Compression: Text encoding: Retrieval Models: Performance Evaluation: Text Categorization and Filtering: Text Clustering: Advanced Topics: Web Information retrieval.

Manning, Raghavan and Schutze, Introduction to Information Retrieval, Cambridge University Press.

Baeza-Yates and Ribeiro-Neto, Modern Information Retrieval, Addison-Wesley.

Soumen Charabarti, Mining the Web, Morgan-Kaufmann.

CO467 SOFTWARE QUALITY ASSURANCE (3-0-0) 3

Evaluation, Role, maturity in development, life cycle, models, maintenance issues, specification, object oriented design, management, testing, mechanisms, verification and validation, cost estimation, tools, debugging, simulators, ISO 9000 standards, Quality Assurance.

Pankaj Jalote, An Integrated Approach to Software Engineering, Narosh Publication, 1995.

John J Marciniack, Editor in chief Encyclopedia of Software Engineering, John Wiley and sons, 1994.

Isabel Evans, Achieving Software Quality through Team Work, Allied Publishers, 2004.

CO468 COMPUTER VISION (3-0-0) 3

Concept of application of computer vision, functional architecture of a vision system visual sensory model and camera calibration, processing tools, 3D vision, 3D representative schemes, High level vision and navigation.

Sonka M., Hlavac V., Boyle R., Image Processing Analysis and Machine Design. PWS Publishers
Ballard D., Brown C., Computer Vision, Prentice Hall
Bratt W., Digital Image Processing, John Wiley & sons

CO469 MOBILE COMPUTING (3-0-0) 3

Introduction to Medium access control – Telecommunication Systems, Standards Wireless Lan – IEEE 802.11 HIPERLAN – Bluetooth, Adhoc Networks, Characteristics-Performance issues-Routing in mobile hosts, Network Issues Mobile IP – DHCP, Mobile transport layer, Indirect TCP, Wireless application protocol, Dynamic DNS – File systems – Synchronization protocol-Context-aware applications-Security-analysis of existing wireless network.

J. Schiller, Mobile Communications, Addison Wesley, 2000.
William C.Y.Lee, Mobile Communication Design Fundamentals, John Wiley, 1993.
Theodore S. Rappaport, Wireless Communications, Principles & Practice, 2nd edition, Pearson.

CO470 SERVICE ORIENTED COMPUTING (3-0-0) 3

SOA Reference Model and Service Models, SOA Business Case, Service Design Principles, BPEL, Modeling SOA with CPN and OPNET, SOA, SOAP and REST, SOA Infrastructure, SOA Governance, Web Services, Identity and Security, Technologies, Tooling and Vendors.

Thomas Erl, Service-Oriented Architecture: Concepts, Technology and Design, 2006
Mark Hansen, SOA Using Java Web Services,.

CO471 PARALLEL PROGRAMMING (1-0-3) 3

Introduction to Parallel Computers , Message-Passing Computing and Programming, Multithread Programming ,OpenMP Programming ,Embarrassingly Parallel Computations ,Partitioning and Divide-and-Conquer Strategies , Pipelined Computations ,Synchronous Computations , Load Balancing and Termination Detection , Sorting Algorithms, Numeric Algorithms , Image Processing Algorithms

Jaja, J.: An Introduction to Parallel Algorithms, Addison-Wesley, 1992, ISBN 0-201-54856-9 Barry Wilkinson and Michael Allen, Parallel Programming – Techniques and applications Using Networked Workstations and Parallel Computers, , Prentice Hall, 1999.
Shameem Akhter and Jason Roberts ,Multi-Core Programming - Increasing Performance through Software Multi-Threading, Intel Press 2006.

CO480 MANAGEMENT INFORMATION SYSTEMS (3-0-0) 3

Functions of Management, Organization Environment, Organization Structure, System Concepts, Stakeholders Analysis, Framework for Information Systems (IS), Decision making process, Problem solving Process, Definition of Management Information System (MIS), EIS, DSS, Artificial Intelligence, Expert Systems, Computer hardware, Hardware standards, Computer Software File and Database Management, Communication Systems, Common Network components, Distributed systems, Design of MIS, Applications of MIS to business, Case studies.

Kenneth C. Laudon and Jane Price Laudon, Management Information Systems, Managing the Digitalfirm, Pearson Education, Asia, 2002.
Gordon B. Davis, Management Information System: Conceptual Foundations, Structure &Development,McGrawHill, 1974.
Joyce J Elam, Case series for Management Information Systems', Simon and Schuster Custom Publishing, 1996.

CO481 DECISION SUPPORT SYSTEM (3-0-0) 3

Designing and Developing DSS, Communications-Driven and Group Decision Support Systems (GDSS), Data-Driven DSS, Model-Driven DSS, Document-Driven DSS, and Knowledge-Driven DSS.

Power, D. J. Decision Support Systems: Concepts and Resources for Managers.

J., D. Oja, R. Ageloff and P. Carey, New Perspectives on Microsoft Excel 2000

CO499 MAJOR PROJECT - II (0-0-9) 6

The Student has to select a project work based on a topic of interest. Periodically the implementation will be evaluated by the project guide. This work, started in VII semester continues through eighth semester at the end of which, the student will be evaluated internally and externally.

Department of Electrical and Electronics Engineering (EE)

Bachelor of Technology in Electrical and Electronics Engineering

Basic Science Core (BSC)		
MA110	Engineering Mathematics – I	(3-0-0) 3
PH110	Physics	(3-1-0) 4
PH111	Physics Laboratory	(0-0-2) 1
MA111	Engineering Mathematics - II	(3-0-0) 3
CY110	Chemistry	(3-0-0) 3
CY111	Chemistry Laboratory	(0-0-3) 2
Engineering Science Core (ESC)		
EE 110	Elements of Electrical Engineering	(3-0-0) 3
ME110	Elements of Mechanical Engineering	(3-0-0) 3
CO110	Computer Programming	(3-0-0) 3
CO111	Computer Programming Laboratory	(0-0-3) 2
EC110	Elements of Electronics and Communication Engineering.	(3-0-0) 3
AM110	Engineering Mechanics	(3-0-0) 3
ME111	Engineering Graphics	(1-0-3) 3
Humanities and Social Science Core (HSC)		
HU110	Professional Communication	(3-0-0) 3
HU300	Engineering Economics	(3-0-0) 3
HU302	Principles of Management	(3-0-0) 3
Programme Core (PC)		
EE200	Circuit Theory	(3-1-0) 4
EE207	Electromagnetic Theory	(3-1-0) 4
EE213	Electrical Machines – I	(3-1-3) 6
EE224	Electrical Measurements and Measuring Instruments	(3-1-3) 6
EE226	Analog Electronic Circuits	(3-1-3) 6
EE256	Signals and Systems	(3-1-3) 6
EE258	Electrical Machines – II	(3-1-3) 6
EE265	Power System Engineering – I	(3-1-0) 4
EE276	Digital Electronic Circuits	(3-1-3) 6
EE308	Power Electronics	(3-1-0) 4
EE326	Linear and Digital Control Theory	(3-1-0) 4
EE350	Power System Engineering – II	(3-1-0) 4
Programme Electives (PE)		
EE229	Polyphase Systems and Component – Transformations	(3-1-0) 4
EE253	Commutator Machines	(3-1-0) 4
EE255	Introduction to Algorithms and Data Structures	(3-1-0) 4
EE260	Digital Computer Organization and Architecture	(3-1-0) 4
EE281	Commutator Machines Laboratory	(0-0-3) 2
EE298	Elements of Analog and Digital Communication	(3-1-0) 4
EE303	Distribution Systems Planning and Control	(3-1-0) 4
EE311	Digital System Design	(3-1-0) 4
EE312	Power System Harmonics	(3-1-0) 4
EE313	Digital Signal Processing	(3-1-0) 4
EE321	Linear and Nonlinear Systems	(3-1-0) 4
EE324	Electronic Measurements and Instrumentation	(3-1-0) 4
EE328	Network Synthesis	(3-1-0)4
EE329	Traveling Waves on Transmission Systems	(3-1-0) 4
EE331	Distribution Systems Laboratory	(0-0-3) 2
EE334	Power Electronics Laboratory	(0-0-3) 2
EE335	Digital System Design Laboratory	(0-0-3) 2
EE337	Power System Harmonics Laboratory	(0-0-3) 2
EE342	Electronic Measurements Laboratory	(0-0-3) 2
EE359	Energy Auditing	(3-1-0) 4
EE360	Microprocessors	(3-1-0) 4
EE361	Power System Communications	(3-1-0) 4
EE362	Optimal Operation of Power Systems	(3-1-0) 4
EE363	Advanced Digital Signal Processing	(3-1-0) 4
EE366	Special Machines and Drives	(3-1-0) 4
EE369	Embedded System Design	(3-1-0) 4
EE371	Power Electronic Applications to Power Systems	(3-1-0) 4
EE373	Electric Power Stations	(3-1-0) 4
EE374	Electric Energy Systems	(3-1-0) 4
EE376	Advanced Control Systems	(3-1-0) 4
EE377	Modeling and Simulation Techniques for Dynamic Systems	(3-1-0) 4
EE378	Shell Scripting with Bash	(3-1-0) 4
EE379	Incremental Motion Control	(3-1-0) 4
EE382	Virtual Instrumentation Laboratory	(0-0-3) 2
EE384	Energy Auditing Laboratory	(0-0-3) 2
EE385	Microprocessors Laboratory	(0-0-3) 2
EE386	Digital Signal Processing Laboratory	(0-0-3) 2
EE387	Advanced Digital Signal Processing Laboratory	(0-0-3) 2
EE389	Embedded System Design Laboratory	(0-0-3) 2
EE392	Power System Operation Laboratory	(0-0-3) 2
EE393	Dynamic System Simulation Laboratory	(0-0-3) 2
EE402	HVDC Transmission	(3-1-0) 4
EE404	Soft Computing	(3-1-0) 4
EE406	Electromagnetic Compatibility	(3-1-0) 4
EE408	Solid-State Drives	(3-1-0) 4
EE410	Power System Protection	(3-1-0) 4
EE411	Operation of Restructured Power Systems under Deregulation	(3-1-0) 4
EE412	Random Signal Processing	(3-1-0) 4
EE414	Non-Conventional Energy Systems	(3-1-0) 4
EE418	Advanced Power Electronics	(3-1-0) 4
EE420	Power System Dynamics	(3-1-0) 4
EE422	Switchgear and Protection	(3-1-0) 4
EE427	Computer Networks	(3-1-0) 4
EE428	The ARM Core: Architecture and Programming	(3-1-0) 4
EE439	Advanced Power Electronics Laboratory	(0-0-3) 2
EE445	Power System Simulation Laboratory	(0-0-3) 2
EE454	Flexible AC Transmission Systems	(3-1-0) 4
EE456	High-Voltage Engineering	(3-1-0) 4
EE458	Photovoltaics and Applications	(3-1-0) 4
EE464	Power Generation and Economics	(3-1-0) 4
EE466	Utilization of Electrical Energy	(3-1-0) 4
EE468	Advanced Electric Drives	(3-1-0) 4
EE470	Computational Technique for large system analysis	(3-1-0) 4

EE472	Insulation and Testing Engineering	(3-1-0) 4
EE476	Optimisation Techniques	(3-1-0) 4
EE478	An Introduction to the Intel IA-32 Architecture	(3-1-0) 4
EE489	Advanced Electric Drives Laboratory	(0-0-3) 2
EE491	Insulation and Testing Engineering Laboratory	(0-0-3) 2

Open Electives (OE)

EE319	Neural Networks and Applications	(3-0-0) 3
EE320	Electrical Safety, Operations, Regulations	(3-0-0) 3
EE467	Industrial Electrical Systems	(3-0-0) 3
EE469	Renewable Energy Systems	(3-0-0) 3

Project

EE449	Major Project – I	(0-2-6) 6
EE499	Major Project - II	(0-2-6) 6

Mandatory Learning Courses (MLC)

CY110	Environmental Studies	(1-0-0) 1
HU211	Professional Ethics and Human Values	(1-0-0) 1
EE448	Seminar	1
EE498	Practical Training	2

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Suggested Plan of Study:

Semester →	III	IV	V	VI	VII	VIII
1	EE200	EE256	HU300	HU302	Elective	Elective
2	EE207	EE258	EE308	EE350	Elective	Elective
3	EE213	EE265	EE326	Elective	Elective	EE498
4	EE224	EE276	Elective	Elective	EE448	EE499
5	EE226	Elective	Elective	Elective	EE449	
6	Elective		Elective			
7						
8						
9						

Degree Requirements :

Category of Courses	Minimum Credits to be Earned
Basic Science Core (BSC)	16
Engineering Science Core (ESC)	20
Humanities and Social Sciences (HSC)	09
Programme Core (PC)	60
Electives	50
Project	12
Mandatory Learning Courses (MLC)	05
Total	**172**

EE110 ELEMENTS OF ELECTRICAL ENGINEERING (3-0-0) 3

Review of circuit elements, voltage sources, current sources, source transformation, mesh current and node voltage analysis of circuits. Network reduction techniques. Concept of the magnetic circuit. AC analysis of single phase systems, wave forms, phasor representation, the j-operator, concepts of real and reactive power and power factor. Extension of AC analysis to symmetrical 3-phase systems, phase sequence, measurement of three phase power under balanced condition. Introduction to transformers, equivalent circuits, phasor diagram, regulation and efficiency. Electro-mechanical energy conversion, three phase induction motors.

Fitzgerald, D.E. Higginbotham, A. Grabel, Basic Electrical Engineering, 5th Edition, McGraw-Hill, 2009.

William H. Hayt Jr., Jack E. Kemmerly, Steven M.Durbin, Engineering Circuit Analysis, 6th Edition,TMH, 2002

Olle I. Elgerd, Basic Electric Power Engineering, Addison-Wesley, 1977.

Edward Hughes, Electrical Technology, 7th Edition, Longman, 1995.

EE200 CIRCUIT THEORY (3-1-0) 4

Review of network geometry and network reduction techniques. Network variables, identification of the number of degrees of freedom, the concept of order of a system, establishing the equilibrium equations, n etwork modeling based on energy-indicating (state) variables in the standard form, natural frequencies and natural response of a network. Introduction to system functions, inclusion of forcing functions, solution methodology to obtain complete solution in the time-domain - the vector-matrix approach. Analysis of network response (in the time-domain) for mathematically describable excitations. Solution strategy for periodic excitations. The phenomenon of resonance and its mathematical analysis. Polyphase circuits, wye-delta connections, sinusoidal steady state analysis of balanced and unbalanced three-phase systems. Introduction to sequence components.

Ernst A. Guillemin, Introductory Circuit Theory, John Wiley and Sons, 1953.

Charles A. Desoer, Ernest S. Kuh, Basic Circuit Theory, McGraw-Hill, 1969.

Russell M. Kerchner, George F. Corcoran, Alternating Current Circuits, 4th Edition, Wiley Eastern, 1960.

EE207 ELECTROMAGNETIC THEORY (3-1-0) 4

Static electric and magnetic fields. E-fields, D-fields, potential fields & Laplace's equation. Time varying fields. Discussion of various laws like Ohm's, Kirchhoff's, Faraday's laws from the field theory point of view. Maxwell' equations. Concept of electromagnetic wave propagations, uniform plane wave. Introduction to computational methods in electromagnetics. Applications and analysis of few power engineering, related problems.

William Hayt Jr., Engineering electromagnetic, John A Back, 8th Edtn. McGraw Hill Publication, 2012.

Mathew N O Sadiku, Elements of electromagnetic, 5th edtn, Oxford unvieristy press, 2010.

John D Kraus and Keith R Carver, Electromagnetics, 2nd Edtn, McGraw Hill Publication, 2012.

Julius dame Stration, Electromgantics, IEEE press, John Wiley and Sons inc publications, 1981.

Paul G Huray, Maxwell's equations, IEEE press, John Wiley and Sons inc publications, 2010

EE213 ELECTRICAL MACHINES – I (3-1-3) 6

Review of power network structures, principle of energy conversion. Transformers : Principle, construction (single phase, three phase), development of equivalent circuit through coupled circuit approach, phasor diagram, regulation, efficiency; autotransformers, vector groups and parallel operation of three phase transformers, tap changers, phase conversion, energisation of transformer and harmonics. Induction machines: Principle, construction, classification, equivalent circuit, phasor diagram, characteristics, starting techniques, speed control, operation under

unbalanced supply conditions and harmonics, effect of single phasing, induction generator operation, linear induction motor. Single phase induction motor: Types, speed control. Testing and diagnostic procedures for machines. Introduction to design of machines.
Laboratory exercises and assignments to supplement the course.
M.G. Say, Performance and design of A.C. Machines, CBS, 1983
Albert E. Clayton and Hancock, Performance and Design of Direct Current Machines
Charles V Jhons, Unified theory of Electrical Machines, Butterworth, 1967
O I Elgerd,Patrick D,Electric Power Engineering,2nd edition, Chapman &Hall,1998.

EE224 ELECTRICAL MEASUREMENTS AND MEASURING INSTRUMENTS (3-1-3) 6
Review of units, standards, dimensional analysis. Measurement basics: significant figures, errors, calibration. Measuring instruments: Analog and digital-Concept of true rms, DVM, multimeter DMM, resolution, sensitivity. Oscilloscope: specifications, applications. Measurement of voltage, current, power, power factor, frequency and energy; Power analyzer. Extension of meter ranges: Shunts & multipliers, CTs and PTs. Measurement of low, high resistances and applications. Measurement of earth resistance, dissipation factor and dielectric strength. Basics of cable fault location. Transducers: Classification, strain gauge, RTD, pressure transducers, inductive LVDT, capacitive, thermocouple, piezo-electric. Photo-electric, Hall effect. Laboratory exercises and assignments to supplement the course.
Golding and Widdis , Electrical Measurements and Measuring Instruments , Wheeler Publishing House, New Delhi 1979.
K. Sawhney , A Course in Electrical Measurement and Measuring Instruments ,Dhanpat Rai and Sons, New Delhi 2007
M. B. Stou , Basic Electrical Measurements
C.T. Baldwin, Fundamental of Electrical Measurement

EE226 ANALOG ELECTRONIC CIRCUITS (3-1-3) 6
Terminal, switching and thermal characteristics of semiconductor devices, establishment of quiescent point, biasing considerations, load line concept, control of devices in switching and active zones, device cooling requirement. Introduction to usage of SPICE device models and simulation. Power amplifiers, feedback in amplifiers, filters, operational amplifiers: configurations, characteristics, applications. Sample and hold, A/D , D/A Converters. Multivibrators, voltage regulators, voltage controlled oscillators, phase locked loop.
Laboratory exercises and assignments to supplement the course.
Jacob Millman and A. Grabel, Microelectronics, Tata McGraw-Hill, 1999
Ramakant Gayakwad, Op-amps and Linear Integrated circuits, Pearson Education , 2007.
J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, 2nd Edition, McGraw Hill, New York, 1992.
P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 4th Edition.

EE229 POLYPHASE SYSTEMS AND COMPONENT-TRANSFORMATIONS (3-1-0) 4
Balanced polyphase circuits: Generation of polyphase voltages, Phase sequence, three-phase 3-wire and 4-wire systems, wye and delta connections, n-phase star and mesh, power calculations in balanced systems, harmonics in wye- and delta-systems. Unbalanced polyphase circuits: unbalanced loads, wye-wye system with and without neutral connections, neutral shift, wye-delta system, phase-sequence effects, extensions to non-sinusoidal behaviour. Introduction to symmetrical components: A brief historical review, application of the method. Calculation of unbalance faults. Multiphase systems: Resolution of multiphase systems into symmetrical components, 2-phase and 4-phase systems, Irregular systems.
C.F. Wagner, R.D. Evans. Symmetrical Components, McGraw-Hill, 1933.

J.L. Blackburn, Symmetrical Components for Power System Engineering, Marcel-Dekker, 1993.
Edith Clarke, Circuit Analysis of AC Power Systems -- Volumes I and II, John Wiley and Sons, 1950.

EE253 COMMUTATOR MACHINES (3-1-0) 4

Constructional details, commutator action analysis, windings, mmf production, limitations, special features, fields of application, fault detection and general maintenance, preliminary design.

E. Openshaw Taylor, The Performance and Design of AC Commutator Machines.
Fitzgerald, Kingsley, Kusko. Electromechanical Energy Conversion.
Atkinson, Generalized Machine Theory.

EE255 INTRODUCTION TO ALGORITHMS AND DATA STRUCTURES (3-1-0) 4

Mathematical basis and notions for algorithm analysis. Sorting, divide and conquer, linear time sorting, elementary data structures, priority queues, BST and RBT. Design and analysis. Paradigms – Dynamic programming, Greedy algorithms, Graph algorithms.

T.H. Cormen, C.E. Leiserson, R.L. Rivest , C. Stein, Introduction to Algorithms, 2nd Edition, PHI, 2004.
D.E. Knuth, The Art of Computer Programming, Volumes I and III, Addison-Wesley, 1973.
Anany Levitin, Introduction to the Design and Analysis of Algorithms, Pearson Education, 2003.

EE256 SIGNALS AND SYSTEMS (3-1-3) 6

Signals and Systems – Classification, time-domain analysis of continuous-time and discrete-time systems, continuous-time system analysis using the Laplace transform, discrete-time system analysis using the z-transform. Fourier series, Fourier transform, sampling, applications. Laboratory exercises and assignments to supplement the course.

B.P. Lathi, Linear Systems and Signals, 2nd Edition, Oxford University Press, 2005.
Simon Haykin , Barry Van Veen, Signals and Systems, John Wiley Asia, 2003.
A.V. Oppenheim, A.S. Willsky , S. H. Nawab, Signals and Systems,2nd. Edition, Prentice-Hall Signal Processing Series, 1997.

EE258 ELECRICAL MACHINES – II (3-1-3) 6

DC Machines : Construction, classification, emf and torque equation, characteristics of DC motors, speed control, brushless DC motor, stepper motor, servomotor. Synchronous machines: Construction, prime-mover and excitation control systems. Steady state characteristics, handling of harmonics, voltage regulation calculations for salient and non salient pole machines, parallel operation, load sharing and associated capacity curves, Synchronous motors and condensors, Permanent magnet synchronous motors, Switched reluctance motors. Dynamic characteristics: Park transformation, the standard parameters of synchronous machines and simplified generator models, electromechanical oscillations, and large disturbance studies with respect to SMIB system, Introduction to equal-area criteria and numerical solutions. Introduction to design of synchronous machines. Laboratory exercises and assignments to supplement the course.

M.G. Say, Performance and Design of Alternating Current Machines, CBS, 1983.
Fitzgerald, Kingsley, Umans, Electric Machinery, 5th Edition, McGraw-Hill, 1992
Arthur R. Bergen, and Vijay Vittal, Power System Analysis, 1st Edition, Pearson Education Asia, 2001.

EE260 DIGITAL COMPUTER ORGANIZATION AND ARCHITECTURE (3-1-0) 4

Evolution of computers, instruction set design, processor design: functional unit design, micro-programmed and hardwired approaches, different architectures, control unit design, memory organization, input-output organization, introduction to system software, operating system basics.

J.P. Hayes, Computer Architecture and Organisation, 2nd Edition, McGraw-Hill, 1988.
M. Rafiquzzaman , Rajan Chandra, Modern Computer Architecture, Galgotia, 1999.

EE265 POWER SYSTEM ENGINEERING – I (3-1-0) 4

Electrical energy sources, power network structure and its components. AC, AC-DC, and DG-based systems, forms of field energy, concepts of real and reactive powers and their conventions, per unit representation. Power system operation and control: State of operation of a power system, voltage and frequency control mechanisms, power generation and demand management, tariff structure. Transmission lines: Design, modeling and performance analysis. Cables, insulators, grounding and safety.

Olle I. Elgerd, Electric Energy Systems Theory – An Introduction, TMH, 1982.
W.D. Stevenson Jr., Elements of Power System Analysis, McGraw-Hill, 1968.
Arthur R. Bergen, and Vijay Vittal, Power System Analysis, Pearson Education Asia, 2001.
I. J. Nagrath , D.P. Kothari, Power System Engineering, TMH.

EE276 DIGITAL ELECTRONIC CIRCUITS (3-1-3) 6

Logic families: TTL, ECL, NMOS, CMOS. Number systems, logic gates, boolean algebra, Karnaugh map. Combinational logic circuits: adders, subtractors, multiplexers, de-multiplexers, encoders, decoders, line drivers. Sequential logic circuits: latches and flip flops, registers and counters. Design of following finite state sequential machines using D flip-flops: Sequential code converters, sequence detectors, sequence generators and system controllers. Memories: read only and read/write memories, programming EPROM and flash. Laboratory exercises and assignments to supplement the course.

M. Mano, "Digital Design", 3rd Ed., Prentice Hall, India.
D.D. Givone, "Digital Principles and Design", Tata McGraw Hill.
J.F. Wakerly, "Digital Design Principles and Practices", Practice Hall.
R.J. Tocci, "Digital Systems Principles and Applications", Prentice Hall
Charles H Roth: Digital Systems Design using VHDL, Thomson Learning, 1998

EE281 COMMUTATOR MACHINES LABORATORY (0-0-3) 2

Laboratory exercises and assignments to provide additional support to EE253.

EE298 ELEMENTS OF ANALOG AND DIGITAL COMMUNICATION (3-1-0) 4

Introduction to analog and digital communication: Bandwidth and information capacity, transmission modes, signal analysis, noise considerations. Modulation and demodulation concepts: AM, FM, PM, TDM and FDM concepts. Classification of amplifiers (Class A, B, and C), tuned amplifiers, oscillators, amplitude modulation, demodulation circuits, mixer, TRF, superheterodyne and direct conversion receivers. Monochrome TV transmitter and receivers.

Digital and data communication: Sampling theorem, coding and decoding, pulse modulation, FSK, PSK, Modem. Serial and parallel interface: Computer network configurations and protocols, OSI reference model, internet protocol, packet switching. Satellite communications, orbital patterns, geostationary satellites, frequency band allocation. Optical fibre communication: Mode of signal transmission, signal sources and detectors, attenuators and channel capacity. Digital telephony, PSTN and cellular telephony.

Wayne Tomasi, Electronic Communication Systems, 4th Edition, Pearson Education, 2002.
Kennedy, Communication Systems, 4th edition.
Gary Miller, Modern Electronic Communication, 7th Edition.
Andrew S. TanenBaum, Computer Networks, 3rd Edition.
William C. Y. Lee, Mobile Cellular Telecommunication, 2nd Edition.

EE303 DISTRIBUTION SYSTEMS PLANNING AND CONTROL (3-1-0) 4

Distribution systems, their importance in energy transfer, distribution loss minimization techniques, radial and ring system , voltage regulation, reconfiguration , capacitor placement , power flow analysis , sizing of conductors and transformers , fault analysis , data acquisition and control, remote reading of energy meter , role of computers in distribution system operation , state of the art.

T. M. Gonen , Electrical Energy Distribution.
C. L. Wadhwa., Electrical Energy Distribution.
Recent publication in reputed journals and conference proceedings of relevance.

EE308 POWER ELECTRONICS (3-1-0) 4

Devices: Characteristics- diode, BJT, IGBT , MOSFET, IPMs, Thyristor based devices: SCRs/TRIAC/GTOs. Reactive elements: capacitors, inductor, transformer, pulse transformer. Data sheets, switching and conduction losses, heat dissipation- heat sink, loss calculation. Drive circuit, current and voltage sensors, opto-couplers. Functional classification of converters: DC-DC converters - switched mode buck converter, switched mode boost converter: control circuit, snubber, applications. Inverters: H-Bridge, single phase, three phase inverters. Rectifiers: single phase and three phase rectifiers.AC power controllers. Simulations of power electronic converters.

Ned Mohan , Undeland, Robbins, Power Electronics, 3rd edition, John Wiley.
M H Rashid, Power Electronics, 3rd edition, PHI.
P C Sen, Power Electronics, Tata McGraw-Hill Publishing Company Ltd.
Bimal K Bose, Modern power electronics and ac drives , PHI.
L Umanand, Power Electronics, Wiley India Pvt Ltd

EE311 DIGITAL SYSTEM DESIGN (3-1-0) 4

Review of combinational logic design using PLD, design of synchronous sequential logic systems, introduction to VHDL, design of system controllers, design of systems using PLD / FPGA, fundamentals of data converters.

C. H. Roth, Digital System Design, PWS, 1998.
J. F. Wakerly, Digital Design, PHI, 3rd Edition., 2001
W. Fletcher, An Engineering Approach to Digital Design, PHI.
M. J. Sebastian Smith, Application Specific Integrated Circuits, Addison-Wesley, 1999.

EE312 POWER SYSTEM HARMONICS (3-1-0) 4

Harmonic Sources: Power electronic converters, transformers, rotating machines, arc furnaces, fluorescent lighting. Harmonic effects within power system- resonances, harmonic torques, static power plant, control systems, power system protection, consumer equipment, measurements, and on power factor. Harmonic effects related to communication interference: telephone circuit susceptiveness, harmonic weights, I-T and kV-T products, shielding. Harmonic effects related to biological effects. Power theory, single and three phase, non-sinusoidal conditions, Fryez and Budeno's methods. Power quality parameters. Transducers and data transmission, Hall effect voltage and current sensors. Harmonic mitigation techniques: passive filters, active filters. Algorithms for extraction of harmonic current in the line.

J. Arrillaga, Power System Harmonics, IEE Press.
G. T. Heydt , Power Quality, Stars in a Circle, 1991.
M. G. Say , Alternating Current Machines, ELBS.

EE313 DIGITAL SIGNAL PROCESSING (3-1-0) 4

Review of FT, DTFT, DFT. Circular Convolution, DFT computation methods: Radix FFTs: Decimation in time and Decimation in frequency FFT, DCT. IIR Filters: Analog filters:

properties and design of Butterworth, Chebychev and Elliptical filters. Frequency transformation. Review of Z-transform and its properties. Structure of digital filters. Methods of converting analog filters to digital filter (IIR): bilinear transformation, pole-zero mapping, Impulse invariant transformation. Methods of designing the FIR filters: window-based methods, frequency sampling method. Introduction to the programmed digital systems. General architecture of Digital Signal Processors, programming of the TMS320F243, application of DFT for linear filtering.

John G. Proakis, D.G. Manolakis, Digital Signal Processing.
Ashok Ambardar, Analog and Digital Signal Processing.
L. R. Rabiner, B. Gold , Theory and Applications of Digital Signal Processing, PHI, 1975
Richard G. Lyons, Understanding Digital Signal Processing.
Roman Kuc , Introduction to Digital Signal Processing.

EE319 NEURAL NETWORKS AND APPLICATIONS (3-0-0) 3

Introduction: Biological neuron, Mc-Culloch-Pitts neuron model., Various threshold functions, Feature vectors and feature space. Classification techniques - nearest neighbour classification. Distance metrics, linear classifiers, decision regions. The single layer and multilayer perception, multilayer perception algorithm, solution of the XOR problem, visualizing the network behaviour in terms of energy functions, Mexican hat function. Learning in neural networks, linearly non-separable pattern classification, delta learning rule. Error back-propagation training algorithms, Feedback networks - Hopfield network, energy landscape, storing patterns, recall phase, Boltzmann machine, traveling salesman problem. Associative memories, retrieval and storage algorithm, stability considerations. Application of neural systems - linear programming, modeling networks, character recognition, control system applications, robotic applications.

R. Beale, T. Jackson, Neural Computing: An Introduction , IOP Publishing Ltd., 1990.
Jack II. Zaruda, Introduction to Artificial Neural Systems , Jaico Publications.

EE320 ELECTRICAL SAFETY, OPERATIONS, REGULATIONS (3-0-0) 3

Electrical safety: Safety of the self. Safety of the equipments, Safety of the public. PPE. General guidelines on earthing and protection. Operations: Sign boards, tagging system and procedures. Safe operating procedures, case studies and, safety audit basics.

Regulations: IS, IEEE standards, Indian Electricity rules and regulations.

HSC- A Practical guide VOL. 1 to 4, National Safety Council, India.
IS 5216 (Part I)- 1982, "Recommendations on safety procedures and practices in electric work".
SP 30 -1985 Special publication-National Electric Code, "Section-14: Electric Aspects of building services".
IEEE Standard 902.

EE321 LINEAR AND NONLINEAR SYSTEMS (3-1-0) 4

Characteristics of linear systems, modeling and analysis of linear time-invariant systems using state-space approach, analysis of linear time-variant systems. Characteristics of nonlinear systems, common types of nonlinearities, phase-plane analysis, describing function analysis.

Thomas Kailath, Linear Systems, Prentice-Hall, 1980.
K.Ogata, State-Space Analysis of Control Systems, Prentice-Hall, 1967.
John E. Gibson, Non linear Automatic Control, McGraw-Hill, 1963.

EE324 ELECTRONIC MEASUREMENTS AND INSTRUMENTATION (3-1-0) 4

Measurement systems, electromechanical instruments, bridges, electronic instrumentation, oscilloscopes, signal analysis, frequency, time interval measurements, physical parameter measurements, transducers, data acquisition systems.

B. H. Oliver, J. M. Cage, Electronic Measurements and Instrumentation, McGraw-Hill, 1975

Albert D. Helfrick, William D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, PHI.

EE326 LINEAR AND DIGITAL CONTROL THEORY (3-1-0) 4

Introduction, classification, mathematical modeling of physical systems, introduction to discrete time control systems, z-plane analysis of discrete time control systems, transient response analysis, design specifications and performance indices, concept of stability and algebraic criteria, Root locus analysis, frequency response analysis, Bode diagrams, polar plots, Nyquist plots, stability in the frequency domain, basic control actions and response of control systems. Introduction to control system design using the root locus and frequency-domain approach.

I. J. Nagrath, M. Gopal, Control Systems Engineering, 4th Edition, New Age International.
K. Ogata, Modern Control Engineering, 3rd Edition, PHI.
K. Ogata, Discrete Time Control Systems, 2nd Edition, Pearson Education..

EE328 NETWORK SYNTHESIS (3-1-0) 4

Review of mathematics for network synthesis- partial -fraction expansion, continued – fraction expansion, Bilinear transformation. The positive real concept - Hurwitz polynomials, analytic tests for positive real functions, positive - definite and positive - semi - definite quadratic forms. Realizability conditions for networks with and without transformers (magnetic coupling) Realization of driving - point functions - Canonical forms – LC, RC and RL driving -point functions.

Louis Weinberg, Network Analysis and Synthesis, McGraw – Hill, New York, 1962
M. E. Van Valkenburg, Modern Network Synthesis, Prentice – Hall, New Jersey

EE329 TRAVELING WAVES ON TRANSMISSION SYSTEMS (3-1-0) 4

Introduction to the line equations. Attenuation and distortion of traveling waves. Reflection of traveling waves. Successive reflections: The reflection lattice, construction and use of the lattice-diagram, Charging of a line from various sources, Reflection between a capacitor and a resistor, effect of short lengths of cable, effect of insulator capacitance. Traveling waves on multi conductor systems. Theory of ground-wires: Direct stroke to a tower, effect of reflections up and down the tower, tower grounding. The counterpoise: Multi velocity waves on the counterpoise, tests on the counterpoise, successive reflections on the insulated counterpoise. Induced lightning surges: The field gradient, induced surges with ideal ground wires. Arcing grounds: Normal frequency arc extinction – single-phase and three-phase, oscillatory-frequency arc extinction, high-frequency effects, interruption of line-charging currents, cancellation waves, initiated waves, steady-state waves, recovery voltage, restriking phenomena.

L. V. Bewley, Traveling Waves on Transmission Systems, John Wiley and Sons, 1951.
H. H. Skilling, Electric Transmission Lines, McGraw-Hill, 1951.
L. F. Woodruff, Principles of Electric Power Transmission, John Wiley and Sons, 1952.

EE331 DISTRIBUTION SYSTEMS LABORATORY (0-0-3) 2

Laboratory exercises and assignments to provide additional support to EE303.

EE334 POWER ELECTRONICS LABORATORY (0-0-3) 2

Laboratory exercises and assignments to provide additional support to EE308.

EE335 DIGITAL SYSTEM DESIGN LABORATORY (0-0-3) 2

VHDL / Verilog programming, design exercises on ECAD software, hardware realization on FPGA / CPLDs, to provide additional support to EE311.

EE337 POWER SYSTEM HARMONICS LABORATORY (0-0-3) 2

Laboratory Exercises and assignments to provide additional support to EE312. Experiments around MATLAB®, PSCAD®, OrCAD™ and laboratory measurement exercises.

EE342 ELECTRONIC MEASUREMENTS LABORATORY (0-0-3) 2

Laboratory exercises and assignments to additional support to EE324.

EE350 POWER SYSTEM ENGINEERING – II (3-1-0) 4

Review of modeling of power system components: transmission lines, transformers, synchronous machines, loads etc., per unit representation, single-line diagram representation, and solution of algebraic and differential system of equations, system modeling. Steady state analysis: power flow, balanced and unbalanced short circuit analysis, generation scheduling. Analysis of system transients: time-range of transients, traveling waves, switching transients, low frequency transients. Stability analysis: Classification, angle stability solution method using equal-area criteria, frequency and voltage stability issues (qualitative treatment only). Solution methodology for large systems.

Jhon J. Grainger and W. D. Stevenson, Power Systems Analysis, McGraw-Hill, 1994
P. Kundur, Power System Stability and Control, McGraw-Hill, 1994.
Olle I. Elgerd, Electric Energy Systems Theory- An introduction, TMH, 1982
P.W. Sauer and M.A. Pai, Power System Dynamics and Stability, Prentice Hall, Upper Saddle River, New Jersy, 1998

EE359 ENERGY AUDITING (3-1-0) 4

Introduction to energy audit. Purpose, methodology, case studies of few selected industries, analysis of results and inference, standards, instruments used in energy auditing.

Shirley J. Hansen, James W. Brown, Jim Hansen, Investment Grade Energy Audit, Marcel Dekker, 2003.
Donald R. Wulfinghoff, Energy Efficiency Manual, Energy Institute Press.

EE360 MICROPROCESSORS (3-1-0) 4

Basics of finite state machines, Von Neumann Architecture, functional blocks of a microcomputer, architecture of 8-bit/16-bit Microprocessors/Microcontrollers [viz. Intel 8051 family, MOTOROLA 68HXX, ARM Core etc.]. Programmers' model of any one microprocessor/microcontroller chosen for detailed study, instruction set, chip configuration and programming, use of development and debug tools, interface applications. Laboratory exercises.

Intel Corporation, 8-bit Microcontroller Handbook, Intel Corporation, 1990.
ARM® Core Processor Hand book.
John B. Peatman, Design with Microcontrollers, McGraw-Hill, 1995.
Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield, ARM System Developer's Guide, Designing and Optimizing System Software, Elsevier, 2004.

EE361 POWER SYSTEM COMMUNICATIONS (3-1-0) 4

The Electric power supply and its properties, historic development of data communication over power lines, The European CENELEC standard EN50065, channel characteristics, coupling and measuring techniques at high frequencies for PLC, estimating power line channel capacity, EMC problems and solutions, modulation schemes for PLC, communication over the electric power distribution grid.

Klaus Dostert, Franzis Verlag, Power Line Communications, PHI.

EE362 OPTIMAL OPERATION OF POWER SYSTEMS (3-1-0) 4

Economic operation of power systems: Economic load dispatch, unit commitment. Load frequency control : Modeling of components of generating systems, concept of coherent units, operation of single area. Introduction to multi-area systems. Sources of reactive power. Introduction to contingency analysis. State estimation: Importance of state estimation, DC state estimation. Energy interchange evaluation.

O. I. Elgerd, Electric Energy Systems Theory: An Introduction, McGraw-Hill, 1971.
I. J. Nagrath, D.P. Kothari, Modern Power System Analysis, TMH.
S. S. Rao , Optimisation Theory and Applications.
Allen J. Wood , Bruce F. Wollenberg , Power Generation Operation and Control, 2nd Edition, John Wiley and Sons, 1996.

EE363 ADVANCED DIGITAL SIGNAL PROCESSING (3-1-0) 4

Time frequency analysis, time frequency distribution, short time Fourier transform. Multirate signal processing: Decimation interpolation, DFT filter banks, QMF filter banks. Multiresolution signal analysis. Wavelets theory of sub band decompositions, sub band coding and wavelet transforms, application of wavelet transforms. Homomorphic signal processing : Homomorphic system for convolution, properties of complex spectrum, applications of homomorphic deconvolution. Multi-dimensional signal processing : Review of convolution and correlation. 2-D signals. Linear estimation of signals and applications: Random signals, linear prediction and applications (deconvolution, least square filters). Recursive estimation and Kalman filters. Adaptive signal processing: Adaptive filters and applications.

P. P. Vaidyanathan, Multirate Systems and Filter Banks, PH, 1993.
S. J. Orfanidis, Optimum Signal Processing, McGraw-Hill, 1989.
John G. Proakis, D. P. Manolakis, Introduction to DSP, Pearson, 2002.
E. C. Ifeachor, B. W. Jervis, Digital Signal Processing: A Practical Approach, Pearson Education.

EE366 SPECIAL MACHINES AND DRIVES (3-1-0) 4

Method of control and application of brushless DC motor, PMSM, stepper motor, AC servomotor, universal motor. Electric drive, motor rating, heating effects, electric braking, modification of speed- torque characteristic of an induction motor by V/f control, starting and braking. Synchronous motor --Speed torque and torque, angle characteristics by V/f control, braking.

G.K. Dubey, Fundamentals of Electrical Drives, Narosa.
A .E. Fitzerald, C. Kingsley, S.D Umans, Electric Machinery, McGraw-Hill.
S. K. Pillai, A First Course on Electric Drives, Wiley Eastern, 1990.

EE369 EMBEDDED SYSTEM DESIGN (3-1-0) 4

Embedded controllers, basic requirements, design of embedded systems, system on chip concept. VLSI CAD application. Case study: DSP/microprocessor based or FPGA based system design.

Charles H. Roth, Digital System Design using VHDL, PWS , 1998.
User manuals of Microprocessor /DSPs

EE371 POWER ELECTRONICS APPLICATIONS TO POWER SYSTEMS (3-1-0) 4

HVDC systems: Classical HVDC systems, CCC systems, HVDC Light systems. Application of FACTS devices such as SVC, TCSC, SSS, UPFC to improve steady state and dynamic behaviour of power systems. Modeling of HVDC systems and FACTS devices to perform system studies.

N. G. Hingorani, L. Gyugi, Understanding FACTS, IEEE Press, 2001.
P. Kundur, Power System Stability and Control, McGraw-Hill, 1994.

EE373 ELECTRIC POWER STATIONS (3-1-0) 4

Choice of site for power plants. Thermal power plant: General layout, air and flue-gas circuit, fuel and ash handling circuit, cooling water circuit, steam and feed water circuit. Nuclear power plant: General layout, heat exchangers, moderators, coolants, control rods. Hydro power plant: Site selection, general layout, type of hydropower plants, hydrographs. Characteristics of hydro turbines. Electrical equipment in generating stations: General layout, excitation systems and voltage regulation. Substation layout, components of substation. bus-bar arrangements, current-limiting reactors and their location. Safety and coordination. Load forecasting and sharing: Load curve and load duration curves, load factor, diversity factor, plant factor and plant use factor, demand factor, load sharing between base and peak load stations.

M. V. Deshpande, Electrical Power Stations.
Tata Electric Co., Operator Training Manual.

EE374 ELECTRIC ENERGY SYSTEMS (3-1-0) 4

Conventional and non- conventional energy sources and systems: Generation, transmission and distribution schemes, energy conservation systems, energy efficient equipment and controllers. Energy audit.

Olle I. Elgerd , Electric Energy System Theory: An Introduction, TMH, 1982.
I.J. Nagrath, D.P. Kothari, Power System Engineering, TMH.

EE376 ADVANCED CONTROL SYSTEMS (3-1-0) 4

Introduction, review of state space approach to modeling of dynamic system. Introduction to discrete time control system, Signal processing in digital control, models of digital control devices and systems, z-plane analysis of discrete time control system, transient response analysis, design specifications and performance indices, design of digital control algorithms, state variable analysis of digital control systems, Pole placement design and state observers, linear quadratic optimal control

K. Ogata, Discrete Time Control Systems, 2nd Edition, Pearson Education.
M. Gopal, Digital Control and State Variable Methods, TMH.

EE377MODELING AND SIMULATION TECHNIQUES FOR DYNAMIC SYSTEMS (3-1-0) 4

Introduction to system dynamics, transfer function approach to modeling dynamic systems, modeling of electrical and electromechanical systems, mechanical systems, state-space approach to modeling dynamic systems, Bond graphs method, transient analysis of dynamic systems, frequency domain analysis of dynamic systems, numerical techniques applied to dynamic systems.

MathWorks Inc., MATLAB®/ SIMULINK™ Reference/User Manuals, MathWorks Inc.
K. Ogata, System Dynamics, 4th Edition, Pearson Education.
K. Ogata, Discrete Time Control Systems, 2nd Edition, Pearson Education.

EE378 SHELL SCRIPTING WITH BASH (3-1-0) 4

The Linux environment: Files and file systems, directories, inodes and links, pipe and socket files, device files. Operating the shell, Bash keywords, command basics, command-line editing; files, users and shell customization, working with files. Script basics, creating a well-behaved script, basic redirection, standard output, error and input, built-in versus Linux commands. Variables: Basics and attributes, bash pre-defined variables, expressions, arithmetic and logical expressions, relational, bitwise and self-referential operations, substitutions. Compound commands, debugging and revision control, shell archives, parameters and subshells, job control and signals. Text file basics, text file processing, console scripting, functions and script execution. Shell security aspects and network programming. Related shells and the IEEE 1003.2 POSIX shell standard.

Cameron Newham, Bill Rosenblatt, Learning the Bash Shell, O'Reilly Media, 2005.
Arnold Robbins, Nelson H. F. Beebe, Classic Shell Scripting, O'Reilly Media, 2005.
Ken O. Burtch, Linux Shell Scripting with Bash, Sams Publishing, 2004.
Stephen G. Kochan, Patrick Wood, Unix Shell Programming, 3rd Edition, Sams Publishing, 2003.
Mendel Cooper, Advanced Bash-Scripting Guide,2005.(Available on-line in pdf at http://www.tldp.org/)

EE379 INCREMENTAL MOTION CONTROL (3-1-0) 4

Introduction to incremental motion systems, Principles of operation of various types of stepper motors, static and dynamic torque characteristics of stepper motors, open loop and closed loop controls, microprocessor based controllers for stepper motors.

P.P. Acarnley, Stepping motors-A Guide to Modern Theory and Practice, 3rd Edition, Peter Peregrinus, 1992.
Takashi Kenjo, Akira Sugawara, Stepping Motors and their Microprocessor controls, 3rd Edition, Oxford University Press, 2005.

EE382 VIRTUAL INSTRUMENTATION LABORATORY (0-0-3) 2

LabVIEW™ programming, data acquisition with LabVIEW™ DAQ VIs, interfacing with GPIB and RS232/RS485 .

EE384 ENERGY AUDITING LABORATORY (0-0-3) 2

Laboratory exercises and assignments to provide additional support to EE359.

EE385 MICROPROCESSORS LABORATORY (0-0-3) 2

Programming and interfacing experiments on the target processor / microcontroller discussed in EE360.

EE386 DIGITAL SIGNAL PROCESSING LABORATORY (0-0-3) 2

Laboratory exercises and assignments to provide additional support to EE313. Exercises around MATLAB®, *MATHEMATICA®*, LabVIEW™, DSP programming.

MathWorks Inc., MATLAB® Signal Processing Toolbox Users Guide, MathWorks Inc.
C. S. Burrus et al, ComputerBased Exercises for Signal Processing, PH, 1994.
S. K. Mitra, DSP: A Computer-Based Approach, TMH, 1998.
TMS 320c54x Users Manual, Texas Instruments, 1997.

EE387 ADVANCED DIGITAL SIGNAL PROCESSING LABORATORY (0-0-3) 2

Laboratory exercises and assignments to to provide additional support to EE363.

MathWorks Inc., MATLAB® Signal Processing Toolbox Users Guide, MathWorks Inc.
C. S. Burrus et al, Computer-Based Exercises for Signal Processing, PH, 1994.
S. K. Mitra, DSP: A Computer-Based Approach, TMH, 1998.
TMS 320c54x Users Manual, Texas Instruments, 1997.

EE389 EMBEDDED SYSTEM DESIGN LABORATORY (0-0-3) 2

Laboratory exercises and assignments to provide additional support to EE369.

EE392 POWER SYSTEM OPERATION LABORATORY (0-0-3) 2

Simulation exercises and assignments to provide additional support to EE362. Experiments around MATLAB® , PSCAD®, PowerWorld™ and SKM® packages.

EE393 DYNAMIC SYSTEM SIMULATION LABORATORY (0-0-3) 2

Laboratory exercises and assignments to provide additional support to EE377.

EE402 HVDC TRANSMISSION (3-1-0) 4

Need, Basic principle of conversion, economics of different configurations, The Graetz bridge circuit, analysis, overlap, firing delay, inversion, converter control, tap-changing control, power reversal, measuring devices, filters, circuit breaker, lighting arrester, DCCT, MRT. MTDC systems, interaction between AC and DC Systems, voltage stability, power modulation, digital Simulation, HVDC simulator, future of the HVDC transmission systems, research and development.

E. W. Kimbark, Direct Current Transmission.
K. R. Padiyar, Power Transmission by Direct Current, Wiley Eastern, 1990.
Recent Publications of relevance.

EE404 SOFT COMPUTING (3-1-0) 4

Fuzzy Sets, operations, relations, fuzzy logic, fuzzy control, neural networks – Single layer, multilayer networks, learning, BP algorithm, simple genetic algorithm, neuro-fuzzy systems, soft computing applications.

J. S. R. Jang, C. T. Sun , E. Mizutani, Neuro-Fuzzy and Soft Computing – A Computational Approach to Learning and Machine Intelligence, PHI, 2002.
Timothy J. Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill, 1997.
Simon Haykin, Neural Networks – A Comprehensive Foundation, Prentice Hall, 1999.
David E. Goldberg , Genetic Algorithms in Search, Optimization and Machine Learning, Pearson Education, 2003.
International Journals and Conference Proceedings of relevance.

EE406 ELECTROMAGNETIC COMPATIBILITY (3-1-0) 4

Review of EM theory. EMI from apparatus and circuits. EMI measurements. Shielding and grounding. EMI filters. Electrostatic discharge. EMC standards.

H. W. Ott, Noise Reduction Techniques in Electronic Systems.
V. Prasad Kodali, Engineering Electromagnetic Compatibility, S. Chand & Co.

EE408 SOLID-STATE DRIVES (3-1-0) 4

Separately excited dc motor drive: Operation and performance, single-phase fully controlled converter, operation on dual converter. Chopper drive: operation and performance calculation on class A, class C, and class E choppers. Induction motor drive: Stator voltage control with constant supply frequency, qualitative comparison of converter combinations, slip energy recovery scheme, VSI fed induction motor, CSI fed induction motor, synchronous motor drive, VSI drive, brushless excitation, true synchronous and self-controlled operation, performance with PMSM and synchronous reluctance motor.

S. B. Dewan, G. R. Slemon, A. Straughen, Power Semiconductor Drives , John Wiley and Sons, 1984.
W. Shepherd, L. N. Halley, D. T. W. Liang, Power Electronics and Motor Control, 2nd Edition, Cambridge University Press, 1998.
Vedam Subrahmanyam, Electric Drives -- Concepts and Applications , TMH, 1994.
G. K. Dubey, Power Semiconductor Controlled Drives, Prentice Hall, 1989.

EE410 POWER SYSTEM PROTECTION (3-1-0) 4

Introduction to power system protection, Review of conventional power system protection schemes, power apparatus protection: viz. transformer, motor, generator, bus bar, transmission and distribution line protection schemes, Introduction to computer aided protection, numeric relay

hardware design, digital protection algorithms, recent trends in power apparatus protection methodology, concepts of adaptive relaying and application of soft computing methods in numeric relaying.

Warrington , Protective Relays – Their theory and practice, Volumes. I, II, and III , Chapman and Hall.

Arun G. Phadke , J. S. Thorpe, Computer Relaying for Power Systems, Research Studies Press.

Gerhard Ziegler, Numerical Distance Protection: Principles and Applications.

A. T. Johns, S. K.Salman, Digital Protection for Power Systems , IEE, 1995.

M. S. Sachdev (Coordinator), IEEE Tutorial Course on Advancement in Microprocessor-based Protection and Communication, IEEE, 1979.

EE411 OPERATION OF RESTRUCTURED POWER SYSTEMS UNDER DEREGULATION (3-1-0) 4

Fundamentals of deregulation, restructuring models and trading arrangements, different models of deregulation, operation and control, wheeling charges and pricing, Role of FACTS controllers and distributed generation in restructured environment, developments in India, IT applications in restructured markets.

K. Bhattacharya, M.H J Bollen and J.E Daalder, "Operation of Restructured Power Systems", Kluwer Academic Publisher, USA, 2001.

L. Philipson and H.L. Willis, "Understanding Electric Utilities and Deregulation", Marcel Dekkar Inc. 1999.

M. Shahidehpour and M. Alomoush, "Restructured Electrical Power Systems, Operation, Trading and Volatility", Marcel Dekkar Inc. 2001.

Steven Stoft, "Power System Economics: Designing Markets for Eligibility". John Wiley & Sons, 2002

EE412 RANDOM SIGNAL PROCESSING (3-1-0) 4

Random signal processing: Review of probability and random variables, Mathematical description of random signals, response of linear systems to random inputs, Wiener filtering, basic estimation theory, discrete Kalman filter, state-space modeling and simulation, nonlinear estimation.

Athanasios Papoulis, Probability, Random variables, and Stochastic Processes, McGraw-Hill, 1991.

R. G. Brown, P. Y. C. Hwang, Introduction to Random Signals and Applied Kalman Filtering, John Wiley and Sons, 1997.

A. P. Sage, James L. Melsa, Estimation Theory with Applications to Communications and Control, McGraw-Hill, 1971.

EE414 NON-CONVENTIONAL ENERGY SYSTEMS (3-1-0) 4

Solar energy, wind energy, chemical energy sources. Energy from the ocean and tides. MHD generation, thermo electric power. Geothermal energy. Energy from bio-mass.

G. D. Rai , Non-conventional Energy Sources.

P. S. Sukhatme , Solar Energy.

EE418 ADVANCED POWER ELECTRONICS (3-1-0) 4

Power devices, design of inductors, transformers, selection of core, design of capacitors, selection of capacitors for different applications. AC to DC converters, multilevel inverters, DC to DC converters, hard switch converters, design and analysis, isolated converters, resonant converters.

Ned Mohan, Undeland, Robbins , Power Electronics.

M. H. Rashid, Power Electronic Circuits – Devices and Applications.

EE420 POWER SYSTEM DYNAMICS (3-1-0) 4

Power system component modeling for dynamic studies: Synchronous generator modeling, exciter and turbine modeling, load modeling. System stability analysis: Angle stability (small signal and large signal), voltage stability, frequency stability.

K.R. Padiyar, Power System Stability and Control, Interline, 1996.
Prabha Kundur, Power System Stability and Control, McGraw-Hill, 1994.

EE422 SWITCHGEAR AND PROTECTION (3-1-0) 4

Fuses and switches, methods of earthing, Circuit breakers. circuit breaker ratings, auto reclosure. Protective relaying, fundamental characteristics. Relay classifications, differential protection schemes. Transformer protection. Buchholtz relay. Alternator protection: Negative phase sequence relay, loss of field protection. Line protection: Over current relays and schemes, distance relays and schemes, carrier current relaying. Induction motor protection: Abnormal operating conditions. Solid state relays: Comparators, duality between phase and amplitude comparators. Realization of directional, Ohm, reactance, impedance and Mho characteristics using the general characteristic equation, static distance relays. Computer aided relaying: Introduction to microcomputer based relays, General functional diagram of microcomputer-based relays.

Ravindranath, Chander , Power System Protection and Switchgear, Wiley Eastern, 1994.
C. L. Wadhwa, Electrical Power Systems, 2nd Edition, PHI, 1993.
Arun G. Phadke, S H Horowitz, Power System Relaying, 2nd Edition, John Wiley, 1995.
Badriram, D. N. Vishwakarma, Power System Protection and Switchgear, TMH, 1995.

EE427 COMPUTER NETWORKS (3-1-0) 4

Introduction, physical layer, data link, media Access, network layer, transport layer, ATM, applications.

Andrew S. Tanenbaum, Computer Networks, Pearson Education.

EE428 THE ARM CORE: ARCHITECTURE AND PROGRAMMING (3-1-0) 4

The ARM design philosophy, ARM processor fundamentals – registers, current program status register, pipeline, exceptions, interrupts and the vector table, core extensions, architecture revisions, ARM processor families. The ARM instruction set: Data processing instructions, branch instructions, load-store instructions, software interrupt instructions, program status register instructions, conditional execution. The THUMB instruction set, THUMB register usage, ARM-THUMB interworking. Writing assembly code, profiling and cycle counting, instruction scheduling, register allocation, looping constructs, bit manipulation, efficient switches, unaligned data handling. GNU assembler. Optimized primitives, exception and interrupt handling. Rudimentary aspects of embedded operating systems.

David Seal (Ed.), ARM Architecture Reference Manual, 2nd Edition, Addison-Wesley, 2001.
Steve Furber, ARM Sytem-on-Chip Architecture, 2nd Edition, Addison-Wesley, 2000.
Andrew N. Sloss, Dominic Symes, Chris Wright, ARM System Developer's Guide, Elsevier, 2004.
ARM Limited, ARM v7-M Architecture Application Level Reference Manual, ARM Limited, 2006.

EE439 ADVANCED POWER ELECTRONICS LABORATORY (0-0-3) 2

Laboratory exercises and assignments to provide additional support to EE418.

EE445 POWER SYSTEM SIMULATION LABORATORY (0-0-3) 2

Time–domain simulation of SMIB and multi-machine power systems in MATLAB®/SIMULINK™ to provide additional support to EE420.

EE448 SEMINAR 1

This course is a 1 credit course to be completed during 7th semester. The student will make presentations on topics of academic interest.

EE449 MAJOR PROJECT-I (0-2-6) 6

EE454 FLEXIBLE AC TRANSMISSION SYSTEMS (3-1-0) 4

Transmission system performance, compensation approaches, static var systems, VSI based FACTS controllers – STATCOM, UPFC, TCSC, TCPAR, TCBR. Applications: Transient stability improvement. Introduction to custom power.

K. R. Padiyar, Power System Dynamics, Stability and Control, 2nd Edition, B.S. Publishers.

Prabha Kundur , Power System Stability and Control, McGraw-Hill EPRI Power System Engineering Series, 1994.

Narain G. Hingorani , Laszlo Gyugyi, Understanding FACTS – Concepts and Technology of Flexible AC Transmission Systems, IEEE Press, 2001.

EE456 HIGH-VOLTAGE ENGINEERING (3-1-0) 4

Electric breakdown in solid, liquid and gas dielectrics. Generation of high AC, DC and impulse voltages. Impulse current generators. Methods of measuring high AC, DC and impulse voltages and current. Partial discharge.

E. Kuffel, Zengal, High Voltage Engineering.

D. Kind, An Introduction to High Voltage Experimental Techniques.

Kamaraju, Naidu, High Voltage Engineering.

C. L. Wadhwa, High Voltage Engineering.

EE458 PHOTOVOLTAICS AND APPLICATIONS (3-1-0) 4

Overview of PV systems, relevance and adaptology, economics and efficiency, insolation and its measurement, types of cells. Elements of solar cell operation, light absorption and carrier generation in semiconductors,conversion efficiency and factors affecting it, Processing techniques. Concentrators, stand-alone inverters, grid operation, issue of energy storage, general applications, large PV power systems, rural power supply systems, Issues in developing countries, unconventional cell systems.

Chenming Hu, R. M. White, Solar cells- From Basic to Advanced Systems, McGraw-Hill.

EE464 POWER GENERATION AND ECONOMICS (3-1-0) 4

Hydro, thermal and nuclear power plants. Electrical equipments in generating stations. Load forecasting and sharing. Economic operation of power systems. Economic choice of transformers and electric motors.

Nagpal, Power Plant Engineering.

M. V. Deshpande, Elements of Power Station Design.

G. P Chalotra, Electrical Engineering Economics.

S. Domkundwar, S. C. Arora, A Course in Power Plant Engineering.

EE466 UTILIZATION OF ELECTRICAL ENERGY (3-1-0) 4

Electric Traction: Requirements of an ideal traction system, requirements of ideal traction motors, comparison and control of traction motors, mechanics of train movement, tractive effort for acceleration ,train resistance, gradient, coefficient of adhesion, speed time curves, specific energy consumption. Electric heating: methods of heat transfer, resistance heating, design of heating element , induction heating, eddy current heating, dielectric heating. Electric welding: resistance welding, arc welding. Electrolytic processes: Faraday's laws of electrolysis. Calculation of current required and related definitions, Factors governing the character of

deposits, preparation of work for electroplating, electro-extraction. Illumination : Laws of illumination, lighting calculations, polar curves, Rousseau's construction.

Partab , Art and Science of Utilization of Electrical Energy.
E. O. Taylor, Utilization of Electric Energy.
C. L Wadhwa , Generation ,Distribution and Utilization of Electrical Energy.

EE467 INDUTRIAL ELECTRICAL SYSTEMS (3-0-0) 3

Overview of electrical systems in manufacturing, chemical, metallurgical, process industries, electric traction, electric heating, electric welding, electroplating, illumination and case studies.

Partab , Art and Science of Utilization of Electrical Energy.
E. O. Taylor, Utilization of Electric Energy.
C. L Wadhwa , Generation ,Distribution and Utilization of Electrical Energy.

EE468 ADVANCED ELECTRIC DRIVES (3-1-0) 4

Electric Drives: DC drives, modeling, analysis and simulation. Space phasors, modeling of brushless DC motor, modeling of induction motor, vector control of brushless DC motor. Induction motor drive: V/f control, vector control of induction motor, DT control of induction motor drives.

W. Leonhard, Electric Drives, Springer Verlag.
B.K. Bose, Power Electronics and AC Drives.

EE469 RENEWABLE ENERGY SYSTEMS (3-0-0) 3

Concept of renewable energy, design and implementation aspects of renewable energy systems employing solar energy, wind energy, chemical energy sources. Energy from the ocean and tides. MHD generation, thermo electric power. Geothermal energy. Energy from bio-mass.

G. D. Rai , Non-conventional Energy Sources.
P. S. Sukhatme , Solar Energy.

EE470 COMPUTATIONAL TECHNIQUES FOR LARGE SYSTEM ANALYSIS (3-1-0) 4

Solution of linear system of equations, solution of nonlinear system of equations, sparsity techniques, numerical integration techniques: explicit methods, implicit methods, fixed step methods, variable step methods, stability and accuracy-analysis of numerical methods, numerical calculation of eigenvalues, EMTP simulation techniques.

Steven C. Chapra, R. P. Canale, Numerical Techniques for Engineers, TMH, 2000.
Mariessa Crow, Computer Techniques for Large Electric Power Systems, CRC Press, 2003.

EE472 INSULATION AND TESTING ENGINEERING (3-1-0) 4

Introduction, review of test sources and measurement associated with insulation studies. Insulation types: solids, liquids, gases and vacuum, properties and characteristics. Dielectric strength and permittivity, methods of measurements, theories of breakdown. Testing of transformer oil, Schering bridges for tan-delta measurement. Measurement of insulation resistance of solids: Bulk and surface. PD measurements. Testing of cables IR, PI, step test, tan delta, PD. Treeing tracking. Radio interference measurements, RI and RIV. Testing of insulators, power transformers, Impulse testing, testing of rotating machines. Accelerated ageing tests and life estimation. Testing of surge diverters, bushings, insulators. Testing of rubber mats. Testing of Gas Insulated Substations.

Kamaraju, Naidu, High Voltage Engineering.
Kuffel, Zeangle, High Voltage Engineering.
Relevant Indian standards and Technical papers.

EE476 OPTIMISATION TECHNIQUES (3-1-0) 4

Linear Programming: Simplex method and extensions. Network models: Shortest path, maximum flow and minimum cost problems. Dynamic programming: resource allocation, production scheduling and equipment replacement problem. Non-linear programming: selected unconstrained and constrained non-linear programming algorithms like quasi Newton, reduced gradient and gradient projection methods. Penalty function methods, quadratic programming.

Lueneburger , Linear and Non linear Programming, McGraw-Hill.

Fletcher, Optimization techniques, John Wiley and Sons.

EE478 AN INTRODUCTION TO THE INTEL IA-32 ARCHITECTURE (3-1-0) 4

A brief history of the IA-32 architecture, the Intel P6 family of processors – Intel Pentium®, Xeon®, Pentium® M, Pentium® Extreme, Core™ Duo and Core™ Solo. SIMD instructions, Hyper-threading technology, Multicore technology. Basic execution environment, memory organization, paging and virtual memory, address calculations in 64-bit mode. Basic program execution registers, instruction pointer, operand addressing, memory operands, segmentation, I/O port addressing. Data types. Implementation of the IEEE 754 floating point format. Overview of FP exceptions and FP exception handling. General purpose instructions, FPU instructions, MMX instructions, SSE instructions, SSE2 and SSE3 extensions. Programming with GP instructions, Programming with the x87 FPU. Programming the IA-32 in the GNU/Linux environment.

Intel Corporation, IA-32 Intel Architecture Software Developer's Manual, Volume1:Basic Architecture, Intel Corporation, 2006.

Intel Corporation, IA-32 Intel Architecture Software Developer's Manual, Volume 2A: Instruction Set Reference, A-M, Intel Corporation, 2006.

Intel Corporation, IA-32 Intel Architecture Software Developer's Manual, Volume 2B: Instruction Set Reference, N-Z, Intel Corporation, 2006.

EE489 ADVANCED ELECTRIC DRIVES LABORATORY (0-0-3) 2

Laboratory exercises and assignments to provide additional support to EE468.

EE491 INSULATION AND TESTING ENGINEERING LABORATORY
(0-0-3) 2

Laboratory exercises and assignments to provide additional support to EE472.

EE498 PRACTICAL TRAINING 2

This course is a 2 credit course. A student may complete the practical training before the beginning of 8th semester (or as stipulated by DUGC) and register for it in 8th Semester. The duration and the details shall be decided by the faculty advisor, with approval from DUGC.

EE499 MAJOR PROJECT-II (0-2-6) 6

Department of Electronics and Communication Engineering (EC)

Bachelor of Technology in Electronics and Communication Engineering

Foundation Courses

Basic Science Core (BSC)

MA110	Engineering Mathematics – I	(3-0-0) 3
PH110	Physics	(3-1-0) 4
PH111	Physics Laboratory	(0-0-2) 1
MA111	Engineering Mathematics – II	(3-0-0) 3
CY110	Chemistry	(3-0-0) 3
CY111	Chemistry Lab	(0-0-3) 2

Engineering Science Core (ESC)

EE110	Elements of Electrical Engg.	(3-0-0) 3
ME110	Elements of Mechanical Engg.	(3-0-0) 3
CO110	Computer Programming	(3-1-0) 4
CO111	Computer Programming Lab	(0-0-2) 1
EC110	Elements of Electronics and Communication Engg.	(3-0-0) 3
AM110	Engineering Mechanics	(3-0-0) 3
ME111	Engineering Graphics	(1-0-3) 3

Humanities and Social Science Core (HSC)

HU100	Professional Communication	(3-0-0) 3
HU300	Engineering Economics	(3-0-0) 3
HU302	Principles of Management	(3-0-0) 3

Program Core (PC)

EC160	Digital Electronics and Computer Arch	(3-1-0) 4
EC220	Linear Systems and Signals	(3-1-0) 4
EC221	Electromagnetic Waves	(3-1-0) 4
EC222	Analog Electronics	(3-1-0) 4
EC223	Digital Electronics Lab	(0-0-3) 2
EC224	Analog Electronics Lab	(0-0-3) 2
EC270	Analog Communication	(3-1-0) 4
EC271	Microprocessor	(3-1-0) 4
EC272	Digital Signal Processing	(3-1-0) 4
EC273	Microprocessor Lab	(0-0-3) 2
EC274	Digital Signal Processing Lab	(0-0-3) 2
EC320	Analog Integrated Circuits	(3-1-0) 4
EC321	Digital Communication	(3-1-0) 4
EC322	Analog Integrated Circuits Lab	(0-0-3) 2
EC323	Communication Lab - I	(0-0-3) 2
EC370	VLSI Design	(3-1-0) 4
EC371	RF and Microwave Engg.	(3-1-0) 4
EC372	VLSI Lab	(0-0-3) 2
EC373	Communication Lab - II	(0-0-3) 2

Program Electives (PE)

EC230	Electronic Instrumentation	(3-0-0) 3
EC231	Biomedical Instrumentation	(3-0-0) 3
EC232	Mathematics for E&C Engineering.	(3-1-0) 4
EC233	Data structures	(3-0-2) 4
EC280	Digital System Design	(3-0-2) 4
EC281	Radiating Systems	(3-1-0) 4
EC282	Control Systems	(3-1-0) 4
EC330	Soft Computing	(3-0-0) 3
EC331	Satellite Communication	(3-0-0) 3
EC332	Radar & Electronic Navigation System	(3-0-0) 3
EC333	Communication Networks	(3-1-0) 4
EC334	Digital Processing of Speech and Audio Signals	(3-0-0) 3
EC335	Applications of Signal Processing in Image and Video	(3-0-0) 3
EC336	Embedded Systems	(3-0-2) 4
EC380	Wireless Mobile Communication	(3-0-0) 3
EC381	Spread Spectrum Communications	(3-0-0) 3
EC382	Information Theory and coding	(3-0-0) 3
EC383	Error Control Coding	(3-0-0) 3
EC384	Adhoc and Sensor Networks	(3-0-0) 3
EC385	Optical Communication Systems and Networks	(3-1-0) 4
EC386	Cryptography and Data Security	(3-0-0) 3
EC430	Advanced Topics in Communication Engineering	(3-0-0) 3
EC431	Advanced Digital Signal Processing	(3-0-0) 3
EC432	Mapping DSP Algorithms to Architecture	(3-0-0) 3
EC433	Multimedia Communication Techniques	(3-0-0) 3
EC434	Real Time Digital Signal Processing	(3-0-0) 3
EC435	VLSI Systems and Architecture	(3-0-0) 3
EC436	Synthesis and Optimization of Digital Circuits	(3-0-0) 3
EC437	Active Filters	(3-0-0) 3
EC438	Techniques in Low Power VLSI	(3-0-0) 3
EC439	Submicron Devices	(3-0-0) 3
EC441	VLSI CAD	(3-0-0) 3
EC442	MEMS and Nano Technology	(3-0-0) 3
EC443	RF IC Design	(3-0-0) 3
EC444	VLSI Testing and Testability	(3-0-0) 3
EC445	Advanced Topics in VLSI Design	(3-0-0) 3

Open Electives (OE)

EC230	Electronic Instrumentation	(3-0-0) 3
EC231	Biomedical Instrumentation	(3-0-0) 3
EC330	Soft Computing	(3-0-0) 3
EC340	Digital Systems & Computer Organization	(3-0-0) 3
EC341	Principles of Communication Engineering	(3-0-0) 3
EC342	Computer Networks	(3-0-0) 3
EC343	Applications of Signal Processing	(3-0-0) 3
EC344	Microprocessors and Microcontrollers	(3-0-0) 3

Project (MP)

EC283	Mini Project in Digital System Design	(0-0-3) 2
EC284	Mini Project in Digital Signal Processing	(0-0-3) 2
EC337	Mini Project in Communication Systems and Networks	(0-0-3) 2
EC338	Mini Project in Microprocessor & Embedded Systems	(0-0-3) 2

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EC339	Mini Project in Analog System Design	(0-0-3) 2
EC387	Mini Project in VLSI Design	(0-0-3) 2
EC388	Mini Project in RF Design	(0-0-3) 2
EC448	Major Project - I	(0-0-6) 4
EC498	Major Project - II	(0-0-6) 4

Mandatory Learning Courses (MLC)

[illegible]	Environmental Studies	(1-0-0) 1
[illegible]	Professional Ethics and Human Values	(1-0-0) 1
EC390	Seminar	(0-0-2) 1
EC446	Practical Training	2

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Suggested Plan of Study:

Semester →	I	II	III	IV	V	VI	VII	VIII
1	EC101		EC220	EC270	EC320	EC370	Elective	Elective
2		EC160	EC221	EC271	EC321	EC371	Elective	Elective
3			EC222	EC272	EC333	EC372	Elective	Elective
4			EC223	EC273	EC323	EC373	Elective	Elective
5			EC224	EC274	Engg. Economics	Management Theory & Practice	Elective	Elective
6			Elective	Elective	Elective	Elective	EC448	EC498
7			Elective	Elective	Elective	Elective	EC446	
8			Elective Mini Project	Elective Mini Project	EC390			
9					Elective Mini Project	Elective Mini Project		

Degree Requirements:

Category of Courses	Minimum Credits to be Earned
Foundation Courses: Basic Science Core (BSC) Engineering Science Core (ESC) Humanities and Social Sciences Core (HSC)	45
Program Core (PC)	60
Electives: Program Electives (PE) (Minimum of 27 credits) Open Electives (OE)	>=50
Project (MP): Major Project Mini Project (Optional: Maximum of 4 credits)	8-12
Mandatory Learning Courses (MLC)	5
Total	172

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EC101 ELEMENTS OF ELECTRONICS & COMMUNICATION ENGINEERING (3-0-0) 3

RC & RL Circuits – low pass, high pass, transient analysis for pulse input; Diode: Principle, Characteristics, Applications (Rectifier, Clipping circuits) & Types (Zener Diode, LED, Photo diode); Transistor: Principle, Operation, Characteristics (CB,CE,CC), CE amplifier (load line analysis), Biasing, small signal model, Transistor as a switch; Digital Circuits: Basic Logic gates, Universal gates, Boolean Algebra, Combinational circuit (Half-Adder, Full-Adder, Decoder), Latch, Flip-Flop, Counters and Registers (brief description about ripple counter, SISO Register); Op-amps & its Applications: Terminal characteristics of Op-amp, Inverting and Non-inverting amplifier, Summing amplifier, Integrator, Introduction to ADC and DAC Systems: Linear power supply, SMPS, UPS, Principles of Communication Systems & Networks.

Albert Malvino, Electronic Principles, Tata McGraw Hill, 1995
Boylstead and Nashelsky, Electronic Devices and Circuits, PHI, 1998
George Kennedy & Bernard Davis, Electronic Communication System, Tata McGraw Hill, 1996
Wayne Tomasi, Electronic Communication Systems, Pearson Education, 2003
Ramakant A Gayakwad, OP-AMPS and Linear Integrated Circuits, Prentice Hall, 1999

EC160 DIGITAL ELECTRONICS & COMPUTER ARCHITECTURE (3-1-0) 4

Combinational logic analysis and design: logic minimization methods, Combinational design using MSI, LSI and PLDs, Number systems and arithmetic, Logic families, Delay, Hazards. Sequential logic design: latches and flipflops, Setup and Hold time , Clock frequency, Finite state machine design, state minimization, state assignment, synthesis using D-FF and JK-FF, counters, shift registers, MSI devices as state machines. Introduction to computer architecture: Instruction Set Architecture, System Software; Processor Design: Data path, Control unit, Instruction types, addressing modes.

J.F.Wakerly, Digital Design Principles and Practices, PH, 1999.
D.D. Givone, Digital Principles and Design, TMH, 2002
M. Raffiquzzman & Rajan Chandra, Modern Computer Architecture, Galgotia Publications, 1990.
David Patterson and John Hennessy, Computer Organization and Design, Elsevier, 2007.
David Harris Money and Sarah Harris, Digital Design and Computer Architecture, Morgan Kaufman, 2007.

EC220 LINEAR SYSTEMS AND SIGNALS (3-1-0) 4

Review of DC circuit analysis, Time domain analysis of continuous-time signals & systems: properties of signals & systems, linear-time invariant systems, impulse response, convolution, correlation, causality and stability; Analysis of RL and RC circuits, representation of systems using differential equations, solution of linear differential equations, Concept of transient and steady state, time constant, Mutual inductance, RLC circuits, characteristic equation, concept of damping and natural frequency, representation of RLC circuits using state variable description, time-domain specifications. Transform domain analysis of systems: Laplace Transform - Definition and properties, inverse transforms, transform circuits, application to transient analysis of networks, transfer function. Network Theorems: Superposition, Thevenin, Norton, Maximum power transfer. Sinusoidal steady state analysis: Steady state response of R, L, C and M elements to sinusoidal excitation, resonance, frequency domain specifications. Frequency domain analysis of continuous time signals and systems: Fourier series, properties, Fourier transform, properties of Fourier transforms and applications to systems. Bode plots, Gain and phase margins

M.E. Van Valkenburg, Network Analysis, Pearson Education, 2006
J.W. Nilsson and S.A. Riedel, Electric Circuits, PHI, 2000
Simon Haykin, Signals & Systems, John Wiley, 1998
B.P.Lathi, Linear systems and signals, OUP, 2002

EC221 ELECTROMAGNETIC WAVES (3-1-0) 4

Review of Static Electric and magnetic fields, Time varying fields and Maxwell's equations, Wave propagation in free space, dielectrics and conductors, Plane waves at boundaries and dispersive media, Transmission lines, Antenna fundamentals.

W.H Hayt, J.A Buck, Engineering Electromagnetics (Seventh edition), Tata-McGraw Hill,2006.
M.N.O. Sadiku, Elements of Electromagnetics (Third Edition), Oxford University Press, 2001.
M.A Plonus, Applied Electromagnetics, Mcgraw-Hill Kogashuka, 1984.
E.C Jordan, K.A Balmain,Electromagnetic Waves and Radiating Systems, Prentice Hall of India, 1968.

EC222 ANALOG ELECTRONICS (3-1-0) 4

Two port networks : Two-port network parameters (z, y, h, ABCD), parameter conversion, interconnection (series, parallel and cascade), ladder networks. Feedback Concepts : Feedback topology (Z, Y, H and G feedback), Positive and Negative feedback, Sensitivity factor, Effect of Negative feedback on basic amplifiers, Instability in amplifiers, Barkhousen condition for Oscillations, Nyquist stability criterion. MOSFET - Review of current equation, regions of operation, small signal model. Current mirrors : Basic current mirror, Cascode current mirror, High swing cascode current mirror, Wilson current mirror. Single-ended amplifiers : CS amplifier – with resistive load, diode connected load, current source load, triode load, source degeneration. CG and CD amplifiers. Differential Amplifier : Single-ended vs differential operation, Basic differential operation – qualitative and quantitative analysis. Differential amplifier with MOS loads - current mirror load and current source load, Slew rate, Common-mode response – CMR & CMRR. Power Amplifiers : Classification (A, B, AB & C), transformer coupled amplifiers, push-pull arrangements, theoretical efficiency.

A.S. Sedra & K.C. Smith, Microelectronic Circuits, Oxford Univ. Press, 2004
Richard C. Jaeger and Travis N. Blalock, Microelectronic Circuit Design, McGraw Hill, 2007
Donald A. Neamen, Electronic Circuit Analysis and Design, Irwin Publications, 1996.
R. R. Spencer & M. S.Ghousi, Introduction to Electronic Circuit Design, Pearson Education, 2003

EC223 DIGITAL ELECTRONICS LAB (0-0-3) 2

Digital Circuit design using SSI/MSI :

Combinational Circuit design using gates, MUX, decoders, arithmetic circuits, ALU
Sequential Circuits design - counters, shift registers, sequence generators, signature detectors.
Design Project

EC224 ANALOG ELECTRONICS LAB (0-0-3)2

Hardware Experiments :

Clipping circuits, Clamping circuits; Design of full wave rectifier; Regulated Power Supply.
Design with RC circuits – AC analysis – Frequency response of First order RC Low pass filter and First order RC High pass filter; Transient analysis – Pulse shaping using RC circuits
Effect of negative feedback on gain and bandwidth of a voltage amplifier.
Power amplifier: Class B push-pull amplifier, Class AB push-pull amplifier

Simulation Experiments:

NMOS and PMOS characteristics (output and transfer), CMOS current mirrors, Single stage amplifiers : Common-source, Common-gate and Common-drain amplifiers,

EC230 ELECTRONIC INSTRUMENTATION (3-0-0) 3

Transducers, Measurement of Physical Quantities: Measurement of Length, Thickness, Linear Displacement, Temperature, Force, Weight, Pressure, Flow, Humidity, Acidity, Density, Sound, level, Motion, Chemical Analysis, Instrumentation Systems, Principles of Telemetry, Process Monitoring and Control, Bio-medical Instrumentation: Bio-medical Electrical Quantities: Bio-potential, Electrodes, ECG, EEG and EMG measuring techniques. Biological Non-Electrical Parameters: Pressure, Blood flow, Pulse rate, Temperature, pH, CO_2, O_2- Measuring methods. Diagnostic Systems Electronic Instruments for affecting the human body: Diathermy, Pace makers, Defibrillators, Respirators, Blood pumps, Lasers.

P.H .Mansfield, Electrical transducers for Industrial Measurement, Butterworth, London, 1973.
George C. Barney, Intelligent Instrumentation, Prentice hall of India, New Delhi, 1988.
C.S.Rangan et. el., Instrumentation, Devices and Systems, Tata McGraw Hill, 1989.
H.K.P. Neubert, Instrument Transducers, Clarendon Press, Oxford, 1975.

EC231 BIOMEDICAL INSTRUMENTATION (3-0-0) 3

Action potential, ECG, EEG and EMG signals, their origin and applications in medical diagnosis. Electrodes for recording ECG, EEG and EMG signals, Instrumentation amplifiers, signal conditioners, A/D and D/A converter interfaces to the PC, Computerised automatic analysis. Biotelemetry. Transducers for physiological parameter reading, their characteristics. Diagnostic methods, ultrasound, CT and MRI. Lasers and applications of lasers in medical diagnostics and therapy. Prosthesis and prosthetic devices. Patient safety, electrical shock hazards incorporation of safety aspects in Biomedical instrumentation.

L. Cromwell, F. Weibell and E. A. Pfiffer, Biomedical Instruments and Measurements, PH, 1980.
R.S.Khandpur, Handbook of Biomedical Engineering, Tata McGraw Hill Publishing, 1992.

EC232 MATHEMATICS FOR ELECTRONICS & COMMUNICATION ENGG. (3-1-0) 4

Linear Algebra: Basis, Vector Spaces and Subspaces, Inverse by partitioning, Linear Transformations, Rank and Echelon matrices, Homogeneous linear equations, Basic Solutions, Similarity, Symmetric matrices, Diagonalization, Quadratic forms, Rotation of co-ordinates, Orthogonal Transformations.

Probability Theory and Applications: Random Variables and Transformations, Bernoulli, Binomial, Poisson, Uniform, Gaussian, Raleigh, Ricean probability distributions, Expectations, Moments and generating functions, Inequalities, Limit Theorems, Random Processes, Markov and Poisson Random processes, Error function, Complementary Error function, Q function and their applications

Theory of Complex variables: Functions of Complex variables, Cauchy-Riemann equations, Properties of analytic functions, Conformal mapping, Line Integrals in a complex plane. Cauchy's Theorems, Evaluation of standard real line integrals using contour integration.

Numerical Methods: Introduction, Solution of equations by iteration, Interpolation, Numerical Integration and Differentiation, Solution of Linear equations and Differential equations.

Finite fields and PN sequences: Polynomials and Euclidean algorithm, Constructing finite fields, subfields, Properties of PN sequences, Generation of PN sequences application of PN sequences

E. Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 1993.
G. Strang, Linear Algebra and its applications, Cenage Learning, 2006
C.W. Therrien and M. Tummala, Probability for Electrical and Computer Engineers, CRC Press, 2005.
T.K Moon and W.C Stirling, Mathematical Methods and Algorithms for Signal Processing, Pearson Education, 2000.

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EC233 DATA STRUCTURES AND ALGORITHMS (3-0-2) 4

Review of program performance. Array based representation. Linked representation. Arrays and matrices. Stacks and queues, implementation and applications. Skip lists and hashing. Binary and other trees. Heap and heap sort. Binary search trees. Graphs, Greedy method, shortest path and spanning trees. Divide and conquer method. Dynamic programming.

Sartaj Sahni, Data Structures, Algorithms and Applications in C++, Universities Press, 2005

A.V. Aho, J.E. Hopcroft and J. D. Ullman, Data structures and Algorithms, Pearson, 2004.

T.H.Cormen, C.E. Leiserson, R.L. Rivest, C. Stein, Introduction to Algorithms, PHI, 2004

Mark Allen Weiss, Algorithms, Data structures and problem solving with C++, Pearson, 2002.

EC270 ANALOG COMMUNICATION (3-1-0) 4

Introduction to Analog Communication, amplitude modulation, circuits for AM generation / detection, AM receiver systems and circuits, Angle modulation (FM/PM), Circuits for (FM/PM) generation and detection, commercial applications, frequency division multiplexing systems, noise performance of analog communication system (AM / FM / PM).

S. Haykin, Communication systems, John Wiley, 2001.

W. Tomasi, Electronic Communication systems, Pearson-Education, 2003.

EC271 MICROPROCESSORS (3-1-0)4

Introduction to computer organization, CISC and RISC processors, concept of pipelining, concept of microcomputer and microcontroller. Introduction to ARM based processor: Processor overview, introduction to programming model, processor and memory organization, concept of stack, introduction to processor instruction set, addressing modes, instruction encoding. Processor implementation, organization and execution: Instruction datapath, timing, processor modes, exceptions, protected mode operation. Hardware interfacing: Introduction to memory, IO interfacing, Concepts of memory mapped and IO mapped IO.

Steve Furber, "ARM System Architecture", Edison Wesley Longman, 1996.

William Hohl, "ARM Assembly Language- Fundamentals and Techniques ", CRC Press, 2009

Andew N. Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide Designing and Optimizing System Software", Elsevier, 2004.

D.A. Patterson and J. Hennessy, Computer Organization & Design, The Hardware/software interface, Elsevier Inc, ARM Edition, 2010.

EC272 DIGITAL SIGNAL PROCESSING (3-1-0)4

Time domain analysis of discrete-time signals & systems: properties, linear-time invariant systems, representation of LTI systems, solution of difference equations. Transform domain analysis of discrete-time signals & systems: Z transforms, application of Z transforms to discrete-time systems, Frequency domain analysis of discrete-time signals and systems: Discrete-time Fourier series, Discrete-time Fourier transform, properties and applications of Fourier representation, Sampling in time and frequency domain; Discrete Fourier transform: properties, linear convolution using DFT, Fast Fourier Transform algorithms. Digital Filter Design: Filter Structures; FIR filter design: FIR filter design by window method, frequency sampling method, least squares approximation, optimal FIR filter design; IIR Filter Design: Impulse invariant and bilinear transformation methods, Filter design using Butterworth, Chebyshev and elliptic approximations, Spectral transformation technique for HP, BP and BS filter design. Direct design of IIR filters.Applications of DSP.

J.G.Proakis and D.G.Manolakis, Introduction to Digital Signal Processing, PHI, 2007

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Ashok Ambardar, "Digital Signal Processing – A Modern Introduction", Thomson, 2007
Sanjit K. Mitra, Digital Signal Processing: A computer based Approach, TMH, 2006

EC273 MICROPROCESSORS LAB (0-0-3)2

Introduction to assembly language programming, C language programming, use of evaluation Boards, interfacing various peripherals and using them.

EC274 DIGITAL SIGNAL PROCESSING LAB (0-0-3) 2

Simulation exercises on linear equation solvers: Digital Filter Design, DFT and spectral analysis, identification of sinusoids in noise. Speech processing, Image processing, Real time experiments using fixed point DSP processor (Assembly language programming) and FPGAs: Waveform generation, Data I/O – effect of sampling and quantization, Digital Filter Implementation – FIR and IIR filter, Implementation of FFT. Design Project

EC280 DIGITAL SYSTEM DESIGN (3-0-2) 4

Review of Combinational and Sequential logic design, digital system design and implementation options, ASICs, PLDs, FPGAs. Programmable ASICs. Digital system modeling, Hardware description based on Hardware Description Languages, VHDL/ Verilog, data path and control path synthesis, Design case studies, computer aided design tools, Design flow, commercial CAD packages, clocking techniques, Functional simulation, timing analysis, testability and fault tolerance in design.

C.H. Roth, Digital system design using VHDL, PWS Publising, 1998
Samir Palnitkar. "Verilog HDL -A Guide to Digital Design and Synthesis." Pearson Education, 1999.
Zainalabedin Navabi, "Verilog Digital System Design", 2nd Ed., McGraw Hill, 2006.
Michael D. Ciletti, "Modeling, Synthesis, and Rapid Prototyping with the Verilog (TM) HDL", Prentice Hall 1999.
T. R. Padmanabhan and B. Bala Tripura Sundari, "Design through Verilog HDL", John Wiley & Sons, 2004.
Peter Ashenden, The Designer's Guide to VHDL, Morgan Kaufman, 2002
J. Bhaskar, "Verilog HDL Synthesis – A Practical Primer", Star Galaxy Publications, 1998.
Donald Thomas and Philip R. Moorby, "The Verilog Hardware Description Language", Springer publications, 2008.

EC281 RADIATING SYSTEMS (3-1-0) 4

Review of EM theory and Antenna fundamentals, Antenna Radiation characteristics, Wire Antennas, Aperture antennas, Antenna Arrays, Antennas for terrestrial and deep space communication, Radio Wave propagation in various environments.

C.A Ballanis, Antenna Theory, John Wiley, 2005.
J. D Kraus, Antennas, McGraw Hill, 2001.
A.R Harish, M. Sachidananda,Antennas and Wave Propagation, Oxford University Press, 2007.

EC282 CONTROL SYSTEMS (3-1-0) 4

System Modeling: modeling of Electrical and Mechanical (Translational and rotational) Systems. Signal Flow Graphs. Basic requirements of a control system. Steady state error. Root locus technique. Review of Bode plot, phase margin and gain margin. Control System Design : Compensators and Controllers, Lead, lag compensators, proportional, Integral and derivative, PI,PD, PID Controllers, Design of controllers using Bode plots. State Space representation and state space analysis.

B.C.Kuo, Automatic Control Systems, PHI 1995
K.Ogata, Modern Control Engineering, Pearson Education, 2002
R.C.Dorf and R.H. Bishop, Modern Control Systems, Pearson 2008

EC320 ANALOG INTEGRATED CIRCUITS (3-1-0) 4

Operational Amplifier & Linear Applications: Difference amplifiers, Instrumentation amplifiers, voltage to current converters.

Filters : Second order filter transfer function (low pass, high pass, band pass and band reject) , Butterworth response, 2nd order passive filters (RC, RLC), Emulation of inductor using Transconductors-Capacitors, and opamps-R-C, Salen-Key biquadratic filters, Tow-Thomas biquad, Realization of higher order filters, All-pass filter (active phase shifters).

Non-linear application of opamps : Opamp as a comparator, Schmitt trigger (inverting & non inverting), astable multivibrator, Triangular wave generator, Precision rectifiers.

Non idealities of opamps and their effects: Finite gain, finite bandwidth, Offset voltages and currents, Common-mode rejection ratio, Power supply rejection ratio, Slew rate.

CMOS differential amplifiers: DC analysis and small signal analysis of differential amplifer with Restive load, current mirror load and current source load, Input common-mode range and Common-mode feedback circuits. OTAs vs Opamps.

Two stage amplifiers, Compensation in amplifiers (Dominant pole compensation).

Introduction to Voltage Controlled Oscillators and Phase Locked Loops

Sergio Franco, Design with OPAMPS and Linear Integrated circuits, Tata McGraw Hill, 2002.
Sedra and Smith, Microelectronics Circuits, Oxford Univ. Press, 2004
Coughlin, Driscoll, OP-AMPS and Linear Integrated Circuits, Prentice Hall, 2001.
Carson Chen, Active Filter Design, Hayden, 1987

EC321 DIGITAL COMMUNICATION (3-1-0) 4

Introduction to digital communication systems, Pulse modulation systems, Non-uniform quantization and companding, Waveform coding techniques; Line codes; Base band pulse transmission, Matched filter and Inter symbol interference; Pass Band digital transmission, Digital modulation schemes; Digital signaling over a channel with inter-symbol interference and additive Gaussian noise, Signal design for band limited channels. Optimum demodulator for inter-symbol interference and additive Gaussian noise, coded modulation for bandwidth constraint channels-PSK, QAM & Trellis coded modulation, Linear equalization, decision feedback equalization, adaptive equalization. Introduction to spread spectrum systems. Introduction to coding theory – Entropy, mutual information, Shannon encoding algorithm Shannon Hartley law, source and channel coding theorems, Huffman and Shannon Fano coding, Error control coding: Linear block codes - Hamming Codes, Cyclic codes and Convolutional codes.

S.Haykin, Communication systems, John Wiley 2001
B.Sklar, Digital Communications, Pearson Education, 2001
J.G.Proakis, Digital Communications, McGraw Hill, 2000.

EC322 ANALOG INTEGRATED CIRCUITS LAB (0-0-3) 2

Hardware Experiments :

OPAMPS Linear application: Voltage follower, Non-inverting amplifier and Non-inverting summing amplifier, Inverting amplifier, Inverting summing amplifier, Difference amplifier, Instrumentation amplifier, Voltage to current converter. Inverting integrator, Allpass filter, Salen-Key biquad,

OPAMP non-linear applications: Opamp based Comparator, Schmitt Trigger (Inverting and non-inverting), astable multivibrator, Triangular wave generator.

Simulation Experiments :

CMOS differential amplifiers : resistive load and Current mirror load, Current source load. Common-mode feedback circuit. Input common-mode range, CMRR and PSRR, Transconductor-Capacitor biquad filter.

EC323 COMMUNICATIONS LAB - I (0-0-3) 2

AM and FM modulation and demodulation, Active equalizers, Video IF, RF timer response, Radio receiver characteristics, Design of active filters, Pulse code modulation, PAM, PWM, PPM, DSB-SC, SSB modulation and demodulation, Carrier recovery, Frequency division multiplexing, Simulation exercises.

EC330 SOFT COMPUTING (3-0-0) 3

Introduction to learning systems - Feed forward Neural Networks - Perception - Multilayer Perceptron propagation algorithm and its variants - Improving generalization by various methods.

Recurrent Neural Networks - Hopfield net - Boltzmann machine and Mean field learning - solving combinational optimization problems using recurrent Neural Networks.

Unsupervised Neural Networks. Competitive learning - Self organizing maps - Growing cell structures Principal component analysis. Basics of fuzzy sets. Genetic algorithms: Population based search techniques, evolutionary strategies, mathematical foundations of genetic algorithms, search operators, genetic algorithms in function and combinational optimization, hybrid algorithms, application to pattern recognition

S. Haykin, Neural Networks : A comprehensive foundation, Pearson, 1999

J. M. Zurada, Introduction to artificial neural networks, Jaico publishing, 1997.

B. Yegnanarayana, Artificial Neural Networks, PHI, 1991

EC331 SATELLITE COMMUNICATION (3-0-0) 3

Introduction to satellite Communications, Space craft, space craft sub systems, Altitude and orbit control systems, Telemetry, tracking and command, Power Systems, Communication sub systems, description of communication systems, transponders, Space craft antennas, Equipment reliability and space qualification, Multiple access systems, FDMA, FDM/FM/FDMA, TDMA, CDMA spread spectrum transmission and reception. Applicability of CDMA to commercial systems, demand access in the INTELSAT. TDMA system, SPADE, the INMARSAT system, Earth station, Satellite television networks .

T. Pratt, Satellite communications, John Wiley, 2002

T. T. Ha., Digital satellite communication, Collier Macmillan, 1986

EC332 RADAR & ELECTRONIC NAVIGATION SYSTEMS (3-0-0) 3

Introduction to Radar, Basic concepts, Radar equation, Radar systems, elementary Radar signal processing, RADAR cross section, RADAR detection, range & Doppler measurements, tracking, Electronic counter measures, Hyperbola system of navigation, Instrument landing system, Microwave landing systems, Satellite navigation systems.

M.Skolnik, Introduction to Radar system, McGraw Hill 2002.

J.C Toomay, Principles of Radar, Sci-Tech, 2004

R J Sullivan, Radar foundation for imaging & advanced concepts, PHI, 2004.

EC333 COMMUNICATION NETWORKS (3-1-0) 4

Switching techniques, Multiplexing and Multiple Access techniques, Packet Switched Networks.
OSI and TCP/IP Models, Internet protocols and addressing, networking devices, data links and transmission, LANs and Network of LANS, Wireless Networks and Mobile IP, Routing and internetworking, transport and end to end protocols, congestion control techniques, Application Layer and network management, Network Security. Packet Queues and delays, Little's theorem, Birth and death process, Queuing disciplines, M/M/1 Queues, Burkes and Jackson theorems. Traffic models, ISDN, ATM Networks, Quality of service and resource allocation, VPNs and MPLS, Cellular Telephone and Optical networks, VOIP and Multimedia networking. Mobile Adhoc Networks and Wireless Sensor Networks

Nader F. Mir, Computer and Communication Networks, Pearson Education, 2007
Garcia and Widjaja, Communication Networks, McGraw Hill, 2006
J.F. Hayes, Modelling and analysis of Computer Comm. Networks, Plenum, 1984.
Jean Walrand & Pravin Varaiya, High Performance Communication Networks , Morgan Kaufmann Publishers, 2002

EC334 DIGITAL PROCESSING OF SPEECH & AUDIO SIGNALS (3 – 0 – 0) 3

Speech Production – human speech production mechanism, acoustic theory of speech production, digital models for speech production. Speech perception – human hearing, auditory psychophysics, JND, pitch perception, auditory masking, models for speech perception. Speech Analysis – Time and frequency domain analysis of speech, speech parameter estimation, Linear prediction. Speech compression – quality measures, waveform coding, source coders, Speech compression standards for personal communication systems. Audio processing – characteristics of audio signals, sampling, Audio compression techniques, Standards for audio compression in multimedia applications, MPEG audio encoding and decoding, audio databases and applications. Speech synthesis – text to speech synthesis, letter to sound rules, syntactic analysis, timing and pitch segmental analysis. Speech recognition – Segmental feature extraction, DTW, HMMs, approaches for speaker, speech and language recognition and verification

Douglas O'Shaugnessy, Speech Communication – Human and Machine, IEEE Press, 2000
L R Rabiner, Digital Processing of Speech Signals, Pearson, 1978
T.F Quatieri , Discrete-time speech signal processing: Principles and Practise Pearson, 2002
Zi Nian Li, Fundamentals of Multimedia, Pearson Education, 2003

EC335 APPLICATION OF SIGNAL PROCESSING ON IMAGE & VIDEO (3–0–0) 3

Digital image fundamentals – image acquisition, representation, visual perception, quality measures, sampling and quantization, basic relationship between pixels, imaging geometry, color spaces, Video spaces, analog and digital video interfaces, video standards. Two dimensional systems – properties, analysis in spatial, frequency and transform domains. Image transforms - DFT, DCT, Sine, Hadamard, Haar, Slant, KL transform, Wavelet transform. Image enhancement – point processing, spatial filtering, Image restoration – inverse filtering, de-blurring Video processing – display enhancement, video mixing, video scaling, scan rate conversion, Image compression – lossless and lossy compression techniques, standards for image compression – JPEG, JPEG2000. Video compression – motion estimation, intra and interframe prediction, perceptual coding, standards - MPEG, H.264 Image segmentation – feature extraction, region oriented segmentation, descriptors, morphology, Image recognition

R. C. Gonzalez and R E Woods, Digital Image Processing, Pearson Education, 2002
A K Jain, Fundamentals of Digital Image Processing, Pearson Education, 1989
W Pratt, Digital Image Processing, Wiley, 2001
Al Bovik, Handbook of Image and Video, Academic Press, 2000
Keith Jack, Video Demystified, LLH, 2001

EC336 EMBEDDED SYSTEMS (3-0-2)4

Embedded Processing: Evolution, Issues and Challenges. Embedded systems and Processor architecture. Memory Systems Architecture: memory devices and their characteristics, Introduction to concept of memory hierarchy, virtual memory and caches. Embedded systems I/O: Interfacing bus, protocols, Timers, Interrupts, DMA, USB, AD and DA converters. Embedded communication: Parallel, serial, network and wireless communication. Embedded Systems software: constraints and performance targets, introduction to RTOS, concept of device drivers. Testing of Embedded systems: performance analysis and optimization.

Steave Heath, "Embedded system design", 2nd edition 2003, Elsevier

K.V.K.K Prasad, "Embedded / Real time systems: Concepts Design & Programming Black Book Black book", Revised edition, DreamTech Press

Jonathan W Valvano, "Embedded Microcomputer Systems: Real Time Interfacing" , Cengage Learning, Jan-2011.

EC340 DIGITAL SYSTEMS & COMPUTER ORGANISATION (3-0-0) 3

Combinational Logic Design, Arithmetic Circuits. Sequential Logic Design, Finite State Machines. Memory, Introduction to Computer Architecture, Programming Model, Hardware Interfacing of Memory & Peripherals, Typical application of Microprocessors

M. Morris Mano & Charles Kime, Logic & Computer Design Fundamentals, Prentice Hall, 2008

M.Morris Mano, Computer System Architecture, Prentice Hall, 2007

John P.Uyemura, A First Course in Digital Systems Design - An Integrated Approach, Brooks/Cole, 2000.

EC341 PRINCIPLES OF COMMUNICATION ENGG (3-0-0) 3

Introduction to Analog and Digital Communication: Bandwidth and Information capacity, Transmission modes, Signal analysis, Noise considerations. Modulation and Demodulation concepts (AM, FM, PM), TDM and FDM concepts. Super Heterodyne receivers and Direct Conversion receivers, Color TV Transmission and reception. Digital and Data Communication: Sampling Theorem, Coding and Decoding, Pulse modulation, FSK, PSK Modem, Serial and Parallel interface, Computer Network configurations and Protocols; OSI Reference model; Internet Protocol; packet switching. Satellite communication: Orbital patterns, geostationary satellites, frequency band allocation. Optical Fiber Communication: Mode of signal transmission, signal source and detectors, attenuation and channel capacity. Digital Telephony, PSTN and Cellular telephony, Voice over packet.

Wayne Tomasi, Electronic Communication Systems: Fundamentals through Advanced, Pearson Education, 2008.

Kennedy, Communication Systems, McGraw Hill,1996

Gary Miller, Modern Electronic Communication, PHI, 2008

Andrew S. Tannenbaum, Computer Networks, PHI, 2003

EC342 COMPUTER NETWORKS (3-0-0) 3

Basics of circuit switching, packet switching, cell switching. ISO-OSI model, need for the model, reasons, advantages etc. Link layer & local area network, Computer network architecture, TCP/IP protocol suite, Routing protocols, Asynchronous transfer mode (ATM), Frame relay concepts, Wireless LAN, Multicasting, Internet security, Voice over IP (VOIP), Storage networks, Socket programming, IPV6, need for IPV6, addressing space, difference between IPV6 and IPV4 etc.

D. E Comer, Internetworking with TCP / IP – Vol. I, Prentice Hall, 2006

James F. Kurose, Keith W. Ross, Computer Networking A Top – Down Approach, Featuring the Internet, Pearson Education, 2005

Andrew S. Tanenbaum Computer Networks, PHI, 2003

EC343 APPLICATIONS OF SIGNAL PROCESSING (3-0-0) 3

Time, frequency and transform domain analysis of signals & systems, Spectral Analysis, Digital Filter Design, Applications of Signal Processing communication, multimedia, entertainment, medicine, surveillance, motion control, embedded systems. Design and simulation tools, Implementation of DSP algorithms options and issues.

James McClellan, RW Schafer, Signal Processing First, Pearson Education, 2003
EC Ifeachor, B W Jervis, DSP, A practical Approach, Pearson Education,2002
Steven W. Smith, The Scientists and Engineers Guide to DSP, (http://www.dspguide.com)

EC344 MICROPROCESSORS AND MICROCONTROLLERS (3-0-0)3

Introduction to Microprocessor Systems:. Introduction to architecture, operation, and application of microprocessors; microprocessor programming; address decoding; system timing; parallel, serial, and analog I/O; interrupts and direct memory access; interfacing to static and dynamic RAM; Introduction to microcontrollers: Overview of the architecture of microcontroller, Assembly language programming and hardware interfacing. Applications of microcontroller.

Douglas V. Hall, Microprocessors & Interfacing, McGraw Hill International Edition, 1992.
Jonathan W Valvano, Embedded Microcomputer Systems: Real Time Interfacing , Cengage Learning,Jan-2011.
Steve Furber, ARM System Architecture, Edison Wesley Longman, 1996.
William Hohl, ARM Assembly Language- Fundamentals and Techniques, CRC Press, 2009

EC370 VLSI DESIGN (3-1-0) 4

Introduction to MOSFETs, MOSFET Equivalent Circuits. MOSFET logic circuits: NMOS inverter, CMOS inverter, CMOS Processing Technology. Layout design rules. CAD tools for VLSI Design. MOSFET Logic gates. CMOS combinational, sequential logic circuits, Flip flop and latch timings, Clocking. Circuit characterization and performance estimation: Resistance, capacitance estimation, Switching characteristics, Delay models. Power dissipation, Packaging, Scaling of MOS transistor dimensions. CMOS subsystem design. Datapath operations: Addition, Multiplication, Counters, Shifters, Memory elements.

Jan M. Rabaey, A. Chandrakasan, and B. Nikolic, Digital Integrated Circuits: A design Perspective, Pearson Education, 2002
S.M.Kang & Y. Leblebici, CMOS Digital Integrated Circuits, McGraw Hill, 2002
Ken Martin, Digital Integrated Circuit Design, Oxford Press, 2000.

EC371 RF AND MICROWAVE ENGINEERING (3-1-0)4

Review of electromagnetic and circuit theory, Micro wave Transmission line theory and co-axial lines. Microwave waveguides and components. Microwave network analysis. Passive and active Microwave devices/circuits, RF amplifiers, oscillators,filters and mixers, RF – Microwave system Design.

David M Pozar , MICROWAVE ENGINEERING, John Wiley, 2004
Samual Y Liao, Microwave devices and circuits PHI 3 rd edition
Reinhold Ludwig and Pavel Bretchko, RF circuit Design: Theory and Applications, PH,2000.

EC372 VLSI DESIGN LAB (0-0-3) 2

Design, Simulation and layout of basic digital blocks
Tools to be used: TANNER, CADENCE, MAGIC, SPICE, ELECTRIC
Design Project

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EC373 COMMUNICATION LAB - II (0-0-3) 2

Experiments with Klyston bench, Gunn source bench, Antenna characteristic – pattern gain measure, Optical fibres experiments, Simulation exercises

EC380 WIRELESS MOBILE COMMUNICATION (3-0-0) 3

Concepts of cellular communication, Geometry of hexagonal cells; Co-channel interference, cellular system design in worst case, co-channel interference with the use of directional antennas, Cell splitting, Frequency allocation in mobile, Power control, JDC, JDC frame structure, TDMA, TDMA frame, delayed in TDMA, advantages CDMA, Capacity Comparison of FDM /TDM systems and cellular CDMA. Standards for Wireless mobile communication, Micro cells, high way micro cells, spectral efficiency, traffic carried, Signaling and call control; Mobility management, Location tracking. Wireless data networking

G.L. Sterber, Principles of Mobile Communications, Kluwer Academic, 1996.
T.S .Rappaport, Wireless communications, Principles and Practice, , Pearson Edn, 2002.
William C.Y. Lee, Mobile cellular telecommunication systems: Analog & Digital Systems, McGraw Hill, 1995.

EC381 SPREAD SPECTRUM COMMUNICATIONS (3-0-0) 3

Spread spectrum overview, Spreading techniques, Pseudo noise sequences, Direct sequence spread spectrum system, Frequency hop spread spectrum system, Hybrid systems, Synchronization, Jamming considerations, Commercial applications, Cellular systems, Performance of spread spectrum systems.

R.L.Peterson, Introduction to spread spectrum communication, PH,1995.
B.Sklar, Digital Communications, Pearson Education, 2001.
M.K.Simon, Spread spectrum communications Handbook, McGraw-Hill, 2001.
J.S.Lee, CDMA Systems Engineering handbook, Artech House, 1998

EC382 INFORMATION THEORY AND CODING (3-0-0) 3

Communication systems and Information Theory, Measures of Information, Coding for Discrete sources, Discrete memory-less channels and capacity, Noisy channel coding theorem, Techniques for coding and decoding, Waveform channels, Source coding with Fidelity criterion.

Thomas M Cover & Joy A Thomas, Elements of Information Theory, John Wiley,1991
R.G.Gallagher, Information Theory and Reliable Communication, Addison Wesley, 1987.
A.J.Viterbi & J.K. Omura, Principles of Digital Communications and Coding, McGraw Hill, 1979.

EC383 ERROR CONTROL CODING (3-0-0) 3

Coding for reliable digital transmission and storage. Groups, Rings, Vector Spaces, Galois Fields, Polynomial rings, Channel models, Linear Block codes, Cyclic codes, BCH codes, Reed Solomon Codes, Berlekamp-Massey and Euclid decoding algorithm, Decoding beyond the minimum distance parameter, Applications of Reed-Solomon codes, Convolutional codes, Decoding algorithms for Convolutional codes, Viterbi, Stack and Fano algorithms, Application of Convolutional codes. Codes based on the Fourier Transform,.Algorithms based on the Fourier Transform, Trellis coded modulation, Combinatorial description of Block and Convolutional codes, Algorithms for the construction of minimal and tail biting trellises, Soft decision decoding algorithms, Iterative decoding algorithms, Turbo-decoding, Two-way algorithm, LDPC codes, Use of LDPC codes in digital video broadcasting, belief propagation (BP) algorithms, Space-Time codes.

Shu Lin and Daniel J. Costello Jr., Error Control Coding: Fundamentals and Applications, Prentice Hall, 2003.

S. B Wicker, Error Control Systems for Digital Communication and Storage, Prentice Hall International, 1995.
Blahut R. E, Theory and Practise of Error Control Codes, Addison Wesley, 1983.
Blahut R.E., Algebraic codes for Data transmission, Cambridge University Press, 2003.

EC384 ADHOC AND SENSOR NETWORKS (3-0-0) 3

Mobile ad hoc networks and wireless sensor networks concepts and architectures. Routing: proactive routing, Broadcasting and multicasting, TCP over mobile ad hoc networks,Wireless LAN (WiFi) standards, Medium Access Control Protocol issues power control, spatial reusability, and QoS, Bluetooth, Wireless sensor networks architecture: hardware and software components of a sensor node, OS for WSN, WSN MAC layer strategies; naming and addressing; Clock Synchronization; Node Localization; WSN Routing

C Sivarama Murthy and B S Manoj, Ad-Hoc Wireless Networks, Architectures and Protocols, PH , 2004.
Labiod.H, Wireless Adhoc and sensor networks, Wiley, 2008.
Li,X , Wireless ad hoc and sensor networks: theory and applications, Cambridge University Press,2008

EC385 OPTICAL COMMUNICATION SYSTEMS AND NETWORKS (3-1-0)4

Introduction to Optical Fibers, Ray Optics-Optical Fiber Modes and Configurations. Signal degradation in Optical Fibers. Optical Sources and Detectors. Optical Communication Systems and Networks. Basic concepts of SONET/SDH Networks.

J.Senior, Optical Communication, Principles and Practice, Prentice Hall of India, 1994/latest edition.
Gerd Keiser, Optical Fiber Communication McGraw –Hill International, Singapore, 3rd ed., 2000/latest edition
J.Gower, Optical Communication System, Prentice Hall of India, 2001.

EC386 CRYPTOGRAPHY AND DATA SECURITY (3-0-0) 3

Elementary Number Theory, Finite series, Arithmetic and Algebraic Algorithms, Secrete key and Public key Cryptography, Pseudo Random bit generators, Block and Stream Ciphers, Hash functions and Message digests, Public key encryption, Authentication, Digital Signatures, Zero Knowledge Interactive Protocols, Elliptic curve cryptosystems, formal verification, Crypt analysis, Hard Problems.

Koblitz N., A Course on Number Theory and Cryptography, Springer Verlag, 1986.
Menezes A. et. all, Handbook of Applied Cryptography, CRC Press, 1996

EC430 ADVANCED TOPICS IN COMMUNICATION ENGG (3-0-0) 3

Fading Channels, characterizing Mobile radio propagation, Signal time spreading, time variance of channel, mitigating the degradation effects of fading, characterizing fading channels, Fundamentals of Statistical Detection Theory, Baye's Theorem, Decision theory, Neyman Pearson Theorem, Receiver operating characteristics, Bayes's risk. Multiple hypothesis testing, minimum Baye's risk detection for binary hypothesis and multiple hypothesis, Orthogonal Frequency Division Multiplexing, OFDM transmission technique, synchronization, modulation, demodulation, amplitude limitation of OFDM signals. Space Time Wireless Communications, Introduction, space time propagation, space time channel and signal models, spatial diversity, space time OFDM

B.Sklar, Digital Communications: Fundamentals and Application, Pearson Education, 2001.
J.G.Proakis & M.Salehi, Communications System Engineering, Pearson Education 2002.

Stevan M Kay, Fundamentals of Statistical signal processing, Vol. II, Detection Theory, PHI, 1998.
A.Paulraj, R.Nabar & D.Gore,Introduction to Space Time Wireless Communications, Cambridge University, 2003.

EC431 ADVANCED DIGITAL SIGNAL PROCESSING (3-0-0)3

Power spectral estimation; Parametric and non-parametric methods of spectral estimation, Linear prediction, Higher order spectral estimation; Adaptive filters and applications. Recursive estimation and Kalman filters;Multirate Signal Processing: Decimation Interpolation, DFT filter banks, QMF filter banks, Multiresolution Signal analysis wavelets theory of sub band decompositions, Sub band codingand wavelet transforms, Application of wavelet transforms.

P.P. Vaidyanathan, Multirate systems and Filter banks, Prentice Hall, 1993.
S.J. Orfanidis, Optimum Signal Processing, McGraw Hill, 1989.
S. Haykin, Adaptive FilterTheory, Pearson, 1996

EC432 MAPPING DSP ALGORITHMS TO ARCHITECTURE (3-0-0) 3

Real time signals and digital signal processing – Processor architectures General Purpose architectures and custom VLSI design, Representations of DSP algorithms dataflow graphs, recursive equations, Iteration bound, Critical paths and limits on implementation speed – Pipelining and parallel processing, Retiming methodology, Unfolding/Folding transformation, register minimization techniques Systolic architectures, mapping algorithms to array structures. Arithmetic: Fixed point, floating point and residue arithmetic, Multiply and Divide algorithms, MAC, Cordic architectures, Issues in arithmetic system design; Algorithms for fast implementation of convolution, FIR, IIR and adaptive filters, DCT, analysis of finite word length effects, Low power designs strategies

K.K. Parhi, "VLSI Digital signal processing systems: Design and implementation", John Wiley, 1999.
Lars Wanhammar, "DSP Integrated Circuits", Academic Press, 1999
Sanjit K. Mitra, "Digital Signal Processing: A computer based Approach", TMH, 2006

EC433 MULTIMEDIA COMMUNICATION TECHNIQUES (3-0-0) 3

Representation of Multimedia Data, Concept of Non-Temporal and Temporal Media, Basic Characteristics of Non-Temporal Media, Images, Graphics, Text, Basic Characteristics of Temporal Media, Video, Audio, Animation, Basics of Morphing, Hypertext and Hypermedia, Multimedia Presentations, Synchronization. Compression of Multimedia Data, Basic concepts of Compression, Still Image Compression JPEG Compression, Natural Video Compression, MPEG-1&2 Compression Schemes, MPEG-4 Video Compression, Audio Compression Introduction to Speech and Audio Compression, MP3 Compression Scheme, Management of Coded Data ,Stream management in MPEG-4 , BIFS, DMIF Multimedia System Design, General Purpose Architecture for Multimedia Processing, Operating System Support for Multimedia, Data, Resource Scheduling with real-time considerations, File System, I/O Device Management, Delivery of Multimedia data, Network and Transport Protocols, QoS issues, RTP and RSVP, Video-conferencing and video-conferencing standards, Overview of Voice over IP, Multimedia Information Management, Multimedia Data base Design, Content Based Information Retrieval, Image Retrieval, Video Retrieval, Overview of MPEG-7.

Ralt Steinmetz and Klara Nahrstedt, Multimedia : Computing, Communication & Applications, Pearson Education Publications, 2004.

EC434 REAL TIME DIGITAL SIGNAL PROCESSING (2-0-2)3

Introduction to DSP systems and architecture; Arithmetic: Fixed point, floating point and residue arithmetic, Cordic architectures; Real time implementation of SP algorithms on Digital Signal

Processors: Architecture and programming; Real time implementation of SP algorithms on Reconfigurable architectures: Architecture and design flow; Issues in implementation of convolution, FIR, IIR and adaptive filters, DCT, Image Filtering, Dynamically reconfigurable architectures for SP, Software Configurable processors, Application case studies in multimedia compression and communication

BehroozParhami, "Computer Arithmetic Algorithms and Hardware Design", Oxford, 2000.
RulphChassaing, " Digital Signal Processing and Applications with the C6713 and C6416 DSK", Wiley, 2005
U. Meyer Baesse, "Digital Signal Processing with FPGAs", Springer, 2001
ShehrzadQureshi, "Embedded Image Processing on the TMS320C6000 DSP" Springer, 2005

EC435 VLSI SYSTEMS AND ARCHITECTURE (3-0-0) 3

Instruction set architectures of CISC, RISC and DSP Processors. CISC Instruction set implementation, Microprogramming approaches. Pipeline implementation of RISC instruction set. Implementation of DSP instruction set. Instruction level parallelism – Dynamic scheduling, Dynamic hardware prediction, hardware based speculation, ILP through software approaches – VLIW, IA64 architecture as a case study, Memory hierarchy design, Multiprocessors, thread level parallelism and multi-core architectures, I/O buses. Arithmetic: Fixed point, Floating point and residue arithmetic, Multiply and Divide Algorithms, Issues in arithmetic system design Issues in the applications (optimizing the hardware – software interface), ASIP, reconfigurable computing, Future microprocessor architectures.

D. A. Patterson and J. Hennessy, Computer Architecture: A Quantitative Approach, Harcourt Asia, 2003.
D. A. Patterson and J. Hennessy, Computer Organization and Design, Harcourt Asia, 1998.
Flynn and Oberman, Advanced Computer Arithmetic Design, Wiley 2001
Behrooz Parhami, Computer Arithmetic Algorithms and Hardware Design, Oxford, 2000.

EC436 SYNTHESIS AND OPTIMIZATION OF DIGITAL CIRCUITS (3-0-0) 3

Introduction to Computer aided synthesis and optimization. Hardware Modeling. Two level combinational logic optimization. Multiple level combinational optimization. Sequential logic optimization. Cell Library Binding. State of the art and future trends: System level synthesis and hardware software co-design.

Giovanni De Micheli, Synthesis and Optimization of Digital Circuits, McGraw Hill, 1994.
Srinivas Devadas, Abhijith Ghosh and Kurt Keutzer, Logic Synthesis, Kluwer Academic, 1998.
G. D. Hachtel and F. Somenzi, Logic Synthesis and Verification Algorithms, Kluwer Academic Publishers, 1996.
S. Hassoun and T. Sasao, (Editors), Logic Synthesis and Verification, Kluwer Academic publishers, 2002.

EC437 ACTIVE FILTERS (3-0-0)3

Butterworth, Chebyshev & Inverse-Chebyshev filter response and pole locations; LC ladder filter – prototype & synthesis; Frequency transformation of lowpass filter. Impedance converters; Gm-C filters – Gm-C biquad, Q-enhancement, Automatic Tuning; Active-RC filters – Comparison with Gm-C filter, Issues in realizing high frequency active-RC filters; Characterization of on-chip integrated continuous time filters.

R. Schaumann and M.E. Van Valkenburg, Design of Analog Filters, Oxford University Press, 2003.
P. V. Ananda Mohan, Current-Mode VLSI Analog Filters - Design and Applications, Birkhauser, 2003
M.E. Van Valkenburg, Analog Filter Design, Oxford University Press, 1995.

EC438 TECHNIQUES IN LOW POWER VLSI (3 – 0 – 0) 3

Introduction to Low Power VLSI. Modeling and Sources of Power consumption. Power estimation at different design levels. Power optimization for combinational circuits and sequential circuits Voltage scaling Approaches. Low energy computing using energy recovery techniques. Low Power SRAM architectures. Software design for low power. Computer Aided Design Tools. Case studies Recent trends in low-power design for mobile and embedded application.

Kaushik Roy and Sharat Prasad, Low-Power CMOS VLSI design, John Wiley, 2000.

Anantha P.Chandrakasan & Robert W. Brodersen, Low Power Digital CMOS Design, Kluwer Academic Publications, 1995.

Gary K. Yeap, Practical Low Power Digital VLSI Design, Kluwer Academic Publications, 1998

EC439 SUBMICRON DEVICES (3 – 0 – 0) 3

Review of basic device physics. MOS capacitor. Transistor theory. Scaling - Moore's law on technology scaling, MOS device scaling theory, Short channel effects, sub threshold leakage, Punch through, DIBL, High field mobility, Velocity saturation and overshoot. Reliability. Various definitions of channel length, Performance metric of digital technology, Transistor design trade-offs, Technology case studies, Silicon on Insulator (SOI) devices, Partially depleted and fully depleted SOI, Floating body effects, SOI for low power, Interconnects in sub micron technology, Foundry technology, International Technology Roadmap for Semiconductors (ITRS)

Yaun Taur, Tak H. Ning, Fundamentals of modern VLSI devices, Cambridge university press, 1998.

B. G. Streetman & S. Banerjee, Solid State Electronic Devices, Prentice Hall, 1999.

M. K. Achuthan and K. N. Bhat, Fundamentals of Semiconductor Devices, McGraw Hill, 2006

A. K. Dutta, Semiconductor Devices and Circuits, Oxford Univ. Press, 2008.

M. S. Tyagi, Introduction to Semiconductor Materials and Devices, John Wiley, 1991

ITRS Road map - http://public.itrs.net/

EC441 VLSI CAD (3-0-0)3

Introduction to VLSI CAD: VLSI design methodologies, use of VLSI CAD tools, Algorithmic Graph Theory, computational Complexity and ROBDD; Partitioning and placement: KL algorithm, FM algorithm etc.; Floor planning: Sliced and non-sliced planning, Polish expression, Simulated annealing, partition based placement; Routing: Global routing, detailed routing, graph models, Line Search, Maze Routing, Channel routing; High Level Synthesis: Introduction to HDL, HDL to DFG, operation scheduling: constrained and unconstrained scheduling, ASAP, ALAP, List scheduling, Force directed scheduling, operator binding; Static Timing Analysis: Delay models, setup time, hold time, cycle time, critical paths, Topological vs logical timing analysis, False paths, Arrival time (AT), Required arrival Time (RAT), Slacks.

Sabih H. Gerez, Algorithms for VLSI Design Automation, John Wiley, 1998.

Majid Sarrafzadeh and C. K. Wong, An Introduction to VLSI Physical Design, McGraw Hill, 1996.

Naveed Sherwani, Algorithms for VLSI Physical Design Automation, Kluwer Academic Pub., 1999.

EC442 MEMS AND NANO TECHNOLOGY (3-0-0) 3

Introduction, emergence, devices and application, scaling issues, materials for micro- and nano-scale size domains; MEMS materials and processes; MEMS devices and applications; nanostructures in semiconductors and metals; introduction to quantum effects in nanostructures; nanostructure applications. Fabrication Technologies: MEMS Sensors and Actuators, Nanostructures, Nanoelectronic Semiconductor Devices, Quantum Devices in Nanostructures

Chang Liu, "Foundations of MEMS", Prentice Hall, 2006
Gabriel M. Rebiez, "RF MEMS: Theory, Design, and Technology", John Wiley & Sons, 2003
G.K. Ananthasuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat and V.K. Aatre, Micro and Smart Systems. John Wiley & Co,2011
V.K. Varadan, K.J. Vinoy, and K.A. Jose, RF MEMS and their Applications. London: John Wiley, 2010.
Stepan Lucyszyn, "Advanced RF MEMS", Cambridge univ. Press, 2010.
Springer Handbook of Nanotechnology, 2011
Neeraj K. Jha et. al., "Nanoelectronic Circuit Design", Springer Publications, 2011
Lundstrom and Guo, "Nanoscale Transistors", Springer Publications, 2006

EC443 RF IC DESIGN (3-0-0)3

Basic concepts in RF Design – harmonics, gain compression, desensitization, blocking, cross modulation, intermodulation, inter symbol interference, noise figure, Friis formula, sensitivity and dynamic range; Receiver architectures – heterodyne receivers, homodyne receivers, image-reject receivers, digital-IF receivers and subsampling receivers; Transmitter architectures – direct-conversion transmitters, two-step transmitters; Low noise amplifier (LNA) – general considerations, input matching, CMOS LNAs; Downconversion mixers – general considerations, spur-chart, CMOS mixers; Oscillators – Basic topologies, VCO, phase noise, CMOS LC oscillators; PLLs – Basic concepts, phase noise in PLLs, different architectures.

Behzad Razavi, RF Microelectronics, Prentice Hall PTR, 1997
Thomas H. Lee, The design of CMOS radio-frequency integrated circuit, Cambridge University Press, 2006
Chris Bowick, RF Circuit Design, Newnes, 2007

EC444 VLSI TESTING AND TESTABILITY (3-0-0)3

Overview of testing and verification, Defects and their modeling as faults at gate level and transistor level. Functional V/s. Structural approach to testing. Complexity of testing problem. Controllability and observability. Generating test for a signal stuck-at-fault in combinational logic. Algebraic algorithms. Test optimization and fault coverage. Logic Level Simulation – Delay Models, Event driven simulation, general fault simulation (serial, parallel, deductive and concurrent). Testing of sequential circuits. Observability through the addition of DFT hardware, Adhoc and structured approaches to DFT – various kinds of scan design. Fault models for PLAs, bridging and delay faults and their tests. Memory testing, Testing with random patterns. The LFSRs and their use in random test generation and response compression (including MISRs), Built-in self test.

M. Abramovici, M. A. Breuer, and A. D. Friedman, Digital Systems Testing and Testable Design, IEEE Press, 1994.
M. L. Bushnel and V. D. Agarwal, Essentials of Testing for Digital, Memory and Mixed – Signal VLSI Circuits, Kluwer Academic Publishers, 2000.
Ajai Jain, Learning Module for the course - VLSI Testing and Testability, IIT, Kanpur, 2001.

EC445 ADVANCED TOPICS IN VLSI DESIGN (3 – 0 – 0) 3

Introduction to digital systems engineering, Modeling and analysis of wires; Circuits; Power distribution; Noise in digital systems; Signaling conventions; Advanced signaling techniques; Timing conventions; Synchronization; Signaling circuits; Timing circuits; Packaging of digital systems

Neil Weste and David Harris, CMOS VLSI Design : A Circuits and Systems Perspective, Addison Wesley, 2005
William J. Dallly and John W. Poulton, Digital Systems Engineering, Cambridge Univ. Press, 2004

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MLC 1	ENVIRONNEMENTAL STUDIES	(1-0-0) 1
MLC2	PROFESSIONAL ETHICS AND HUMAN	(1-0-0) 1
EC283	MINI PROJECT IN DIGITAL SYSTEM DESIGN	(0-0-3) 2
EC284	MINI PROJECT IN DIGITAL SIGNAL PROCESSING	(0-0-3) 2
EC337	MINI PROJECT IN COMMUNICATION SYSTEMS AND NETWORKS	(0-0-3) 2
EC338	MINI PROJECT IN MICROPROCESSOR & EMBEDDED SYSTEMS	(0-0-3) 2
EC339	MINI PROJECT IN ANALOG SYSTEM DESIGN	(0-0-3) 2
EC387	MINI PROJECT VLSI DESIGN	(0-0-3) 2
EC388	MINI PROJECT IN RF DESIGN	(0-0-3) 2
EC390	SEMINAR	(0-0-2) 1
EC446	PRACTICAL TRAINING	2
EC448	MAJOR PROJECT - I	(0-0-6) 4
EC498	MAJOR PROJECT – II	(0-0-6) 4

Annexure-VII

Department of Information Technology (IT)

Bachelor of Technology in Information Technology

Basic Science Core (BSC)

MA110	Engineering Mathematics – I	(3-0-0) 3
PH110	Physics	(3-1-0) 4
PH111	Physics Lab	(0-0-2) 1
MA111	Engineering Mathematics – II	(3-0-0) 3
CY110	Chemistry	(3-0-0) 3
CY111	Chemistry Lab	(0-0-3) 2

Engineering Science Core (ESC)

EE110	Elements of Electrical Engg.	(3-0-0) 3
ME110	Elements of Mechanical Engg.	(3-0-0) 3
CO110	Computer Programming	(3-1-0) 4
CO111	Computer Programming Lab	(0-0-2) 1
EC110	Elements of Electronics and Commn Engg	(3-0-0) 3
AM110	Engineering Mechanics	(3-0-0) 3
ME111	Engineering Graphics	(1-0-3) 3

Humanities and Social Science Core (HSC)

HU110	Professional Communication	(3-0-0) 3
HU300	Engineering Economics	(3-0-0) 3
HU302	Principles of Management	(3-0-0) 3

Programme Core (PC)

MA200	Mathematical Foundations of IT	(3-1-0) 4
IT200	Data Structures and Algorithms	(3-1-0) 4
IT201	Digital Design and Computer Organization	(3-1-0) 4
IT202	Unix Programming and Practice	(1-0-3) 3
IT203	Computer Systems Organization Lab	(1-0-3) 3
IT204	Data Structures and Algorithms Lab	(0-0-3) 2
IT250	Operating Systems	(3-0-2) 4
IT251	Computer Communication and Networking	(3-0-2) 4
IT252	Design and Analysis of Algorithms	(3-0-2) 4
IT300	Parallel Computing	(3-0-2) 4
IT301	Database Systems	(3-0-2) 4
IT302	Web Technologies and Applications	(3-0-2) 4
IT303	Automata and Compiler Design	(3-0-2) 4
IT350	Software Engineering	(3-0-2) 4
IT351	Human Computer Interaction	(3-0-2) 4
IT352	Information Assurance and Security	(3-0-2) 4

Programme Minor & Major Project (MP)

IT399	Minor Project	(0-0-3) 2
IT449	Major Project –I	(0-0-3) 2
IT499	Major Project –II	(0-0-9) 6

Mandatory Learning Courses (MLC)

CV110	Environmental Studies	(1-0-0) 1
HU111	Professional Ethics and Human Values	(1-0-0) 1
IT290	Seminar	(0-0-2) 1
IT390	Professional Practice	(0-0-2) 1
IT440	Practical Training	1

Programme Specific Electives (PSE)

IT205	Information Systems	(3-0-0) 3
IT206	Paradigms of Programming - I	(3-0-2) 4
IT253	Paradigms of Programming - II	(3-0-0) 3
IT254	Computer Graphics	(3-0-2) 4
IT255	Microprocessors and Interfacing	(3-0-2) 4
IT304	Multimedia Signal Computing	(3-0-2) 4
IT305	Performance Modeling	(3-0-2) 4
IT306	Object Oriented Analysis & Design	(3-0-0) 3
IT307	Advanced Computer Networks	(3-0-0) 3
IT353	Perceptual Audio Processing	(3-0-2) 4
IT354	Perceptual Video Processing	(3-0-2) 4
IT355	Soft Computing	(3-0-2) 4
IT356	Genetic Algorithms	(3-0-2) 4
IT357	Artificial Intelligence	(3-0-0) 3
IT358	Artificial Neural Networks	(3-0-2) 4
IT359	Fuzzy System Models	(3-0-0) 3
IT360	Distributed Computing Systems	(3-0-0) 3
IT361	Advanced Database Systems	(3-0-0) 3
IT362	Information Retrieval	(3-0-0) 3
IT363	Simulation and Modeling	(3-0-2) 4
IT364	E-Commerce	(3-0-0) 3
IT400	Mobile Computing	(3-0-0) 3
IT401	Embedded Systems	(3-0-0) 3
IT402	Bioinformatics	(3-0-0) 3
IT403	Knowledge Management	(3-0-0) 3
IT404	System Integration	(3-0-0) 3
IT405	Data Warehousing & Data Mining	(3-0-2) 4
IT406	Middleware Technologies	(3-0-2) 4
IT407	Computer Vision	(3-0-2) 4
IT408	Pattern Recognition	(3-0-2) 4
IT409	Cloud Computing	(3-0-2) 4
IT410	Wireless Sensor Networks	(3-0-2) 4
IT411	Mobile Adhoc Networks	(3-0-2) 4
IT412	Semantic Web Technologies	(3-0-2) 4
IT413	Virtual Reality	(3-0-2) 4
IT414	Rich Internet Applications	(3-0-2) 4
IT450	Web Services	(3-0-0) 3
IT451	Software Architecture	(3-0-0) 3
IT452	Computer Architecture	(3-0-0) 3
IT453	Transaction Processing	(3-0-0) 3
IT454	Software Quality Assurance	(3-0-0) 3
IT455	Information Technology for Healthcare	(3-0-0) 3
IT456	Enterprise Resource Planning & Systems	(3-0-0) 3

Open Electives (OE)

IT305	Performance Modeling	(3-0-2) 4
IT357	Artificial Intelligence	(3-0-0) 3
IT358	Artificial Neural Networks	(3-0-2) 4
IT359	Fuzzy System Models	(3-0-0) 3
IT405	Data Warehousing & Data Mining	(3-0-2) 4
IT456	Enterprise Resource Planning & Systems	(3-0-0) 3

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL

DEPARTMENT OF INFORMATION TECHNOLOGY (IT)

Bachelor of Technology (IT)

Suggested Plan of Study

Semester →	III	IV	V	VI	VII	VIII
1	MA200	IT250	IT300	IT350	IT440	IT499
2	IT200	IT251	IT301	IT351	IT449	Elective
3	IT201	IT252	IT302	IT352	Elective	Elective
4	IT202	IT290	IT303	IT390	Elective	Elective
5	IT203	Elective	HU300	IT399	Elective	
6	IT204	Elective	Elective	HU302	Elective	
7	Elective	Elective	Elective	Elective		
8				Elective		
9						
10						

Degree Requirements:

Category of Courses	Minimum Credits to be Earned
Basic Science Core (BSC)	16
Engineering Science Core (ESC)	20
Humanities and Social Sciences Core (HSC)	09
Programme Core (PC)	60
Electives: 1) Programme Specific Electives (PSE) ≥ 38 2) Open Electives (OE): 0-12 Credits	50
Minor and Major Project (MP)	10
Mandatory Learning Courses (MLC)	05
Total	**170**

DEPARTMENT OF INFORMATION TECHNOLOGY

Bachelor of Technology (Information Technology)

IT200 DATA STRUCTURES AND ALGORITHMS (3-1-0) 4

Simple Data types and data structures, Concepts of complexity analyses, worst, best and amortized analyses, Linked lists, stacks, queues, arrays; Concepts of Priority Queues, Hash Tables, Sorting, Search Trees, Graphs; Algorithms design concepts like Divide & Conquer, Dynamic Programming and Greedy.

Aho, Ullman and Hopcroft – Data Structures and Algorithms, Addison Wesley
Mark Allen Weiss, Algorithms, Data Structures and Problem solving with C++, Addison Wesley
T.H Cormen, C.E. leiserson and R.L Rivest - Introduction to Algorithms – The MIT Press, Cambridge, Massachusetts, USA, 1990.

IT201 DIGITAL DESIGN AND COMPUTER ORGANIZATION (3-1-0) 4

Combinational and Sequential Circuits, Basics of CPU, CPU Organization, Data Representation. Instruction Sets, Data Path Design, Fixed Point Arithmetic, ALU Design, Memory Organization, Control Design, Input/output Organization.

N. S. Gill, J. B. Dixit, Digital Design and Computer Organization, USP, 2008
Hamaher, V.Carl, Vranesi, Zvonko, Computer Organization McGraw Hill
J.P. Hayes, Computer Architecture and Organization, 3rd Edition, McGraw Hill, 1998
W. I. Fletcher, An Engineering Approach to Digital Design, PHI, 1999.
D.D. Givone, Digital Principles and Design, TMH, 2002

IT202 UNIX PROGRAMMING AND PRACTICE (1-0-3) 3

Introduction to UNIX OS, history, features, architecture, basic utility commands such as cp, mv, mkdir,rm, ls, grep, find, sed, file utility commands, file attributes, ownerships, permissions and other related utility commands, Usage of vi/vim editor, for programming in C/C++, compilers, debuggers, profilers (like gprof), makefiles, IDEs (for Java development like eclipse), Shell and shell programming, process control commands such as ps, nice, at, mesg, cron, etc, Assignments for lab sessions.

Sumitaba Das, UNIX Concepts and Applications
Richard W Stevens, UNIX Network Programming, Prentice Hall PTR
Roderick Smith O'Relly, UNIX Power Tools

IT203 COMPUTER SYSTEMS ORGANIZATION LAB (1-0-3) 3

Design of Adders, Substractors, Encoders, Decoders, Shifters, Counters, Flip-flops, Multiplexers, Simple ALU Design using VHDL, Assembly Level Programming with 80X86.

M. Morris Mano, Digital Design Prentice Hall, India, 2nd Ed
Enoch O. Hwang Digital Logic and Microprocessor Design with VHDL Thomson, India, 2007
D.D. Givone, Digital Principles and Design, TMH, 2002
Douglas Perry, VHDL McGraw Hill International, 1998.

IT204 DATA STRUCTURES AND ALGORITHMS LAB (0-0-3) 2

Implementation of array operations: Stacks, Queues, Circular Queues, Circular Queues, Multiple stacks and queues. Implementation of linked lists: stacks, queues, polynomial operations. Doubly linked lists; Tree traversal: AVL tree implementation, application of trees. Hash Table. Searching and sorting.

Mark Allen Weiss, Algorithms Data Structures and Problem Solving with C++, Addison Wesley

IT205 INFORMATION SYSTEMS (3-0-0) 3

Introduction to IS development, Tools for determining system requirements, Structured analysis and development strategy, Design of files, Introduction to database design, Systems engineering and quality assurance, Managing systems implementation, Hardware and software selection

James A. Senn, Analysis and Design of Information System, 2nd edition, McGraw Hill International Edition
Jeffrey. L. Whitten, Lonnie. D. Bentley, System Analysis and Design Methods 4th Edition. TMH, 2002.

IT206 PARADIGMS OF PROGRAMMING - I (3-0-2) 4

Fundamentals of Object Oriented Programming (OOP): Introduction, Objects and Classes in Java – Methods – Access specifiers – static members – constructors – finalize method – Arrays – Strings - Packages – JavaDoc comments; OOP Inheritance: Inheritance – class hierarchy – polymorphism – dynamic binding – final keyword – abstract classes – Object class – Reflection – interfaces – object cloning – inner classes – proxies; Generic Programming: Motivation for generic programming – generic classes/methods – generic code/virtual machine – inheritance and generics – reflection and generics – exceptions –exception hierarchy – throwing and catching exceptions – Stack Trace Elements -assertions – logging; Concurrent Programming: Multi-threaded programming – interrupting threads – thread states/properties – thread synchronization – thread-safe Collections – Executors – synchronizers – threads and event-driven programming.

Brac J Cox, Object Oriented Programming: An Evolutionary Approach – Addison Wesley Publishing Company.
Cay S. Horstmann, Gary Cornell, "Core Java: Volume I – Fundamentals", 8th Edition, Sun Microsystems Press, 2008.
K. Arnold and J. Gosling, "The JAVA programming language", Third edition, Pearson Education, 2000.
Timothy Budd, "Understanding Object-oriented programming with Java", Updated Edition, Pearson Education, 2000.
C. Thomas Wu, "An introduction to Object-oriented programming with Java", Tata McGraw-Hill, 4th Edition, 2006.

IT250 OPERATING SYSTEMS (3-0-2) 4

Introduction to OS, File systems, CPU Scheduling, Memory management, Disc scheduling, Virtual memory concept, Deadlocks, Concurrent processes, Operating systems security, Case studies – UNIX operating system; Exercises using Linux and / or other OS to practice / simulate: scheduling, memory management algorithms; Concurrent programming; use of threads and processes; kernel reconfiguration, device drivers and systems administration of different operating systems O/S internals: Writing utilities O/S tuning.

Silberschartz and Galvin, Operating System Concepts, Addison Wesley.
Melin Milenkovic, Operating Systems - Concepts and Design, McGraw Hill, New York 1987

IT251 COMPUTER COMMUNICATION AND NETWORKING (3-0-2) 4

Evolution of Data Communication and Networks, Transmission Fundamentals: Signaling Schemes, Encoding and Modulation, Data Transmission over Networks – Switching Techniques, Layered Architecture of Computer Networks, OSI & TCP/IP Architectures and Layers with protocols, Data link Control and Protocols, Error Detection and Correction, Internetworking & Routing, Transport Layer Protocols, Applications: E-Mail, HTTP, WWW, Multimedia; Implementation of Signaling and Modulation, Bit, Byte & Character Stuffing and Error Detection/Correction Coding Techniques, TCP/IP Level Programming, Routing Algorithms, Exercises comprising simulation of various protocols.

Andrew S. Tannenbaum – Computer Networks, Prentice Hall of India, 2nd Edition, 1990
Behrouz A. Forouzan - Data Communications and Networking, 3rd Edition, Tata McGraw Hill, 2002.
William Stallings - Data and Computer Communications, 2nd Edition; Maxwell, MacMillan International Edition, 1989.
Leon, Garcia and Widjaja - Communication Network, 2nd Edition, Tata McGraw Hill, 2002.

IT252 DESIGN AND ANALYSIS OF ALGORITHMS (3-0-2) 4

Brief overview of Functions, Relations and Sets; Models of computation, various performance measures, General techniques of algorithm design, Analysis of different algorithms for sorting and selection, Data structures for efficient manipulation of sets and partition, Efficient Graph algorithms based on Depth first search, Strassen's matrix multiplication algorithm, Efficient algorithms for matrix inversion and LUP decomposition, Modular arithmetic, NP complete problems and approximation algorithms; Exercises to apply & practice the advanced algorithms: graph algorithms, internet algorithms etc. and analyze them.

Aho, Hopcroft and Ullman the design and analysis of Computer Algorithms, Addison Weseley.
Horowitz and Sahni, Fundamentals of Computer Algorithms, Galgotia Publications, 1985.
Baase S., Computer Algorithm Introduction to Design and Analysis, Addison Wesley.
Knuth D.E., The Art of Computer Programming, Vol. I: Fundamental Algorithmsa, Addison Wesley.

IT253 PARADIGMS OF PROGRAMMING - II (3-0-0) 3

Programming domains; Language Evaluation; Programming Paradigms – Imperative, Functional, OOP and Logic programming; Formal methods: syntax and semantics - Backus Naur Form, Attribute grammars; Describing semantics - Denotational semantics; Data types, Names, Variables, Bindings, Scope and lifetime, Referencing Environments; Named Constants-Variable Initialization-Subprograms-Parameter Passing – Coroutines; Even Driven Programming: Fundamentals; Case studies from Desktop to Mobile applications, VB.NET, ANDRIOD Applications; Functional programming languages - Lambda calculus - LISP; Application of functional programming languages; Logic programming languages –introduction to predicate calculus - Horn clauses - Logic programming: Prolog, Applications; Asynchronous Programming Model with a Case study (AJAX, C#...); Run-time Program Management; Virtual Machines: Java Virtual Machine, Common Language Infrastructure, Late Binding of Machine Code, Just-in-Time and Dynamic Compilation, Binary Translation, Binary Rewriting, Mobile Code and Sandboxing, Performance Analysis.

Robert W.Sebesta, "Concepts of Programming Languages", 9th Edition, 2009
Ravi Sethi, "Programming Languages - concepts and constructs", Addison Wesley, 2nd Edition, 1996.
Michael L. Scott, "Programming Language Pragmatics", Morgan Kaufmann, 3rd Edition, 2009.
Kenneth.C.Louden, "Programming Languages: Principles and Practices", 2nd Edition, Thomson Learning.

IT254 COMPUTER GRAPHICS (3-0-2) 4

Computer Graphics Hardware; Scan Conversion: lines, circles, ellipses; Filling Algorithms, Clipping Algorithms, Viewing in 3D: Projections, 2D & 3D transformations, Visible surface determination, Animation of 2D images: Implementation of 2D packages which support graphics editor with classical input techniques and animation.

Hearn and Backer, Computer Graphics Principles and Practice-2nd edition
Van Dam, Foley, Feimer, Hugher Computer Graphics Principles and Practice in C- Addison Wesley

IT255 MICROPROCESSORS AND INTERFACING (3-0-2) 4

Microprocessor history, Microprocessor architecture, 8086, instruction set, subroutines, Programming examples, software development systems, Interrupts, Polling, Daisy chain, RST instructions, Priority encoder, Programmable peripheral devices, 8255, 8253, 8259, 8257, Intel 80386, 80486 & Pentium Processors, Motorola 68000, 68020, 68030 processors, Mother boards, I/o bus, I/O channel, BIOS, DOS PC bus, Multibus I& II, VME and peripheral controllers.

Douglas V. Hall, Microprocessors and Interfacing, 2nd Edition, Tata McGraw-Hill, 2006.
Babby B.Brey, The Intel Microprocessors – Architecture, Programming & Interfacing, Pearson/Prentice Hall, 2008

IT290 SEMINAR (0-0-2) 1

This seminar is a 1 credit mandatory learning course to be completed during 4th semester. Each student will make technical presentation on a topic of academic interest as per recommendations of the DUGC of IT department.

IT300 PARALLEL COMPUTING (3-0-2) 4

Introduction to Parallel Computer Architectures, Parallel Programming with OpenMP, Parallel Programming with MPI, Advanced concepts in MPI, Recent Advances in Parallel Programming techniques like Task, Parallelism using TBB, TL2, Cilk++ etc. and software transactional memory techniques.

J. Dongara, I. Foster, G. Fox, W. Cropp et al, "Sourcebook of Parallel Programming", Morgan Kaufmann.
Barbara Chapman et.al, "OpenMP: Portable Shared Memory Parallel Programming", Scientific & Engg Computation, MIT 2008.
B. Wilkinson and M. Allen, "Parallel Programming: Techniques and Applications", Prentice Hall.
S. Akhter and J. Roberts, "Multi-Core Programming–Performance through Multi-threading", Intel Press, 2006.

IT301 DATABASE SYSTEMS (3-0-2) 4

Basic concepts, Data models and languages, Database design (conceptual and physical), System implementation techniques, Current trends in database system, Distributed databases; Design and Implementation of Database systems or packages for applications such as office automation, hotel management, hospital management; deployment of Forms, Reports Normalization, Query Processing Algorithms in the above application projects; Implementation of few important functionalities of relational database management systems

Raghu Ramakrishnan, Database Management Systems, McGraw Hill, 2000
R. Elmasri and S.B Navathe , Fundamentals of Database Systems, The Benjamin/Cummings Publishing Company, 2000
M. Tamer Özsu, Principles of Distributed Database Systems, Prentice Hall, 1999.
Silberschatz, Korth A.F., Sudarshan S., Database System Concepts, McGraw Hill,2005

IT302 WEB TECHNOLOGIES AND APPLICATIONS (3-0-2) 4

Internet and Web Technology, Infrastructure and tools for Internet Commerce / E-Commerce Current Trends in E-Commerce applications development, Enterprise level E-Commerce: SCM, CRM, EDI, B2Bi, ERP; Exercises to develop web based applications design using client server architecture; CGI programming and middleware exercises; Search engines & e-commerce related exercises; site management & server management and security studies.

Henury Chan et al. E-commerce-Fundamental and applications, John Wiley & Sons, 2002
G. Winfield Treese and Lawrence C.S. Designing Systems for Internet Commerce, Pearson Education, 2002.

IT303 AUTOMATA AND COMPILER DESIGN (3-0-2) 4

Introduction to Compiler Design, Regular Expressions, DFA, NFA, Minimization of states, Lexical analysis, usage of Lex, CFG, BNF notation, PDA, Parsing Techniques, Top-down and bottom-up parsing, Error Recovery strategies, Intermediate Code Generation, Runtime environment, Code Generation and introduction to code optimizations.

Aho, Ullman and Sethi, "Compilers: Priniciples, Techniques, Tools",
Compiler Design in C, Holub

IT304 MULTIMEDIA SIGNAL COMPUTING (3-0-2) 4

Signals in the Physical World, Signals in the Computer: Discrete Signals & Spectra; Discrete Fast Fourier Transforms - FFT Algorithms (DIT, DIF); Discrete Cosine Transforms (DCT); Discrete Wavelet Transforms (DWT); Z-Transform and Convolution; Feed-forward and Feedback Filters; Compression: Audio (MP3), Image (JPEG) and Video (MPEG4).

Ifeachor E C and Jervis B W, "Digital Signal Processing – A Practical Approach", Pearson education, 2002
Michael Stiber and Bilin Stiber, "Signal Computing: Digital Signals in the Software Domain".
J H. McClellan, R W. Schafer, and M A. Yoder, "DSP First: A Multimedia Approach", Prentice Hall, 1999.

IT305 PERFORMANCE MODELING (3-0-2) 4

Performance Evaluation methods. Analytical versus simulation modeling. Performance measurement and benchmarking. Workload modeling. Random variables. Commonly used distributions. Stochastic processes. Markov chain models of computer systems. Queuing models. Discrete event simulation. Simulation Languages. Confidence intervals. Variance reduction techniques. Case studies of analytical & simulation of computer systems.

Raj Jain, The Art of Computer Systems Performance Analysis, Jon Wisely and Sons, New York, USA, 1991.
KS Trivedi, Probability and Statistics with Reliability, Queuing and computer science, PHI 1982.
Paul & Howard, Computer systems performance Evaluation & Prediction, Elsevier, 2005.

IT306 OBJECT ORIENTED ANALYSIS & DESIGN (3-0-0) 3

Introduction to object technology and applications; object oriented decomposition vs. structured decomposition in software development, concepts and applications of object oriented analysis and design, object oriented databases, application development using programming language JAVA

Grady Booch, Object Oriented Analysis and design with applications, Addison Wesley
Michael R. Blaha and James Rumbaugh, Object Oriented Modeling and Design with UML, Prentice-Hall

IT307 ADVANCED COMPUTER NETWORKS (3-0-0) 3

Review of TCP/IP Protocol suit with latest developments, Broadband networks, advanced concepts: ATM, Frame Relay, Fiber Optic Networks: SONET, VOIP, MIPv6 etc., Remote Access and Wireless Networking: Virtual Private Networks - L2 and L3 Switches, Tunneling; BGP and Adaptive Routing, MPLS: QoS, Network Recovery/Restoration; Security Issues in TCP/IP and BGP, DoS/DDoS attacks, Mitigation with recent trends, Cryptography, Intrusion Detection; Network Management issues and protocols, Internet Management, Common Management Information services/protocol (CMIS/CMIP), Network Trouble Shooting, QoS (Integrated/Differentiated Services), Port based Network Access control, Availability, Scalability, Load Balancing and Recent Trends.

James F Kurose and Keith W Rose, Computer Networking, Pearson Education, 2003
Andrew. S. Tannenbaum, Computer Networks, Prentice Hall of India, 2nd Edition, 2002.
M. Subramanian, Network Management: Principles and Practice, Addison- Wesley, 2000.
William Stallings, Data and Computer Communications and Networking, 2nd Edition, TMH, 2002.
Behrouz A Forouzan, Data Communications and Networking, 2nd edition, TMH, 2002.
Leon, Garcia and Widjaja - Communication Networks, TMH 2002.

IT350 SOFTWARE ENGINEERING (3-0-2) 4

Introduction to Software Engineering, Software Development Life Cycle & Various Models, Requirement Engineering, Software Specification, Software Metrics, Software Design, Modular Structure, Object Oriented Software Engineering, Software Testing & Testing Mechanisms, Software Verification & Validation, Verifying Performance & Reliability, Software Cost Estimation Models, Software Development Tools incl. CASE, Software Project Management.

R.S. Pressman, Software Engineering, McGrawHill
Pankaj Jalote, An Integrated Approach to software Engineering, Narosa Pub., 1995
Ian Sommerville, Software Engineering, 5th Edition. Addison-Wesley Publication House, 1997
Bell Morry, and Pugh. Software Engineering Approach. Prentice Hall.
Dr. K.C. Shet. Software Engineering & Quality Assurance. BPB Publications, New Delhi.
Waman S. Jawadekar, Software Engineering- Principles and practice, Tata McGraw Hill

IT351 HUMAN COMPUTER INTERACTION (3-0-2) 4

Foundations: The Human, The Computer, The Interaction and Paradigms; The Process of Developing Interactive Systems: Models, Theories, Design Process and Evaluation; Interacting with Computers: Vision, Graphic Design, and Visual Displays - Touch, Gesture and Marking, Speech, Language and Audition; Psychology and Human Factors: Human Information Processing, Designing to fit human capabilities; Research Trends.

Andrew Sears and Julie A. Jacko, The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications, 2nd Edition, Lawrence Erlbaum Associates (CRC Press, Taylor and Francis Group), New York 2007.
Philip Kortum, HCI beyond the GUI: Design for Haptic, Speech, Olfactory and other Nontraditional Interfaces, Elsevier, 2008.
Alan Dix, Janet Finlay, Gregory D Abowd and Russell Beale, Human Computer Interaction, 3rd Edition, Pearson, 2004.
Ben Shneiderman, Catherine Plaisant, Designing the User Interface: Strategies for Effective HCI, 5th Edition, Pearson, 2009.
J. Preece, Y. Rogers and H. Sharp, Interaction Design: Beyond Human Computer Interaction, 3rd Edition, Wiley, 2011.

IT352 INFORMATION ASSURANCE AND SECURITY (3-0-2) 4

Cryptography, private and public key encryption, uses of encryption; Network Security: threats, controls –encryption, authentication, network security tools (firewalls, intrusion detection); Program security: non-malicious program errors such as buffer overflow, viruses, other malicious code, targeted malicious code, controls against program threats; Protection in operating systems: protected objects, methods of protection, access control, authentication; Web Security; Data security and privacy; Forensics and Incident response; Security Policies and Procedures.

William Stallings, Network Security Essentials, 4/e, Pearson Education, 2008
Atul Kahate, Cryptography & Network Security, McGraw Hill, 2004
Yi Qian et al, Information Assurance–Dependability & Security in Networked Systems, Morgan Kaufmann, 2008.
N. Nedjah, A. Abraham et al, Computational Intelligence in Information assurance and security, Springer 2007.

IT353 PERCEPTUAL AUDIO PROCESSING (3-0-2) 4

Fundamentals of Audio and Speech Processing; Speech and Audio Analysis: Transforms – STFT, DCT; Audio and Speech Compression Standards: MPEG and AAC; Human Auditory Perception; Perceptual Audio Quality Metrics, Perceptual Processing of Digital Speech; Speech and Audio Rendering; Speech and Audio Storage and Retrieval; Applications and Research Trends.

Jacob Benesty, M. Mohan Sondhi and Yiteng Huang, Handbook of Speech Processing, Springer-Verlag, 2008.
A Spanias, T Painter and Venkatraman A, "Audio Signal Processing and Coding", Wiley-Interscience, 2007.
Hugo Fastl and Eberhard Zwicker, "Psychoacoustics: Facts and Models", Springer, 3rd edition, 2006.
Marina Bosi and Richard E. Goldberg, "Introduction to Digital Audio Coding Standards", Springer, 2002.
Ben G, Nelson M, "Speech & Audio Signal Processing: Processing and Perception of Speech and Music", Wiley, 1999.

IT354 PERCEPTUAL VIDEO PROCESSING (3-0-2) 4

Fundamentals of Image and Video Processing; Image and Video Analysis: Image Transforms - DCT, Hadamard, Haar, KL and Wavelets; Image and Video Compression Standards: JPEG, JPEG2000, MPEG1, MPEG2, MPEG4 & MPEG7; Image and Video Rendering and Assessment; Human Visual Perception; Perceptual Video Quality Metrics, Perceptual Coding and Processing of Digital Pictures; Image and Video Storage, Retrieval; Applications and Research Trends.

Perceptual Based Image Processing, Morgan & Claypool, 2009

Al Bovik, "Handbook of Image and Video Processing", Elsevier Academic Press, 2005

H. R. Wu and K. R. Rao, "Digital Video Image Quality and Perceptual Coding", CRC Press, 2005

R. C. Gonzalez and R E Woods, "Digital Image Processing", Pearson Education, 2002

William K Pratt, "Digital Image Processing", Wiley, 2001.

IT355 SOFT COMPUTING (3-0-2) 4

Optimization and Some Traditional Methods and issues, Introduction to Genetic Algorithms, Some Specialized Genetic Algorithms, Introduction to Fuzzy Sets, Fuzzy Reasoning and Clustering, Fundamentals of Neural Networks, Fundamentals biologically inspired computing, Applications and Recent Research Trends.

A. Ghosh, S. Dehuri and S. Ghosh (eds.), Multi-Objective Evolutionary Algorithms for Knowledge Discovery from Databases, ISBN 978-3-540-77466-2, Springer, 2008.

S. Bandyopadhyay and S. K. Pal, Classification and Learning using Genetic Algorithms: Applications in Bioinformatics and Web Intelligence, ISBN 978-3-540-49606-9, Springer-Verlag, Hiedelberg, Germany, 2007.

A. Ghosh, R. K. De and S. K. Pal (eds.), Pattern Recognition and Machine Intelligence, Springer, 2007.

D K Pratihar , Soft Computing , Narosa , 2007.

IT356 GENETIC ALGORITHMS (3-0-2) 4

Robustness of traditional optimization and search techniques, Simple Genetic Algorithms, Similarity templates, goals of optimization, Schema Theorem of John Holland, Computer Implementation and Applications of genetic algorithms, advanced operators and techniques in genetic algorithms, Recent research Trends.

David Goldberg, Genetic Algorithms in search, optimizations and machine learning, Addition Wesley, 1999

Charles L Karr and L Michael Freeman, Industrial applications of Genetic Algorithms, CRC Press 1998.

IT357 ARTIFICIAL INTELLIGENCE (3-0-0) 3

Problem Solving: Solving Problems by Searching, heuristic search techniques, constraint satisfaction problems, stochastic search methods, Game Playing: mini-max, alpha-beta pruning. Knowledge and Reasoning: Building a Knowledge Base: Propositional logic, first order logic, situation calculus. Theorem Proving in First Order Logic.Planning, partial order planning. Uncertain Knowledge and Reasoning, Probabilities, Bayesian Networks. Learning: Overview of different forms of learning, Learning Decision Trees, Neural Networks. Introduction to Natural Language Processing. Applications and Recent Research Trends

Nilsson, Nils (1998). Artificial Intelligence: A New Synthesis. Morgan Kaufmann Publishers

Russell, Stuart J.; Norvig, Peter (2003), Artificial Intelligence: A Modern Approach, Prentice Hall

NPTEL Videos: Artificial Intelligence

IT358 ARTIFICIAL NEURAL NETWORKS (3-0-2) 4

Introduction to Artificial Neural Networks , Artificial Neuron Model and Linear Regression, Gradient Descent Algorithm, Nonlinear Activation Units and Learning Mechanisms, Learning Mechanisms, Associative Memory Model, Statistical Aspects of Learning, Single-Layer Perceptron, Least Mean Squares Algorithm, Perceptron Convergence Theorem, Bayes Classifier, Back Propagation Algorithm, Multi-Class Classification Using Multi-layered Perceptrons, Radial Basis Function Network, Introduction to Principal Component Analysis and Independent Component Analysis, Introduction to Self Organizing Maps, Applications and Recent Research Trends

Simon Haykin, "Neural networks - A comprehensive foundations", Pearson, 2004

Laurene Fausett: "Fundamentals of neural networks: architectures, algorithms and applications", Prentice Hall

James A. Anderson, "An Introduction to Neural Networks", Prentice Hall of India.

Yegnanarayana: "Artificial Neural Networks", Prentice Hall of India,2004.

IT359 FUZZY SYSTEM MODELS (3-0-0) 3

Classical /crisp set, fuzzy sets, Fuzzy numbers, Fuzzy arithmetic, Fuzzy measures, Operations on Fuzzy sets, Fuzzy relations, Multi valued logic, Fuzzy logic, Uncertainty and information, Approximate reasoning, Fuzzy decision making, Fuzzy models, case studies.

Klir and Yuan, Fuzzy Sets and Fuzzy logic, Prentice Hall of India 2001.

Li Xin Wang, A course in fuzzy systems and control, Prentice Hall

J. Yen and R. Langari, Fuzzy logic: Intelligence, control and information, Pearson Education.

IT360 DISTRIBUTED COMPUTING SYSTEMS (3-0-0) 3

Basic concepts - Computer networks, Distributed systems and Computing, Design goals, Fundamental issues and transparencies in DCS, Ordering of events, Ordering of messages and concerned protocols, Global state detection Process synchronization, Process communications, Load balancing techniques.

Mukesh Singhal and Niranjan G. Shivaratri, Advanced Concepts in Operating System, Tata McGraw Hill, 1994.

A.S Tanenbaum and M.V. Steen, Distributed Systems – Principles and Paradigms, PHI.

Randy Chow, Distributed Operating Systems and Algorithms, Addison Wesley.

G.F. Coulouies, J.D. Dollimore and T. Kindberg, Distributed Systems: Concepts & Design, Addison Wesley, 1994.

IT361 ADVANCED DATABASE SYSTEMS (3-0-0) 3

Basic concepts, Buffer management, Query optimization, Selectivity estimation, Concurrency control, Recovery, Database tuning, Distributed databases– principles, architecture, design, query processing, transaction management, Replication, Web databases, Current trends in database system.

M. Tamer Özsu, Principles of Distributed Database Systems, Prentice Hall, 1999.
Ceri S and Pelagatti G, Distributed databases: Principles and Systems, McGraw Hill, 2000.
Thomas Connolly and Carolyn Begg, Database Systems: A practical Approach to Design, Implementation and Management, Pearson Education, 2002.

IT362 INFORMATION RETRIEVAL (3-0-0) 3

Introduction: Basic IR Models, Basic Tokenizing, Indexing, and Implementation of Vector-Space Retrieval, Experimental Evaluation of IR,Query Operations and Languages, Text Representation, Web Search, Text Categorization and Clustering, Recommender Systems, Information Extraction and Integration.

C. D. Manning, P. Raghavan and H. Schütze, Introduction to Information Retrieval, Cambridge University Press. 2008.
Richardo & Bertheir, Modern Information Retrieval, Pearson Education, 2000
Korfhage Robert R, Information Storage and Retrieval, John Wiley & Sons, Inc, 1997.

IT363 SIMULATION AND MODELING (3-0-2) 4

System models and Role of Simulation, Types of Systems, Statistical Tools and Techniques, Discrete Event Simulation Languages, Modeling and Performance Evaluation of Computer Systems, Biological and Sociological System Simulation, Verification and Validation.

A. M. Law and W.D. Kelton, "Simulation Modeling and Analysis", McGraw Hill, 2000
A. M. Law, "Simulation Modeling and Analysis", McGraw Hill, 4th Edition, 2008

IT364 E-COMMERCE (3-0-0) 3

Infrastructure and Tools for E-Commerce, Current Trends in E-Commerce applications development, The Business of Internet Commerce, Enterprise level E-Commerce, Security and encryption, Electronic payment systems, Search engines, Intelligent agents in E-Commerce, On-line auctions, Data mining for e-commerce, Web metrics, Recommender systems, Knowledge management, Mobile e-commerce, Legal, ethical and social issues.

Henry Chan et al., E-Commerce- Fundamental and applications, John Wiley & Sons, 2002
G.Winfield Treese and Lawrence C.S, Designing Systems for Internet Commerce, Pearson Education, LPE, 2002
Fensel, Dieter, Brodie M. L., "Ontologies: A Silver Bullet for Knowledge Management/E-Commerce", Allied Publishers, 2004.
Zimmermann, Olaf; Tomlinson, Mark R.; Peuser, Stefan, Perspectives on Web Services, Allied Publishers, 2004.

IT390 PROFESSIONAL PRACTICE (0-0-2) 1

Invited Lectures by various personalities from industry on various topics like Professional Life, Career Development, Skills required for IT Professionals etc and interface with UG/PG students (who are placed in reputed IT companies) on various aspects of Training and Placement.

IT399 MINOR PROJECT (0-0-3) 2

Design/Experimental/Simulation tasks of relatively minor intensity and scope as compared to the Major Project and in line with the guidelines formulated by the DUGC of IT Department. The Student has to select a project based on the topic of interest. Periodical implementation of the project will be evaluated by the project guide.

IT400 MOBILE COMPUTING (3-0-0) 3

Evolution of Wireless and Cellular Systems; Wireless Propagation: Encoding, Modulation, Multiplexing, and Error Handling Techniques; MAC Layer: Channel Allocation Techniques; Study of Mobile Communication Systems: Infrastructure, Registration and basic Call Establishment & Termination, Handoff, Roaming Support; Threat, Logical Migration, Mobile agents, Security issues.

Kumkum Garg, Mobile computing - Theoory and Practice, 2010
Raj Kamal, Mobile computing, Oxford University Press 2007.
Joschen Schiller, Mobile Communications, Pearson Education, 2003
Dharma Prakash Agarwal & Qing-An Zeng, Wireless & Mobile Systems, CENGAGE, 2nd Edition, 2006.
William Stallings, Wireless Communication & Networks, Prentice Hall of India, 2nd Edition, 2004.

IT401 EMBEDDED SYSTEMS (3-0-0) 3

Embedded system design process: embedded Computing Platform, Program design and analysis for Embedded System, Real Time Operating System for Embedded Systems, Networks: Distributed Embedded Architeture, System on Chip (SOC) and the current trends

David E Silmon, An Embedded Software Printer Pearson Edition Asia, 2001

Wayne Wolf, Computer as Components – Harcort India Pvt. Ltd. 2001

IT402 BIOINFORMATICS (3-0-0) 3

Introduction to Bioinformatics, Biological Databanks, Sequence Analysis, Structure Prediction, Protein Folding, Porteomics, Emerging Areas in Bioinformatics

Krane D.E. & Raymer M.L. Fundamental Concepts of Bioinformatics, Pearson, 2003

Attwood & Parrysmith : Introduction to Bioinformatics Person Ed, 2003

Gibas & Jamnbeck : Developing Bioinformatics Computer Skills, O'Rielly, 2003

IT403 KNOWLEDGE MANAGEMENT (3-0-0) 3

Introduction to knowledge management, Types of Knowledge within an organization. Intellecutal capital. KM Architecture and Tools. ERP for KM. Knowledge sharing tools. Data ware housing, Knowledge strategy creation. KM practice. KM Process. Integrating knowledge sharing and learing, The chief knowledge Officer (CKO) and his/her job. T4raining programmes for organization. widelearing. Making KM work across various segments of industry and business firms. Case studies of KM practices in successful companies, Future challenges in KM

Ratnja Gogula, Knowledge management: A New Dawn, Institute of Chartered Financial Analysts of India, 2002.

IT404 SYSTEM INTEGRATION (3-0-0) 3

ENTERPRISE INTEGRATION DRIVERS, REQUIREMENTS AND STRATEGIES, The Business Imperative for Enterprise Integration. Business Drivers and Requirements. Enterprise Integration Strategy, Enterprise Integration Architecture Overview. Current Integration Architecture Assessment. Technical Integration Architecture, Service Integration Architecture, Information Integration Architecture. Process Integration Architecture, ENTERPRISE INTEGRATION SOLUTIONS. Application Integration. Information Integration, Composite Application Integration. Process-Driven Integration. Best Practices for Enterprise Integration.

B. G. Bernstein and W. Ruh. Enterprise Integration: The Essential Guide to Integration Solutions. Addison-Wesley.

C. Britton and P. Bye, IT Architecture, Middleware: Strategies for Building Large Integrated Systems, Addison-Wesley.

IT405 DATA WAREHOUSING AND DATA MINING (3-0-2) 4

Data Warehousing concepts; Components and building data warehouse. Data Mining – Objectives and examples, data mining process, Data mining techniques, Generalization, Data mining knowledge representation

Raph Kimball Data Warehouse Toolkit, John Wiley

Michael. J. Berry, Gordon Linoff Data Mining Techniques: Marketing, Sales, Customer Support, John Wiley.

IT406 MIDDLEWARE TECHNOLOGIES (3-0-2) 4

Introduction to Middleware Technologies, General Middleware, Service Specific Middleware, Client/Server Building blocks: RPC, Messaging – P2P, Java RMI, Computing standards, OMG, Introduction to CORBA, EJB and .NET, XML Technologies - XML, DTD, XSD, XSLT, XQUERY, XPATH, Web Services and SOA.

G. Sudha Sadasivam "Distributed Component Architecture", Wiley India Edition.

Thomas Erl "Service Oriented Architecture: Concepts , Technology & Design", Prentice Hall

G. Brose, A Vogel and K. Duddy, "Java programming with CORBA", 3rd Edition, Wiley India John Wiley and Sons

Ed Roman, "Mastering Enterprise Java Beans", John Wiley & Sons Inc.

IT407 COMPUTER VISION (3-0-2) 4

Concept of application of computer vision, functional architecture of a vision system visual sensory model and camera calibrative, processing tools, 3D vision, 3D representative schemes, High level vision and navigation.

Sonka M., Hlavac V., Boyle R., "Image Processing Analysis and Machine Design". PWS Publishers

Ballard D., brown C., "Computer Vision", Prentice Hall

Bratt W., "Digital Image Processing", John Wiley & Sons

IT408 PATTERN RECOGNITION (3-0-2) 4

Pattern and features. Pattern recognition approaches. Discriminant functions. Statistical pattern recognition, Gaussian model. Parametric estimation. Bayesian parameter estimation, pattern.classification by distance functions Cluster analysis, Syntactics pattern recognition. Features extraction and recent advances.

Earl Gose, Richard Johnsonbaugh, Steve Jost, Pattern Recognition and Image Analysis, Prentice Hall 1999.

Duda RO and Hart PE, Pattern Classification and Scene Analysis,. Wiley 1973.

IT409 CLOUD COMPUTING (3-0-2) 4

Introduction to Cloud Computing, Cloud Computing Delivery Models, Open Source and Industry Case Studies of Cloud (Apache VCL, Amazon, IBM and Eucalyptus), Introduction to Map/Reduce and Apache Hadoop Programming models for cloud computing and examples/applications, Virtualizations as an enabler for cloud computing infrastructure.

Cloud Application Architectures" by George Reese, O'Reilly Publications, 2009
"Cloud Security and Privacy", Tim Mather, Subra Kumaraswamy, O'Reilly, 2009
The Hadoop – Definitive Guide, Tom White, O'Reilly, 2009.

IT410 WIRELESS SENSOR NETWORKS (3-0-2) 4

Introduction to wireless communication networks and wireless sensor networks, Network architecture and design principles, MAC and link layer protocols, Topology control in WSN, Routing protocols, Information aggregation, Information storage and query, Localization, Security issues, Applications and recent trends: Wireless multimedia sensor networks.

Wireless sensor networks: An information Processing Approach by F. Zhao and L. Guibas, Elsevier/Morgan-Kaufmann, 2004.
Adhoc and Sensor Networks: Theory and Applications by Carlos de Morais Ciordeiro nad Dharma Prakash Agrawal, World Scientific Publications, 2006.

IT411 MOBILE ADHOC NETWORKS (3-0-2) 4

Mobile ad hoc networking; imperatives, challenges and characteristics, Bluetooth networks, Routing approaches, Proactive and reactive protocols. Clustering and hierarchical routing, Multipath routing, Security aware routing, Energy efficient communication in ad hoc networks, Measuring energy consumption, Power save protocols, Maximum life time routing, Secure routing protocols, Intrusion detection, Security considerations in ad hoc sensor networks, Key management, Characterization of IP traffic, QOS classification, Self similar processes, Statistical analysis of non – real time traffic and real – time services.

C.S. Murthy & B.S. Manoj, AdHoc Wireless Networks, Pearson
T.Janevski, Traffic Analysis and Design of Wireless IP Networks, Artech House
Ozan K. Tonguz & Gianluigi, Adhoc Wireless Networks, Wiley.

IT412 SEMANTIC WEB TECHNOLOGIES (3-0-2) 4

Introduction to the Semantic Web – What is Semantics; Syntax, Structure and Semantics, Layered Cake Architecture; Structured Web Documents and Resource Description Framework – Understanding content, Metadata, metadata standards, XML + metadata specification, RDF and metadata processing; Programming with RDF/XML; Web Ontology Language (OWL) - Ontology, Domain Modeling, Logic, Inferencing, Context; Logic Reasoning for the Semantic Web - Classification and semantic metadata extraction techniques: statistical, statistical learning/AI, lexical and natural language, knowledge based; Programming with Ontology; Semantic Applications - demonstrating power of semantic technology for services, search, personalization, contextual directory and custom/enterprise applications; next generation semantic content management, Review of some of the active projects (e.g., SHOE, OntoBroker, InfoQuilt) and initiatives (OntoWeb, DAML) and Recent Trends.

Pascal Hitzler et al, Foundations of Semantic Web Technologies, Chapman & Hall, 2009.
Karin Breitman et al, Semantic Web: Concepts, Technologies and Applications, Springer, 2010.
Grigoris Antoniou and Frank van Harmelen, A Semantic Web Primer, The MIT Press, 2nd Edition, 2008.
John Hebeler, Matthew Fisher, Ryan Blace, Andrew Perez-Lopez, Semantic Web Programming, Wiley, 2009.

IT413 VIRTUAL REALITY (3-0-2) 4

Introduction to Virtual Reality Technology and its effectiveness in Real-Time Applications, Scientific Visualization, Input Devices: Trackers, Navigation and Gesture Interfaces; Output Devices: Graphics, 3D Sound and Haptic Displays; Computing Architectures for Virtual Reality, Modeling, Virtual Reality Programming, Human Factors in Virtual Reality; Overview of Virtual Humans, Face Cloning & Face Motion Capture/Analysis and Research Trends.

Gerard Jounghyun Kim, Designing Virtual Reality Systems – The Structured Approach, Springer-Verlag, 2005.
N Magnenat-Thalmann and D Thalmann, Handbook of Virtual Humans, Wiley, 2004.
L. J. Hettinger, M W. Haas, Virtual & Adaptive Environment: Apps, Human Performance, Lawrence Erlbaum, 2003.
Grigore C Burdea and Phillippe Coiffet, Virtual Reality Technology, John Wiley, 2003.

IT414 RICH INTERNET APPLICATIONS (3-0-2) 4

Web2.0 concepts, SaaS model, Evolution of Web 2.0, Web Programming concepts, HTML, XHTML, CSS, Javascript. JS Execution Environment, Overview of XML, Web Services, Building Rich Internet Applications, AJAX, XML HTTP Object, ActionScript, Products from Industry like Flex (Adobe), Flash/AIR (Adobe)., Silverlight (MS), JavaFX (SUN), OpenLazzlo technologies, Recent Trends.

Robert Sebesta: "Programming the World wide web", Pearson Education, Third Edition
Nicholas C Zakas et al: "Professional AJAX", Wrox publications, 2006
Chafic Kazoun: "Programming Flex 2", O'Reilly publications, 2007
Colin Moock: "Essential Action script 3.0", O'Reilly Publications, 2007
Steven Holzner : "Ajax Bible" Wiley India edition, 2007
Justin Gehtland et al: "A Web 2.0 primer Pragmatic Ajax", SPD Publications, 2006.

IT440 PRACTICAL TRAINING 1

The Student has to undergo a practical training programme or carrying out a research/practical oriented project or any equivalent training programme fixed by the DUGC of IT department. This practical training will be done during vacation period (4-8 wks) before the evaluation semester. Final evaluation is based on the report/seminar by the student.

IT449 MAJOR PROJECT – I (0-0-3) 2

The Student has to select a project based on a topic of interest. This project work will be commencing in VII semester and continued in VIII semester, at the end of each semester, the project work will be evaluated internally and externally.

IT450 WEB SERVICES (3-0-0) 3

Basic concepts, Enabling Infrastructure, Core functionality and standards, Service semantics, Web service composition, Service development and recent research trends.

Alonso G, Casati F, "Web Services - Concepts, Architectures and Application Series: Data-Centric Systems and Applications" 2004
S Weerawarana et al, "Web Services Platform Architecture: SOAP, WSDL, WS-Policy and More", Prentice Hall, 2005.
Thomas Erl, Service-Oriented Architecture: Concepts, Technology, and Design, Prentice Hall Publication, 2005.
R. Allen Wyke et-al, XML Programming, WR Publishers, ISBN: 81-7853-064-3
J2EE Web Services, Richard Monson-Haefel, Pearson (LPE), 2005.

IT451 SOFTWARE ARCHITECTURE (3-0-0) 3

Definition and overview of software architecture, The architecture business cycle: what influences software architects, Different Architectural styles, Architecture description language, Understanding and achieving quality attributes, Attribute-driven design, Documenting/Evaluating Software Architecture and its reuse, Case studies and Recent Trends.

Mary Shaw, David Garlan, "Software Architecture", Prentice Hall ,India, 2000
Bass, Len; Paul Clements, Rick Kazman, Software Architecture In Practice, Second Edition. Addison-Wesley, 2003.
Clements, Paul et al, Documenting Software Architectures: Views and Beyond. Addison-Wesley, 2003.

IT452 COMPUTER ARCHITECTURE (3-0-0) 3

Flynn's Classification, RISC Vs CISC, Data and control flow, Pipelining: Linear and non linear, pipeline hazards, instruction scheduling, Branch handling techniques, Arithmetic pipeline, VLIW architecture, Superscalar processors. Instruction level Data-Parallel architectures: SIMD architectures, Systolic and Vector architecture; MIMD architectures, Systems interconnect architecture: Network properties/routing, Static/dynamic interconnection networks. Multiprocessor architectures, models of memory consistency, cache coherence/directory protocols.

Dezso Sima, Peter Karsuk, Advanced Computer Architectures: A Design Space Approach, Addison-Wesley.
K.Hwang and F.A. Briggs, Computer Architecture and Parallel Processing, McGraw Hill Publication.
J. Hennesy and D. Patterson, Computer Architecture –A Quantitative Approach, Morgan Kaufmann, 2003

IT453 TRANSACTION PROCESSING (3-0-0) 3

Introduction and need of transaction processing, online transaction process (OLTP), OLTP program design, OLTP and system Reliability, OLTP and CICS standards in OLTP, current trends.

Gary McClain, OLTP handbook, McGraw Hill, 1997.

IT454 SOFTWARE QUALITY ASSURANCE (3-0-0) 3

Overview of Software Engineering. Requirement Engineering Analysis, software reliability. Definition and concepts of software reliability, software quality. Introduction to software quality principles, total quality management, Quality Assurance Standards. ISO 9000 Tick-It method. Miscellanious Issues: Software maintenance. Future OF SQA

John J. Marciniak, Encyclopedia of Software Engineering. - Vol. I & II. John Wiley & Sons, 1994.
Ince Darrel. ISO 9001 and Software Quality Assurance. McGraw Hill, 1994
Pankaj Jalote, An Integrated Approach to Software Engineering Narosh Publications, 1995
Isabel Evans, Achieving software Quality through team work, Allied publishers, 2004.

IT455 INFORMATION TECHNOLOGY FOR HEALTHCARE (3-0-0) 3

Evolution of IT Enhanced Healthcare, Internet Technologies in Telemedical Systems, Wireless Systems in E-Health, Decision Support Systems in Medicine, Health Telematics Networks, Computer Aided Diagnosis and Recent Trends.

Krzysztof Zielinski, Mariusz Duplaga and David Ingram, IT Solutions For Healthcare, Springer, 2006
Robert E Hoyt, Nora Bailey, Ann Yoshihashi, Health Informatics, 5th Edition, Lulu Publishers, 2012
Kevin Beaver, Healthcare Information Systems, Auerbach Publications, 2nd Edition, 2002.

IT456 ENTERPRISE RESOURCE PLANNING & SYSTEMS (3-0-0) 3

ERP: Needs, Models, Commercial ERP Packages, Client Server and Open Technology Solutions, Supply Chain Management-Issues, Drivers and Obstacles, Coordinating SCM and ERP in E-Business

Vinod Kumar G & N.K. Venkitakrishna, ERP- Concepts and Practice, PHI, 1998
Sunil C & Peter-SCM – Strategy and Planning and Operation, Pearson Education, LPE, 2002
Pete Loshin, Paul A. Murphy, Electronic Commerce, A JAICO Book.

IT499 MAJOR PROJECT – II (0-0-9) 6

The Student has to select a project based on a topic of interest. This project work will be commencing in VII semester and continued in VIII semester, at the end of each semester, the project work will be evaluated internally and externally.

Basic Science Core (BSC)

MA110	Engineering Mathematics-I	(3-0-0)3
PH110	Physics	(3-1-0)4
PH111	Physics Lab	(0-0-2)1
MA111	Engineering Mathematics-II	(3-0-0)3
CY110	Chemistry	(3-0-0)3
CY111	Chemistry Lab	(0-0-3)2

Engineering Science Core (ESC)

EE110	Elements of Electrical Engineering	(3-0-0)3
ME110	Elements of Mechanical Engineering	(3-0-0)3
CO110	Computer Programming	(3-1-0)4
CO111	Computer Programming Lab	(0-0-2)1
EC110	Elements of Electronics and communication Engineering	(3-0-0)3
AM110	Engineering Mechanics	(3-0-0)3
ME111	Engineering Graphics	(1-0-3)3
AM201	Mechanics of Solids	(3-0-0)3
AM217	Mechanics of Solids Lab	(0-0-2)1
AM317	Fluid Mechanics & Machinery Lab	(0-0-2)1

Humanities and Social Science Core (HSC)

HU110	Professional Communication	(3-0-0)3
HU300	Engineering Economics	(3-0-0)3
HU302	Principles of Management	(3-0-0)3

Programme Core (PC)

ME201	Basic Engineering Thermodynamics	(3-1-0)4
ME202	Fluid Mechanics and Machinery	(3-1-0)4
ME203	Mechanics of Machines	(3-1-0)4
ME204	Basic Manufacturing Process	(3-1-0)4
ME205	Materials Science and Metallurgy	(3-0-0)3
ME206	Engineering Drawing	(1-0-3)3
ME207	Workshop Practice	(0-0-3)2
ME250	Applied Thermodynamics	(3-1-0)4
ME251	Analysis & Design of Machine Components	(3-1-0)4
ME252	Manufacturing Technology	(3-0-0)3
ME253	Machine Drawing	(1-0-3)3
ME301	Design of Mechanical Drives	(3-1-0)4
ME302	Metrology	(3-0-0)3
ME303	Metrology & CAD Lab	(0-0-2)1
ME304	Mechanical Lab-I	(0-0-2)1
ME350	Heat Transfer	(3-1-0)4
ME351	Machine Dynamics and Vibrations	(3-1-0)4
ME352	Machine Shop-I	(0-0-3)2
ME401	Mechanical Lab-II	(0-0-2)1
ME402	Machine Shop-II	(0-0-3)2

Programme Specific Electives (PSE)

ME210	Computer Aided Engineering	(3-0-0)3
ME211	Mechanical Behavior of Engg. Materials	(3-0-0)3
ME212	Mechanical Measurements & Instrumentation	(3-0-0)3
ME213	Fuels And Combustion	(3-0-0)3
ME214	Metal Cutting and Press Working	(3-0-0)3
ME310	Measurements In Thermal Systems	(3-0-0)3
ME311	Hydraulic and Pneumatic Control	(3-0-0)3
ME312	Synthesis of Mechanisms	(3-0-0)3
ME313	Internal Combustion Engines	(3-0-0)3
ME314	Mechatronics System Design	(3-0-0)3
ME315	Turbo-machines	(3-0-0)3
ME316	Theory of Elasticity	(3-0-0)3
ME317	Energy Engineering	(3-0-0)3
ME318	Manufacturing Technology of Plastics	(3-0-0)3
ME319	Mechanics of Compressible Fluids	(3-0-0)3
ME320	Automobile Engineering	(3-0-0)3
ME321	Quality Control	(3-0-0)3
ME322	Automatic Control Engineering	(3-0-0)3
ME323	Human factors in Engineering Design	(3-0-0)3
ME324	Product Development & Prototyping	(3-0-0)3
ME325	Manufacturing and Design of MEMS	(3-0-0)3
ME326	Refrigeration Technology	(3-0-0)3
ME410	Non Conventional Energy sources	(3-0-0)3
ME411	Pollution Control & Environmental Management	(3-0-0)3
ME412	Operations Research	(3-0-0)3
ME413	Microprocessors and PLC	(3-0-0)3
ME414	Advanced I.C. Engines	(3-0-0)3
ME415	Fracture Mechanics	(3-0-0)3
ME416	Cryogenics	(3-0-0)3
ME417	Applied Finite Element Method	(3-0-0)3
ME418	Composite Materials	(3-0-0)3
ME419	Propulsion	(3-0-0)3
ME420	Mechanical Vibration & Acoustics	(3-0-0)3
ME421	Theory of Plasticity	(3-0-0)3
ME422	Automation systems	(3-0-0)3
ME423	Nuclear Energy	(3-0-0)3
ME424	Industrial Tribology	(3-0-0)3
ME425	Engineering Acoustics	(3-0-0)3
ME426	Applied Computational Methods in Mechanical Sciences	(3-0-0)3
ME427	Collaborative Manufacturing	(3-0-0)3
ME428	Air-conditioning Technology	(3-0-0)3
ME429	Welding Technology	(3-0-0)3
ME430	Advanced Machine Design	(3-0-0)3
ME431	Flexible Manufacturing Systems	(3-0-0)3
ME432	Design of Solar Energy Systems	(3-0-0)3
ME433	Energy Audit and Management	(3-0-0)3
ME434	Experimental Stress Analysis	(3-0-0)3
ME435	Modeling & Simulation of Engineering Systems	(3-0-0)3
ME436	Data Base Management Systems	(3-0-0)3
ME437	Production and Operations Management	(3-0-0)3

Open Electives (OE)

ME341	Mechatronics	(3-0-0)3
ME342	Environmental Pollution Control	(3-0-0)3
ME343	Fluid Power Control	(3-0-0)3
ME344	Condition Monitoring and Predictive Maintenance	(3-0-0)3
ME441	Nuclear Science & Engineering	(3-0-0)3
ME442	Micro System Technology	(3-0-0)3
ME443	Product Design and Manufacturing	(3-0-0)3
ME444	Solar Energy	(3-0-0)3
ME445	Energy Management	(3-0-0)3

Programme Major Project (PMP)

ME449	Major Project –I	(0-1-3)3
ME499	Major Project –II	(0-1-9)7

Mandatory Learning Courses (MLC)

CV100	Environmental studies	(1-0-0)1
HU111	Professional Ethics and Human values	(1-0-0)1
ME440	Practical Training	(0-0-2)2
ME490	Seminar	1

Bachelor of Technology in Mechanical Engineering

Suggested Plan of Study

Sem →	III	IV	V	VI	VII	VIII
1	ME201	ME250	ME301	ME350	ME440	ME490
2	ME202	ME251	ME302	ME351	ME449	ME499
3	ME203	ME252	HU302	HU300	Elective	Elective
4	ME204	ME253	Elective	Elective	Elective	Elective
5	AM201 / ME205	ME205 / AM201	Elective	Elective	Elective	Elective
6	ME206	Elective	Elective	Elective	Elective	Elective
7	----	---	Elective	Elective	Elective	Elective
8	AM217 / ME207	ME207 / AM217	ME303 / ME352	ME352 / ME303	ME401 / ME402	ME402 / ME401
9	--	--	AM317 / ME304	ME304 / AME317	--	--

Degree Requirements:

Category of courses	Minimum credits to be earned
Foundation courses (45-55): Basic Science core Engineering Science core Humanities and Social science core	50
Programme core(≥60):	60
Programme Electives(≥50): Programme electives: 39 credits (min) Open Electives: 0-12 credits	51
Major Project (MP)(: (8-12)	10
Mandatory Learning Courses (MLC) (5-6):	5
Total:	176

ME110 ELEMENTS OF MECHNICAL ENGINEERING (3-0-0) 3

Module-1: Introduction to Mechanical Engineering, Emerging trends & its role, Mechanics in Mechanical Engineering:

Module-2: Materials and Stresses: Mechanical design concept, Types of drives, Friction and wear

Module-3: Prime movers, Introduction to refrigeration, centrifugal pumps and compressors. Sources of energies: conventional and renewable.

Module-4: Manufacturing Processes: Basic processes like machining, casting, forging etc. welding, brazing and soldering. Manufacturing Systems

Module-5: Introduction to Mechatronics, electro-mechanical elements, working principles, construction and their applications (Sensors & actuators).

An introduction to Mechanical Engineering, J.wickert, Cengage learning, 2nd edn. 2006

Gopalkrishna K.R., Mechanical Engineering Sciences. Subhas Publications, Bangalore.1999

Roy and Choudhary, Elements of Mechanical Engineering. Media Promoters and Publishers, Bombay, 1975

Gupta, P.N., and Poona, M.P., Elements of Mechanical Engineering. 4th Edition, Standard Publications Ltd; 2009.

ME111 ENGINEERING GRAPHICS (1-0-3) 3

Orthographic Projections of points, Straight lines, Planes, Solids (Auxiliary Plane Method and Change of position method), Isometric Projections.

Gopalkrishna K. R, Engineering Graphics (Ist angle projection) Subhas Publication, Bangalore, 1999.

Bhat N. D., Engineering Drawing, Charotar Publication,1991.

ME200 WORKSHOP (0-0-2) 1

Fitting, Carpentry, Demonstration of Welding & Soldering.

Hajara H.K. and Choudhary Workshop Practice vol I, Media Promoters and Publishers, Bombay, 2007

Workshop Technology, Choudhary and chapman, Viva publications,1996.

ME201 BASIC ENGINEERING THERMODYNAMICS (3-1-0) 4

Fundamental Concepts, system, temperature, Heat and Work, I law and II law of Thermodynamics, applications, Pure substance, Entropy, Available and unavailable energy , Analysis of cycles, Helmoltz and Gibbs Functions and its applications, Ideal and Real gases, Non reactive mixtures, properties of air and water vapour.

Spalding and Cole, Engineering Thermodynamics, ELBS Edition Longmans,1987.

Arora C.P. Thermodynamics, TMH, 1998.

Gordan J. Van Wylen and Richard E.Sountag, Fundamentals of Classical Thermodynamics, 4th Edition, Wiley, 1994.

P. K. Nag, Basic and Applied Thermodynamics, Tata McGraw Hill. 3rd Edition, 2005.

ME202 FLUID MECHANICS AND MACHINERY (3-1-0) 4

Fundamentals of fluid properties, pressure measurement, hydrostatic forces on surfaces, Buoyancy and floatation, Kinematics of fluid flow, Fluid dynamics, Compressible flow, gas nozzles, Flow of real fluids, Boundary layer theory, Flow around immersed bodies, Flow through pipes, Impact of jets, Hydraulic Machines, pumps, Turbines, Hydraulic systems.

Kumar K.L. Fluid Mechanics, Eurasis Publishing House, New Delhi, 1995.

Yahya S.M., Turbomachines, Satya Prakashan, New Delhi, 1972.

F .M. White, Fluid Mechanics, Springer-Verlag. New York. 1999.

ME 203 MECHANICS OF MACHINES (3-1-0) 4

Basics of Machines – Link pair mechanism inversions etc. Velocity and Acceleration, Static force analysis, Inertia forces in machines, Synthesis of Mechanics, Type number and dimensional system, Coupler curves.

R.L. Norton, Design of Machinery, McGraw Hill Boston, 1999.

E.J. Hearn, Mechanics of materials, Volume 1, B.H. Publications vol I, Pergamon press, 1991

H.H. Mabe and C.F. Rainbotten, Mechanism and Design, John Wiley, 1967.

Arthur G. Erdman, George N, Sandor, Mechanism Design –Analysis and Synthesis, Vol. I, Prentice Hall, New Jersey, 1984.

ME 204 BASIC MANUFACTURING PROCESS (3-1-0) 4

Metal joining process: Gas Welding, Arc Welding, Advanced Welding processes, Welding defects, Brazing Soldering Metal removal Processes: Introduction to machine tools and classification, Lathe, Drilling Machine, Shaping Machine, Milling Machine, Advanced machine tools. Metal casting processes, special casting processes, casting defects, rising and gating design, solidification mechanisms, melting practices.

Ghosh and Mallick, Manufacturing Science, Prentice hall PTR, 2001.
Paul Degramo, Materials and Processes in Manufacturing, 9th edition, John Wiley & Sons, 2003.
Rao P. N, Manufacturing Technology. Vol I and II 2nd Edition TMH, 2001.

ME205 MATERIAL SCIENCE AND METALLURGY (3-0-0) 3
Structure & properties of Engineering materials, Solidification, Alloys and Phase diagrams, Iron carbon equilibrium diagram, Heat treatment of ferrous and non-ferrous alloys, Testing of Engineering materials, Fracture and failure of materials, An introduction to Advanced Engineering materials.
Avner H., Introduction to Physical Metallurgy– McGraw Hill, New York, 1987.
Raymond A. Higgins, Engineering Metallurgy –Part 1: Applied Physical Metallurgy, ELBS, London, 1988.
Callister W.D., Material Science and Engineering-An Introduction, John Wiley & Sons, Inc., New York, 2003.

ME206 ENGINEERING DRAWING (1-0-3) 3
Screw Thread forms and Threaded fasteners, Rivetted joints, Section of Solids, Development of Surfaces Othographic views with sections, Intersection of Solids.
Gopalkrishna K. R., Engineering Graphics, Subhas Publications, Bangalore, 1999.
Gopalkrishna K. R, Machine Drawing, Subhas Publications, Bangalore, 1985.
Bhat N. D, Engineering Drawing, Charotar Publishing House, Anand, India, 1991.
Bhat N. D, Machine Drawing, Charotar Publishing House, Anand, India, 1984.

ME207 WORKSHOP PRACTICE (0-0-3) 2
Fitting, Carpentry, Study and demonstration of hand tools in sheet metal working and foundry, Sheet metal models, Foundry models, Press working equipments, Wood working: Wood working and wood turning tools and models. Use of Power tools, Welding & Plumbing.
Hajara and Choudhary, Workshop technology vol.I &II, Median promotors & publishers, Bombay.
Khanna O. P, Workshop Practice Vol. I, Dhanpat Rai & Co , 2000.

ME210 COMPUTER AIDED ENGINEERING (3-0-0) 3
Fundamental of CAD- Hardware and software requirements, methods of modeling- wire frame, surface, solid modeling and feature based modeling, Analytic and synthetic cure entities, Parametric representation of curves and surfaces, NURBS, Computer graphics: display, transformation, visualization, animation, graphics standards, translators. Product Design : Mass property calculations, assembly modeling, Finite element methods. Product Manufacturing: Part programming, CNC machine tool and control system.
Ibrahim Zeid, Mastering CAD/CAM, TMH publishing company ltd, New Delhi, 2007.
P. N. Rao, CAD/CAM Principles and Applications2nd Edition, TMH education, 2007.

ME211 MECHANICAL BEHAVIOR OF ENGINEERING MATERIALS (3-0-0) 3
Simple flexure theory, Bending stress and shearing stress distribution across sections, Macaulay's method for deflection of statically determinate beams. Compound stresses - Analytical Method, Graphical Method – Mohr's Circle. Torsion, Transmission of Power through hollow and solid shafts. Beams of Uniform strength, Springs, combined bending & Torsion, Strain energy. Thick and Thin pressure vessels
Singer, F.L. Strength of Materials, 3rd Edition, Harper and Row Publishers, New York, 1980.
Hearn, E.J., Mechanics of Materials, Pergaman Press, England, 1972.
Beer and Johnston E. R. Mechanics of Materials, 3rd Edition, Tata McGraw Hill, New-Delhi, 2007.

ME 212 MECHANICAL MEASUREMENTS AND INSTRUMENTATION (3-0-0) 3
Scope nad methods of measurements, generalized measuring system, sensors transducers detailed classification and principles, static characteristics, signal conditioning and input circuitry, read out devices, measurement uncertainties and error analysis, strain gauge theory, construction, installation, strain gauge for stress and strain analysis. measurement of force, pressure, torque by variety of principles. temperature measurement. heat flux, sensors, flow measurement. dynamic characteristics of instruments and transducer, mathematical representation and response analysis of zero , first and second order systems and time response specification. accelerometers and vibro meters, theory and characteristic of seismic type.
Ernest O. Doebelin, Measurement Systems – Application Design, McGraw Hill International Edition-1990.
TG Beckwith, NLBuck and RD Marangoni, Mechanical Measurements, Indian Student Edition, Narosa Publishing House, 3rd Ed., 1987.
D. V. S. Murty, Transducers & Instrumentation, Ist Ed., 2nd printing, Prentice Hall of India Pvt. Ltd, 1995.
JP Holman, Experimental methods for engineers, Mc Graw-Hill book, 6th Ed.1994.
RS Sirohi and HC Radha Krishna, Mechanical measurements, Wiley Easter Ltd., 2nd Ed., 1983, India
R Raman, Principles of Mechanical measurements Oxford and IBH Pub, 2nd Ed., 1997, India

ME213 FUELS & COMBUSTION (3-0-0) 3

Fuels for SI and CI engines, solid, liquid and gaseous fuels, Octane and Cetane rating method, Combustion equipments, combustion stoichiometry, Combustion phenomenon in the SI engines, combustion knock, factors affecting the combustion knock, Control of knock, Combustion chamber designs for SI engine, Combustion phenomenon in the CI engines, Delay period and Diesel knock, Factors affecting delay period, Combustion chamber designs for CI engines, Use of alternate fuels.

E.F. Obert, Internal Combustion Engine, International Textbooks & Co, 3rd Edition, 1968.
Jhon B. Heywood, Internal Combustion Engine fundamentals, McGraw Hill, 1st Edition 1988.
P.M. Heldt., High Speed Combustion Engines, Oxford & IBH publishing co, Calcutta, 1965.
Chandra Mohan and S.P. Sharma, Fuels and Combustion, Tata McGraw Hill, New Delhi, 1984.

ME214 METAL CUTTING AND PRESS WORKING (3-0-0) 3

Orthogonal and Oblique cutting, Tool geometry and Machining parameters, Mechanics, Force and Temperature measurements, Surface Integrity, Tool Wear, and tool life, Machinability, Types of presses, Dies and punches, Force calculations, Design principles, Economics of machining.

G. Boothryod, Fundamentals of Metal cutting and Machining, TMH, 1975.
B. L. Juneja and Shekon G. S., Fundamentals of Metal cutting and Machine Tools; 2nd Edition, New Age International publishers, 2003.
P. N. Rao, Manufacturing Technology.2nd edition, TMH, 2001.
ASME Metals Hand Book. 9th edition, 1989.
Taylor, Metal cutting, 3rd edition, ASME, 1907.

ME250 APPLIED THERMODYNAMICS (3-1-0) 4

Compressors, reciprocating and rotary, Steam nozzles and steam turbines, Air standard cycles, Vapour power cycles, Gas turbine cycles, performance testing of IC engines, Refrigeration cycles, vapour absorption system, Psychrometric processes.

Arthur G. Erdman, George N, Sandor, Mechanism Design –Analysis and Synthesis, Vol. I, Prentice Hall,New Jersey, 1984.
Holman J. P., Thermodynamics, McGraw Hill International Student Edition. Newyork, 1969.
Rajput R.K, Thermal Engineering, Laxmi Publications (Pvt) LTd., NewDelhi. 6th Edition , 2007.
Eastop and McConkey, Applied Engineering Thermodynamics, ELBS, 1995.

ME 251 ANALYSIS AND DESIGN OF MACHINE COMPONENTS (3-1-0) 4

Design of shafts, keys and coupling, Variable and Impact loading, structural loading, springs, cam follower mechanism Synthesis of mechanism, collar and pivot friction, Design of power screws, Design of shafts, coupling and clutch, lubrication, selection of journal & roller Bearings.

R.L. Norton – Machine Design, An integrated approach, Pearson Education Asia, 2000.
J.E. Shigley and Mische, Mech. Engineering Design, Tata Mc Graw Hill -2003.

ME252 MANUFACTURING TECHNOLOGY (3-0-0) 3

Milling machine, advanced machine tools, Grinding and Micro-finishing operations, Non Traditional Machining Operations and analysis, Sheet Metal Forming, Dies, Jigs and Fixtures.

Ghosh and Mallick, Manufacturing Science, Prentice Hall PTR, 2001
Paul Degramo, Materials and Processes in Manufacturing, 9th Edition, John Wiley & sons, 2003.
Rao P. N, Manufacturing Technology Vol I and II, 2nd Edition, TMH education, 2006.
P .K Mishra, Non Conventional Machining, 6th Edition Narosa Publishing house, 1997.

ME253 MACHINE DRAWING (1-0-3) 3

Machine components done using conventional drawing board and AutoCAD, Assembly drawing from working drawing: Swivel bearing, Machine Swivel vice, Tool head of shaper, Tailstock, Fuel pump, Fuel Injector, Rams bottom safety valve, Stop valve, Blow-off cock, Screw Jack, Centrifugal pump. Part drawing from assembly drawing: Foot step bearing, Eccentric, connecting rod, square tool post, Drill jig, Feed check valve.

Bhat N. D, Machine Drawing, Charotar Publishing House, Anand, India, 1984.
Gopalkrishna K. R. Machine Drawing, Subhas Publication, Bangalore, 1999.
Narayana K. L, Kannaiah P, Venkat Reddy K, Machine Drawing 3rd Edition, New Age International Ltd, 2006.
Goutam Pohit, Goutam Ghosh, Machine drawing with AutoCAD, Pearson Education, 2007.

ME270 THERMODYNAMICS AND FLUID MECHANICS (3-1-0) 4

Laws of thermodynamics, Concept of entropy, Air standard efficiencies and MEP representation on P-V and T-S diagrams, Compressor. Reciprocating, Use of compressors in Mining equipment, Fluids: Definition and properties, Ideal and real fluids, Pressure and its measurement for liquids. Dynamics of fluid flow, Flow in pipes, Centrifugal and reciprocating pumps.

Nag, P.K., Thermodynamics, Tata Mc Graw Hill, 2002.
Kumar, K.L, Engineering fluid mechanics, Eurasia, 3rd Edition, 1984.
Eastop and McConkey, Applied Engineering Thermodynamics, ELBS, 1995.

ME301 DESIGN OF MECHANICAL DRIVES (3-1-0) 4

Belt, rope and chain drives, theory of gearing and forces on gears design of gears, design of industrial gear drives, Design standards, Optimization and reliability principles in Engineering Design, Human factors in Engineering design.

Shegley J.E. and Vicker J.J, Theory of Machines and Mechanisms, McGraw Hill, 1981.
Rajendra Karwa, A Text book of Machine Design, Laxmi Publications, 1989.
Sanders and McCormick, Human factors in Engineering Design, McGraw Hill book company, 7th Edition, 1993.

ME302 METROLOGY (3-0-0) 3

Standards, Errors in measurement, calibration, Linear, angle measurement, Quality control fundamentals, Standard deviation, normal curve pattern of variations, control charts for variables, Comparators, Limits and Tolerances, statistical aspect of tolerances and setting tolerances, Surface finish terminology and measurement, Optical measuring instruments; Measurement of screw thread and Gear elements, Acceptance test for machines.

I.C. Gupta, Engineering Metrology, Dhanpat Rai Publications, New Delhi, 1994.
Grant, Statistical Quality Control, Mc Graw Hill Publication. 6th Edition, 1988.

ME303 METROLOGY AND CAD LAB (0-0-2) 1

Metrology Lab: Linear and angular measurement, measurement using slip gauges, Calibration, Screw thread and gear tooth parameter measurement, Tool makers microscope, surface measurement, comparators, acceptance test on lathe. CAD Lab: Graphics programming, drafting techniques, solid modeling practices.

I.C. Gupta, Engineering Metrology, Dhanpat Rai Publications, New Delhi, 1994.
Ibrahim Zeid, Mastering CAD/CAM, TMH publishing company ltd, New Delhi, 2007.

ME304 MECHANICAL LABORATORY-I (0-0-2) 1

Determination of Fuel properties, Calibration of pressure gauge, Performance of IC Engines.

Mathur and Sharma, Internal Combustion Engines, Dhanpath Rai and Sons. New Delhi, 8th Edition, 1996.

ME310 MEASUREMENTS IN THERMAL SYSTEMS (3-0-0) 3

Measurement of specific heat, Viscosity, Thermal Conductivity, Thermal diffusivity, Heat flux, Calorific value, Thermal and solar radiation measurements, Gas composition analysis by Orsat apparatus, Gas Chromatograph, Infra-red analyzer, Mass Spectrometer, Turbulence measurements using hot wire anemometer, laser Doppler anemometer. Measurements in controlled environments, Mass transfer measurements, Shadowgraph, Schlieren and Interferometer, High speed Photography, Data acquisition and processing, Analysis of experimental data.

Landis, Lab experiment and demonstration in fluid mechanics and heat transfer. Dept of Mechanical Engg, school of Engg & science, New York University, 1964..
Sotoukhim and Afgan, Measurement techniques in heat and mass transfer-Hemisphere, New York, 1985.
Eckert and Goldstein, Measurements in heat transfer –hemisphere, Pub Corp, 2nd Edition, 1976.
Beckwith and Buck, Mechanical Measurements – Addison Wesley publishing company, 3rd Edition, 1982.
Doeblin, Measurement Systems Application and Design – Mc Graw Hill education, 5th Edition, 2003.

ME311 HYDRUALIC AND PNEUMATIC CONTROL (3-0-0) 3

Introduction, Circuit Symbols, Fluid Pumps and Motors, Control Valves, Servo Systems, Design consideration of Circuits, Pneumatic Compressors and their Working Principles, Hydro-Pneumatics, Fluidics, Principles of Pneumatic circuit design, Maintenance of Circuits, K-V Diagrams and Electrical Controls in Pneumatic Circuits, PLC control of hydraulic and pneumatic systems.

Esposito A.P., Fluid Power, Pearson Education Asia, 2005.
Text Book of Hydraulics and Pneumatics, Festo Didactic, 4th Edition, 2001.
Andrew Parr, Hydraulics and Pneumatics, Jaico Pub, 2000.
S.R. Majumder, Pneumatic Systems – Principles and Maintenance, Tata McGraw Hill Co. 15th Edition, 2006.

ME312 SYNTHESIS OF MECHANISMS (3-0-0) 3

Introduction, tasks of Kinematics Synthesis, Type synthesis, Tools of dimensional synthesis, Graphical synthesis: Motion generation-two and three prescribed motions, Path generation – three prescribed positions, prescribed timings, four positions without prescribed timings, Function Generator: Three prescribed points, Introduction to Analytical synthesis, Standard Dyad form, three prescribed positions for

motion, path and function generation, circle, point and center-point circles, Freudenstein's equations for three point function generation, order synthesis, coupler curves for four-link, slider-crank and inverted slider-crank mechanisms, Application of coupler curves in design of six-link mechanism, Coupler cognate mechanisms.

Arthur G. Erdman, George N, Sandor, Mechanism Design –Analysis and Synthesis, Vol. I, Prentice Hall, New Jersey, 1984.
A.H Soni, Mechanism Synthesis and Analysis, McGraw Hill, 1984.
Robert L. Norton, Design of Machinery- An Introduction to the Synthesis and Analysis of Mechanisms, WCB Mc Graw Hill, Boston, 1999.

ME313 INTERNAL COMBUSTION ENGINES (3-0-0) 3

Fuel-air cycles, Actual cycles, Combustion in SI engines, Stages of combustion, Flame propagation, SI combustion chambers, Combustion in CI engines, Delay period, CI engine combustion chambers, Carburetion, Fuel injection, Ignition, Engine friction and lubrication. Engine cooling, Testing and performance.

M.L Mathur & R.P Sharma, A Course in Internal Combustion Engine, Dhanpat Rai & Sons, New Delhi, 2001
John. B. Heywood, Internal combustion engine fundamentals, McGraw Hill, 1st Edition, 1988.
E.F Obert, Internal combustion engines, Addision Wesley, 3rd edition, 1968,
C.F.Taylor, The Internal combustion engines theory and practice, Vol.I&II,MIT press. Cambridge, MA, 1966.
V.Ganesan, Internal Combustion Engines, McGraw-Hill, 1995.

ME314 MECHATRONICS SYSTEM DESIGN (3-0-0) 3

Introduction to Mechatronics system, Modeling and simulation of physical system, Sensors and transducers, Signals systems and control, Actuating devices, Modeling of systems, system response, transfer function and frequency response, feedback and intelligent systems, Microprocessors and Microcontrollers, Mechatronics system design, Applications in Mechatronics

Botton W., Mechatronics 3rd Ed, Pearson Education Ltd. Indian print, 2003.
N.P.Mahalik, Mechatronics, TMH publishing Co. Ltd, New Delhi India, 2003.
Bradley D. A, Mechatronics, Chapman & hall, London, 1997.
H. M .T Hand Book, Mechatronics, TMH Publication, 1997.

ME315 TURBO MACHINES (3-0-0) 3

Dimensional analysis and principle of similitude, Terminology of aero foil and its importance in Turbomachines, Energy transfer between fluid and rotor, Thermal analysis in Turbomachines, Potential flow through cascades of blades, 3-dimensional viscous and compressibility effects, Power absorbing machines: Compressors, blower, and fans. Power producing machines: Hydraulic, steam and gas Turbines.

D. G Shephard, Principles of Turbomachinery, McMillan Co., New York, 1956.
G. T Csanady, Theory of Turbomachines, Mc Graw Hill 1964.
Yahya S.M, Turbomachines, Satya Prakashan, New Delhi, 1972.
H. Cohen and Rogers, Gas Turbines Theory, Longman Green Co., Ltd, 5th Edition, 2001.

ME 316 THEORY OF ELASTICITY (3-0-0) 3

Components of stresses, equations of equilibrium, principle stresses and Mohr's diagram in three dimensions, boundary conditions, strain components, compatibility equations, stress-strain relation and the general equation of elasticity, formulation of elasticity problems, existence and uniqueness of solution, Saint-Venant's principle, principle of super-position and reciprocal theorem, Airy's stress function to solve two dimensional problem, stresses in thin disk and long cylinder, torsion of prismatic bars, soap film analogy, membrane analogy and elastic stability.

Wang C.T., Applied Elasticity, Mc-Graw Hill Book Company, New York, 1953
Timoshenko and Goodier, Theory of Elasticity, Mc-Graw Hill Book Company, 2nd Edition, 1951.
T.G. Sitharam, Applied Elasticity, Interline publishing, 2008.
L. S. Srinath, Advanced Mechanics of Solids, Tata Mc-Graw Hill Book Company, 3rd Edition, 2009.

ME317 ENERGY ENGINEERING (3-0-0) 3

Conventional Energy Sources: Hydel, Steam, Gas turbine, Diesel and Nuclear Power Plant, Layout, function of different components and types, Power plant Economics, Non-conventional or Renewable energy sources: Solar energy, application of solar energy, Wind, Ocean, Geothermal, Biomass Energies, Energy Conversion Principles and types.

Houghton E.L., Carruthers, Aerodynaimcs for Engineers studentents, Butterworth-Hinemann Ltd., 2006
Sukathme S.P., Solar Energy Principles of Thermal Collection and Storage, 2nd Ed., TMC New Delhi,1984
M.M.El.Wakil, Power Plant Techniques, McGraw Hill, New York, 1985.

G.D. Rai, Non-Conventional Energy, Dhanpat Rai & Sons, New Delhi, 1998

ME318 MANUFACTURING TECHNOLOGY OF PLASTICS (3-0-0) 3

Structure and basic properties of plastics, Design criteria, Structural Design Analysis, Processing: Model Building, Molds and dies, Process Control, Inspection, Injection molding, Extrusion, Inline post forming, Blow molding, Extrusion blow molding, Forming, Auxiliary Equipment and secondary operations, testing of quality Control, Design features that influence performance.

Donald V. Rosato, David P. DiMattia and Dominick V. Rosato, Designing with Plastics and Composites, Van Nostrand Reinhold, NY, 1991.
A.S Athalye, Plastics Materials Handbook, Multi-tech publishing Co. Bombay, 1995.
N.J Mills, Plastics, Microstructure and Engineering Applications, Edward Arnold, London, 1993.
R. J. Crawford, Plastics Engineering, Butterworth-Heinemann 3rd Edition, 1998

ME319 MECHANICS OF COMPRESSIBLE FLUIDS (3-0-0) 3

Recapitulation of fundamentals: Navier Stokes equations, aerofoil theory, boundary layer separation criterion. Introduction to compressible flow, velocity of sound and Mach number, Isentropic flow, flow with friction and heat transfer, Analysis of flows with normal and oblique shock waves, Supersonic flows, Unsteady flows.

S. M. Yahya; Fundamentals of Compressible Flow, Wiley Eastern Ltd, New Delhi, 1989.
Cambel and Jennings, Gas Dynamics, Mc Graw Hill. New York, 1958.
B.T. Nijaguna, Thermal Science/Engineering data Hand Book, 1st Edition, Allied Publishers Ltd, New Delhi, 1992.
Balachandran P., Fundamentals of Compressible Fluid Dynamics, Eastern Economy Edition, Prentice Hall of India. New Dekhi, 2006.
White F.M., Fluid Mechanics, McGraw Hill, Singapore, 1999.

ME320 AUTOMOBILE ENGINEERING (3-0-0) 3

Automotive Chassis Layout, Frame and body Construction, I.C. Engine Construction and Components. Engine Cooling and Lubrication System, Fuel Supply System for petrol and diesel Engine, Ignition System, Clutches, Transmission System, Drive Line System, Steering System, Suspension and Shock Absorber System, Braking System, Automotive Electrical System, Maintenance, Engine Testing, Servicing and Repair.

Heitner Joseph, Automotive Mechanics, East West Press, 2nd Edition, 1974.
Crouse, Automotive Mechanics, Mc Graw Hill, 6th Edition, 1970.
K.M. Gupta, Automobile Engineering, Umesh Publications. New Delhi, 2001.
Kirpal Singh, Automobile Engineering, Standard Pub, 8th Edition, 1999.
N.K. Giri, Automotive Mechanics, Khanna Pub. New Delhi, 2004.

ME321 QUALITY CONTROL (3-0-0) 3

Fundamentals of quality control, Statistics, probability theory. Control charts for variables and attributes. Acceptance Sampling, Classifications and their applications, Statistical aspects of tolerances and setting of tolerances, Reliability and factors associated with reliability.

Mahajan, Statistical Quality Control, Dhanpat Rai & Sons, 2001.
Grant, Statistical Quality Control, McGraw- Hill Publications, 1946.
Duncans, Quality Control & Industrial Statistics, Irwin Press, 5th edition, 1986.
B.L. Hanan & Prabhakar M. Ghare, Quality Control & Application, Prentice hall, 1987.

ME322 AUTOMATIC CONTROL ENGINEERING (3-0-0) 3

Overview of feedback control, mathematical models of dynamical systems, linear time invariant systems, transfer function, time and frequency response of a system, stability analysis, Feedback systems, concept of root locus, dynamic compensation, PID control, state space representation of dynamical systems.

Gene F. Franklin et.al., Feedback control of dynamic systems, Pearson Ed. Asia, 1998.
K. Ogata, Modern Control engineering, Pearson Ed, 2002.
Harison and Boilinger, Introduction to Automatic Control System, John Wiley Publication, 1976.
G. V. Reklatis, A. Ravindran, and K. M. Ragsdell, Engineering Optimization: Methods and applications, Interscience, 1983.

ME323 HUMAN FACTORS IN ENGINEERING DESIGN (3-0-0) 3

Introduction, Information input, Human output and control, workspace and arrangement, Environment, Human factor applications in system design, Human error and work, Case studies.

Sanders and McCormick, Human factors in Engg Design, Mc Graw Hill Book Co, 5th edition, 1982.
Christopher D.Lackers, John D.Lee, Yili Lin, Sallie Gordon-Becker, Introduction to Human factors engineering, Prentice Hall, 2003.

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Neville A. Stantaon, Paul M, Salmon, Guy H. Walker and Chris Baber, Human factor methods, A practical guide for Engineering and Design, Ashgate publishing, 2005.

ME324 PRODUCT DEVELOPMENT AND PROTOTYPING (3-0-0) 3

Generic process of Product Development, Concept generation, selection and Testing, CAD applications in Testing, Virtual Prototyping, Product Architecture, Industrial Design and Design for manufacturing, Design considerations, Design for production, Metal and Plastic components, Optimum Design, Rapid Prototyping Technologies.

Karl T. Ulrich and Steven D. Eppinger, Product Design and Development, Mc Graw Hill, 2000.
A. K. Chitale and R. C. Gupta, Product Design and Manufacturing, PHI Pvt. Ltd, 2002.

ME325 MANUFACTURING AND DESIGN OF MEMS

Introduction to electromechanical systems and MEMS, Micro sensors and Micro actuators, Scaling and Material Issues, Micro fabrication techniques, Electro mechanics, Design of MEMS and Design realization tools. Packaging of MEMS.

J J Allen, MEMS Design, Taylor and Francis 2005
Tai Ran Hsu, MEMS and Microsystems-Design and Manufacture, TMH 2002
Nadim Maluf, An Introductionn to MEMS Engg, Artech House 2004
Stephen D Senturia, Microsystem Design, Springer 2001
Marc J Madou, Fundamentals of Microfabrication, CRC Press 2nd Ed 2002
Menz, Mohr and Paul, Microsystem Technology, Wiley VCH 2001

ME326 REFRIGERATION TECHNOLOGY (3-0-0) 3

Refrigerants, Refrigeration Cycles, Air cycle refrigeration, Vapour compression system, multi pressure system, Cascade refrigeration, Vapour absorption system, Dry ice manufacturing, Ejector refrigeration system, Decicant cooling system, Pollution by refrigerants. Use of solar energy, low grade energy to run the refrigeration system, (Use of Refrigeration data handbook permitted in examination).

Arora C. P, Refrigeration and Air Conditioning, Tata McGraw- Hill Company Limited, New Delhi, 1981.
Manohar Prasad, Refrigeration and Air conditioning, Wiley Eastern Limited, New Delhi, 1983.
Manohar Prasad, Refrigeration & Air conditioning Data Hand Book. Wiley Eastern Ltd, New Delhi, 1989.
Refrigeration/Thermodynamics/Heat transfer/Air conditioning data hand book.

ME328 MACHINE DESIGN (3-1-0) 4

Fundamentals: Hooke's law, Elastic constants, Shear force and bending moment diagram, Bending equation, Beam deflection, Compound stress and Mohr's circle, working stresses, modes of mechanical failure, stress concentration, fatigue, Soderberg equation, members subjected to steady and alternating loads. Shafting, ASME design of transmission shafts, keys, design of square and rectangular key joints, welded joints, modes of failure, strength and efficiency of the joint, Springs: stresses in coil springs of round and square, deflection of coil springs, design of compression and tension springs. Flexible machine elements: Flat belt, V belt drives rope drives, Gears: spur, helical, bevel, worm gear, nomenclature, Lewis equation, Lewis form factor, design based on strength dynamic and wear loads, Bearings: mechanism of fluid film lubrication, Journal bearing, rolling contact bearing.

K. Mahadevan and K. Balaveera Reddy, Design and data book (SI Units) 2nd Edition, CBS publishers & distributors, 1984.
V.B.Bhandary, Design of Machine Elements, Tata Mc Graw Hill, New Delhi, 2nd Edition, 2007.
Robert. L. Norton, Design of Machinery, Mc Graw- Hill International, 1992.

ME 341 MECHATRONICS (3-0-0) 3

Introduction, Synthesis of mechanism and manipulators, Different sensors and its applications, Actuators, Hardware components for Mechatronics, Basic component modeling and system modeling, Applications in Mechatronics.

Botton W., Mechatronics 3rd Ed, Pearson Education Ltd. Indian print, 2003.
N.P.Mahalik, Mechatronics, TMH publishing Co.Ltd, New Delhi India, 2003.
Bradley D A, Mechatronics, Chapman & hall, London, 1993.
Dean C. Karnopp, Donald L Margolis, Ronald C. Rosenberg, System Dynamics, Modeling and Simulation of Mechatronics Systems, Wiley-Interscience, 3rd Edition, 1999.

ME 342 ENVIRONMENTAL POLLUTION CONTROL (3-0-0) 3

Sources and classifications of Air pollutants, Air pollution, Air Quality, characteristics and their ill effects, Meteorology and economic effects of Air pollution, Management of Air quality, Air pollution sampling procedures and measurements, Methods of control and equipments used. Air pollution due to automobiles, smoke and its control, control of gaseous contaminants, Sources and classification of water pollutants, waste water sampling and analysis, waste water treatment, Solid waste management, Noise and odor pollution.

C.S. Rao, Environmental pollution control Engineering, Wiley Eastern Ltd, 1994.
Howard.S Peavy, Donald R Rowe & George Tchobanoglous, Environmental engineering, McGraw Hill Intnl. Edition, 1986.
S.P Mahajan, Pollution control in process industries, Tata McGraw Hill, 1985.
W.L. Faith, Air pollution control, John Wiley & sons Inc, New York, 1959.
Henry. C. Perkins, Air Pollution, McGraw Hill Book company, 1974.
K.V.S.G. Murali Krishna, Air Pollution and Control, Kaushal & Co 1995.

ME 343 FLUID POWER CONTROL (3-0-0) 3

Contents: Introduction, Components of hydraulic and Pneumatic control system, Energy and power in hydraulic systems, hydraulic pumps, cylinders and motors, Hydraulic circuit design and analysis, Electrical controls for fluid power circuits, Introduction to PLC.

Anthony Esposito, Fluid power with applications, Pearson Education, 6th Edition, 2003.
Herbert E Merritt, Hydraulic Control system, John Wiley Inc, 1967.
Basic and Electro Hydraulics and Pneumatics, Festo Didactic Series, 7th Edition, 2003.
S. R. Majumdar, Pneumatic Systems, T.M.H, 1996.

ME344 CONDITION MONITORING AND PREDICTIVE MAINTENANCE (3-0-0) 3

Mechanical vibration theory, A review, Theory of vibration measuring instruments, Maintenance methods, machinery diagnostics and predictive maintenance, condition monitoring parameters, methods, Machine health prediction using vibration monitoring, machihe signature, vibration standards, vibration analysis, Case studies, Predictive maintenance using wear debris analysis, Case studies.

R. A. Collacott, Vibration monitoring and diagnosis, George Godwin Ltd London, 1979
W. T. Thomson, Theory of Vibration with application, Prentice Hall, Eaglewood cliffs, 4th edition, 1993
B. S. Prabhu, Condition monitoring and condition based maintenance ISTE New Delhi, 1997.
H. P. Garg, Industrial Maintenance, 3rd Edition, S Chand & Company ltd, 1987

ME350 HEAT TRANSFER (3-1-0) 4

Introduction, Conduction Heat transfer, Insulation, Fin theory, Convection Heat transfer, Natural and Forced flow inside and outside tube, two phase heat transfer, Boiling and condensation, Heat exchangers, Radiation heat transfer (Non participating media), Introduction to mass transfer.

Nicati M. Ozisik, Heat Transfer a Basic Approach, McGraw Hill Publication, 1985.
Holman J. P., Heat Transfer, McGraw Hill Publication, 8th Edition, 1996.
C. P. Arora, Engineering Heat Transfer, Khanna Publishers, India, 1996.
Frauk P Incropera, Fundamentals of Heat and Mass tranfer, John Wiley and sons, Fifth Edition, 2002.

ME351 MACHINE DYNAMICS AND VIBRATIONS (3-1-0) 4

Balancing of Machines, Whirling of shafts, Free damped and forced vibrations, Review of Basic theory of Vibration, Theories of Vibration measuring instruments, free damped and torsional vibration, Torsional vibration for single and multi degree freedom system.

W.T. Thomson, Theory of vibration with Application, 4th Edition, Prentice hall, Eagle wood cliffs, 1993.
M.K. Groover, Mechanical Vibration, PHI Publication, 1996.
J.E. Shigley and John Joseph Vicker, Theory of Machines and Mechanism, 3rd Ed. TMH, 1995.
Robert L. Norton, Design of Machinery, McGraw- Hill Inc, 3rd Editions, 2003.

ME352 MACHINE SHOP – I (0-0-3) 2

Study and Demonstration of different Lathes for various jobs, different cutting tools and different Lathe operations, Marking, Centre drilling, Facing, Taper turning, Grooving, knurling, Profile turning, Drilling, Boring, Thread cutting, Eccentric turning.

Hajara and Choudhary, Workshop Technology Vol.I &II, Median Promoters & publishers, Bombay.
Khanna O. P, Workshop Practice Vol.I, Dhanpat Rai & Co., 2000.

ME401 MECHANICAL LABORATORY- II (0-0-2) 1

Heat transfer experiments, Performance analysis of Compressors, Blowers, Boilers, Refrigerators and Air Conditioning equipments, Dynamics of Machinery experiments.

C. P. Arora, Engineering Heat Transfer, Khanna Publishers, India, 1996.
J.E. Shigley and John Joseph Vicker, Theory of Machines and Mechanism, 3rd Ed. TMH, 1995.
Manohar Prasad, Refrigeration and Air conditioning, Wiley Eastern Limited, New Delhi, 1983.

ME402 MACHINE SHOP - II (0-0-3) 2

Demonstration of Machine tools and Power tools, Practice on Shaper, Milling Machine, Cylindrical and Surface Grinding, Slotter, Drilling Machines, etc. Programming for CNC Machines,

Hajara and Choudhary, Workshop Technology vol.I &II, Median Promoters & publishers, Bombay.
Khanna O. P, Workshop Practice Vol.I, Dhanpat Rai & Co., 2000.

ME410 NON CONVENTIONAL ENERGY SOURCES (3-0-0) 3

Different Forms of Energy, Energy resources, Renewable & Non-renewable energy resources, Energy scenario of India and World. Solar energy and its applications, Wind energy, Ocean energy, wave, tidal and ocean thermal energy conversion, geothermal energy, Biomass energy, biogas, biomass gasification system, direct energy Conversion: Thermoelectric, Thermo ionic, solar cell and Magneto-Hydrodynamic conversion Systems, Hydrogen production and Utilization.

P.D.Dunn, Renewable Energies: Sources, Conversion and Application, P.Peregrinius Ltd, London, 1986.
J.W.Twidell and A.D.Weer, Renewable Energy Sources, ELBS, 2nd Edition, Taylor & Francis, 2006.
S. Rao and B. B.Parulekar, Energy Technology- Non conventional, Renewable and Conventional 3rd Edition, Khanna Pub, 1999.
B.T. Nijaguna, Biogas Technology, New Age International Pub, 2002.

ME 411 POLLUTION CONTROL AND ENVIRONMENTAL MANAGEMENT (3-0-0) 3

Air pollution, Air quality, Definitions, Characteristics and perspectives, classification of pollutants, Their ill effects, Air quality management concepts, Meteorology and natural purification processes, Air pollution sampling and measurement, Air pollution control methods and equipment, Control of specific gaseous pollutants, Pollutants from automotive engines, Legal and necessity of legislation, Sources and classification of water pollutants, Wastewater sampling and analysis, Wastewater treatment, Solid waste management, Noise and odor pollution.

C.S Rao, Environmental pollution control Engineering, Wiley Eastern Ltd, 1994.
Howard. S Peavy, Donald R Rowe & George Tchobanoglous, Environmental Engineering, McGraw Hill Intnl. Edition, 1986.
S.P. Mahajan, Pollution control in process industries, Tata McGraw Hill, 1985.
W.L. Faith, Air pollution control, John Wiley, 1959.
Henry. C. Perkins, Air Pollution, Mc Graw Hill, 1974.
K.V.S.G Murali Krishna, Air Pollution and Control, Kaushal & Co, 1995.

ME412 OPERATIONS RESEARCH (3-0-0) 3

Definition, Formulation of LPP, Graphical Solutions, Simplex Algorithms, Sensitivity Analysis, Maximization Application, Transportation, Traveling Salesman Problems, Dynamic Programming, Game Theory, Solution Methods, Dominance Concept, Approximation Method, Waiting Line Theory, Poisson Arrival Rate, Exponential Service Times, System Characterization and Economy, Simulation, Steps, Applications and Limitations, Monte Carlo Technique, Waiting Line Situations, Networks: CPM and PERT Analysis, Total, Free and Independent Float, Network Crashing, Non-Linear Programming.

S.D. Sharma & H. Sharma, Operations Research- Theory, Methods & Applications- Kedarnath & Ramnath Publishers, 2002.
Taha H.A., Operations Research – An Introduction, 7th Edition, Prentice Hall Pub, 2002.
Shambling and Stevens, Operations Research – Fundamental Approach. McGraw-Hill Inc, US, 1974.

ME413 MICROPROCESSORS AND PLC (3-0-0) 3

PLC Architecture, General PLC programming procedure, basic PLC functions, Data Handling, Intermediate Functions, Analog PLC Operation, Networking PLCs, PID control of continuous processes, Microprocessor programming and interfacing, Case Studies on applications in manufacturing.

John W. Webb & Ronald A. Reis, Programmable Logic Controllers – Principles and Applications, Prentice Hall India, 2003.
Alan J. Crisper, PLC and their Engineering Applications, McGraw Hill Pub, 1996
Douglas Hall, Microprocessor & Interfacing - Programming and Hardware, 2nd Edition, Tata McGraw Hill Pub, 2002.

ME 414 ADVANCED I.C. ENGINES (3-0-0) 3

Engine types, Engine design and operating parameters, Thermo chemistry of fuel-air mixture, Properties of working fluids, Characteristics of flames, Combustion stoichiometry, First law and Second law of thermodynamics applied to combustion, Chemically reacting gas mixtures, Unburned mixture composition, Combustion charts, gas exchange processes, Fuel injection system, Combustion in SI Engine and CI engine, Engine heat transfer, friction and lubrication, Measurement and testing of power and emissions, Heat balance, Supercharging and turbo charging of IC engines.

John.B.Heywood, Internal combustion engine fundamentals, McGraw Hill, 1st Edition, 1988.
E.F Obert, Internal combustion engines, Addison Wesley, 3rd Edition, 1968.
V.Ganesan, Internal combustion engines, 2nd Edition, TMH Education, 2002.
C.F.Taylor, The internal combustion engines theory and practice, vol. I & II, MIT press, 2nd Edition, 1985.
Colib R, Furguson, Internal Combustion Engine, Applied Thermosciences, John Willey and Sons, 2004.

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ME 415 FRACTURE MECHANICS (3-0-0) 3

Introduction, Mechanics of Elastic fracture, Quasi- Elastic fracture, combined flow and fracture, Crack and craze nucleation, fracture under repeated loading, crack arrest, crack stability.

A.G.Atkins and Y.W. Mai, Elastic and Plastic Fracture, 1st Ed, Ellis Horwood Ltd, 1985.

David Broek, Elementary Engineering Fracture Mechanics, Sijthoff & Noordhoff International Publishers, Netherlands, 1978.

J.F. Knott, Fundamentals of Fracture Mechanics, Butterworths, 1973.

ME416 CRYOGENICS (3-0-0) 3

Liquefication of permanent gases, Methods of air liquefaction, separation, storage and transport, applications, Properties of solids and liquids at cryogenic temperatures, Cryogenic Insulation, Vacuum technology cryo pumping, Cryogenic heat pipe, Applications of cryogenic engineering in various fields, Food preservation process, Cryogenic Instruments.

R.B. Scott, Cryogenics Engineering, Van Nostrand & Co, 1962.

Randall F. Barron, Cryogenic Systems, McGraw Hill, New York, 1966

Arora C. P., Refrigeration and Air Conditioning, Tata McGraw Hill Company Limited, New Delhi, 1981.

Refrigeration/Thermodynamics/Heat transfer/Air conditioning data hand book.

ME 417 APPLIED FINITE ELEMENT METHOD (3-0-0) 3

Variational formulation, Ritz method, one-dimensional FEM, Finite element modeling of Beams, trusses and frames, Two dimensional formulation, plane stress/ strain for triangular and rectangular model, Solution techniques, alternative formulation, Applications of FEM, Programming for FEM.

R.D. Cook, D.S. Malkus, M. E.Plesha, R. J.Witt., Concepts and application of Finite Element Analysis, 4th Edition, John Wiley and Sons, 2002.

Singiresu S. Rao, The Finite Element method in Engineering, Elsevier, 2005.

J. N. Reddy, An Introduction to Finite Element method, 3rd Edition, McGraw- Hill, 2005.

Zienkiewicz O. C, Finite Element Method in Engineering Sciences, McGraw-Hill, 1971.

ME418 COMPOSITE MATERIALS (3-0-0) 3

Basic concepts and characteristics: Definition and characteristics of composite materials, overview of advantages and limitations of composite materials, Significance and objectives, Sciences and technology, Types and classification of typical composite materials, current status and future prospects, Micromechanical and Macro mechanical Behavior of a Lamina, Macro mechanical Behavior of a laminate, Processing of Polymer Matrix, Metal Matrix and Ceramic Matrix Composite Materials, Testing of Composite Materials.

R.M. Jones, Mechanics of Composite materials; Mc Graw- Hill Kogakush Ltd., Tokyo, 1975.

Isaac Daniel and Ori Ishai, Engineering Mechanics of Composite Materials, Oxford University press, New York, 1994.

M.W. Hyer, Stress analysis of fiber reinforced composite materials, WCB, Mc Graw -Hill, Boston, 1998.

P.M. Mallick, Fibre Reinforced composites: Materials, Manufacturing and Design, Marcel Dekker, Inc, New York, 1998.

J.W. Wheeton, D.M. Peters and K.L. Thomas, Engineers' Guide to Composite Materials, ASM International, Ohio, 1986.

ME419 PROPULSION (3-0-0) 3

Reaction principles, essential features of propulsive devices, momentum theory applied to propulsive devices, operating performance and equilibrium running conditions, augmentation of thrust, ramjet engine, rocket engines.

Zucrow N.J, Principles of Jet propulsion and gas turbine, John Wiley, New York, 1970.

Mathur M.L and Sharma R.P, Gas Turbines and Jet and Rocket Propulsions, Standard Publishers, New Delhi, 1988.

Nijaguna B.T, Thermal Science/Engineering Data and Book, 1st Edition, Allied Pub. Ltd. New Delhi, 1992.

ME420 MECHANICAL VIBRATION & ACOUSTICS (3-0-0) 3

Importance and scope, Single DOF systems, Free, damped, forced vibration, Two DOF system, Multi DOF systems, Eigen values and vectors, numerical solutions, Continuous systems, non linear systems. Theory of vibration measuring instruments, Vibration reduction methods, Fundamentals of acoustics, Plane wave, prorogation, radiation and scattering, effect of noise on human, acoustics measurement, Noise reduction methods.

W.T.Thomson, Theory of Vibration with application, 5th Edition, Prentice Hall, 2001.

Kinsir L. E & Fray A. R, Fundamentals of acoustics, 3rd Edition, Jon Wiley & Sons, 1982.

Philip M .Morse, Vibration and Sound, 2nd Edition, McGraw- Hill, 1948.

Lyon R. C, Machine Noise and Diagnostics, Butterworths, 1987.

Leo L Beranek, Noise and Vibration control, McGraw Hill Higher Education, 1971.

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ME 421 THEORY OF PLASTICITY (3-0-0) 3

A brief review of elasticity, octahedral stress, spherical and deviatoric stress, representative stress, Engineering and natural strains, cubical dilation, finite strains coefficients Octahedral strain, strain rate, tensor, yield criteria for ductile metal, stress space, stress–strain relations, plastic stress-strain relations, yield locus, symmetry convexity, normality rule, upper and lower bound theorems and corollaries and slip line theory.

R.A.C.Slater, Engineering Plasticity: Theory and Application to Metal Forming Process, The McMillan Press Ltd, London, 1977.

Sadhu Singh, Theory of Plasticity and Metal forming Process, Khanna Publishers, New Delhi, 2008.

Chakraborty. J, Theory of plasticity, Mc-Graw Hill Book Company, New York, 1987.

ME422 AUTOMATION SYSTEMS (3-0-0) 3

Introduction to Digital Control Systems, CNC technology, Evolution of Automation, Microcontrollers, Programmable Logic Controllers, Automated Process Planning, Scheduling and Management systems, Data Acquisition systems, FMS Elements, Concepts of Agile Manufacturing, STEP-NC systems.

Mikel P. Grover, Automation Production Systems and Computer Integrated Manufacturing, PHI, 2004.

P. Radha Krishna & S. Subramanian, CAD/CAM/CIM, New Age International Publishers, 2009.

Chris Mc Mohan & Browne. J, CAD CAM, Prentice Hall, 1998.

Jerome H. Fuchs, The Prentice Hall Illustrated Handbook of Advanced Manufacturing Methods, Prentice Hall, 1988.

ME423 NUCLEAR ENERGY (3-0-0) 3

Status and prospects: Fuel for Nuclear fission reaction, Energy from fission reaction, nuclear fission and chain reaction, nuclear fuel Cycle, Storage and transportation. Power reactor system: Reactor thermal design, power distribution in reactor core, fuel element temperature and heat fluxes, Reactor operations, Reactor kinetics, reactivity coefficients, Fission product poisoning, nuclear waste management.

Richard Stephenson, Introduction to Nuclear Engineering, McGraw Hill Edition, 1954.

Charles F. Bonilla, Nuclear Engineering, McGraw Hill Book Company, 1957.

K.S. Ram, Basic Nuclear Engineering, Wiley Eastern Ltd, 1977.

M.M. El Wakil, Power Plant Technology, McGraw Hill International Edition, 1984.

ME424 INDUSTRIAL TRIBOLOGY (3-0-0) 3

Introduction to the concept of tribo design, Basic principles of tribology, elements of contact mechanics, Friction, Lubrication and Wear in kinematics pairs, Tribological properties of solid materials, Fluid lubricated Thrust and Journal bearings, Lubrication of lightly loaded contacts, lubricating systems, Bearing selection, Tribology in metal working processes, Steel, Mining, paper and pulp, Glass fiber industries, Transportation sector.

T.A. Stolarski, Tribology in Machine Design, Industrial Press Inc. New York, 1990.

R.D. Arnell. P.B. Davies, J. Halling and T.L. Whomes, Tribology - Principles and Design applications, Springer- Verlag, New York, 1991.

ME425 ENGINEERING ACOUSTICS (3-0-0) 3

Fundamentals of wave propagation, propagation and radiation of sound, Elastic isolation, Sound absorber materials, fundamentals of Room Acoustics, silencers, sound refraction, Electro Acoustic transducer for Air borne sound.

Moser.M, Engineering Acoustics, Springer Ed-1, 2004.

Harris.C.M., (Ed) Handbook of Acoustic measurement and noise control, ASA New York, 1998.

Kutturuff. H, Room Acoustics, Elsevier Science Publication, 1991.

Kinsler .L. E & Fray. A. R, Fundamentals of Acoustics, John Wiley & Sons, New York, 1982.

ME426 APPLIED COMPUTATIONAL METHODS IN MECHANICAL SCIENCES (3-0-0) 3

Modeling, Computers, and Error Analysis, Roots of Equations, Statistical description of thermal data, Modeling of data, Boundary value and initial value problems of mechanical science, Numerical solution of partial differential equations of mechanical sciences, Eigen value problems.

William H Press, Saul A Teukolsky, William T Vellerling and Brain P Flannery, Numerical Recipes in C, 2nd Ed., Cambridge university press, 1992.

E.V. Krishnamurthy and S. K. Sen, Numerical Algorithms, 2nd Edition, Affiliated East-West Press Pvt Ltd, 1986.

ME427 COLLABORATIVE MANUFACTURING (3-0-0) 3

Evolution of modern manufacturing concept, virtual manufacturing, concurrent engineering, open architectural soft CNC systems with PLCS, CNC architecture design, real time OS for CNCS, process management, process synchronization, inter process communication, multi processing hard ware, OS configuration, CNC system architecture, open CNC system, object oriented data modeling, feature based modeling, agent based manufacturing, agent protocols, AI protocols, OSI communication network

protocols, network configuration, STEP-NC systems, STEP-NC data models, intelligent STEP-CNC Systems, implementation of collaborative systems.

A.Dashchenko, Manufacturing technologies for machines of the future, Springer Publ, 2003
Suk-Hwan Suh & others, Theory and design of CNC systems, Springer, 2008
Cornelius T.Leondes, Intelligent systems Vol 5, Manufacturing, Industrial and management systems, CRC Press, 2003
Behrouz A Forouzan, Data Communications and networking, Mc Graw -Hill, 2006.

ME428 AIR CONDITIONING TECHNOLOGY (3-0-0) 3

Psychrometry, Air-conditioning processes, use of Psychrometric chart, air conditioning processes, Cooling load calculations. types of air conditioning systems, winter and Summer air conditioning, Applications of air conditioning. (Use of Refrigeration data handbook permitted in examination)

Arora C. P, Refrigeration and Air Conditioning, Tata McGraw Hill Company Limited, New Delhi, 1981.
Manohar Prasad, Refrigeration and Air conditioning, Wiley Eastern Ltd, New Delhi, 1983.
Refrigeration/Thermodynamics/Heat transfer/Air conditioning data hand book.

ME429 WELDING TECHNOLOGY (3-0-0) 3

Classification and characteristics of Welding, Equipment details and working of Gas Metal Arc Welding (TIG & MIG), Carbon Arc Welding, Ultrasonic welding, Plasma Welding, Under Water Welding, Physics and Metallurgy of Welding, Welding of Jigs and Fixtures, Inspection and testing of welds, Welding defects, residual stresses, welding distortion.

O. P. Khanna, A Text book of Welding Technology, Dhanpat Rai & Sons, 2006.
Parmar, R.S, Welding processes and Technology, Khanna Publishers, 1997.
Richard L. Little, Welding & Welding Technology, McGraw Hill, 1973.

ME 430 ADVANCED MACHINE DESIGN (3-0-0) 3

Review of failure theories, fatigue design methods, fundamentals of LEFM and application to fatigue crack growth, Stress-life and strain-life approaches, notches and their effects, fatigue from variable amplitude loading, spectrum loading, cumulative damage theories, cycle counting methods, statistical aspects of fatigue.

Ralph I. Stephens, Ali Fatemi, Robert .R. Stephens and Henry O Fuchs, Metal Fatigue in engineering, John Wiley, New York, Second Edition, 2001.
Jack. A. Collins, Failure of Materials in Mechanical Design, Second Edition, John Wiley & Sons, New York, 1981.
Robert L. Norton, Machine Design- An Integrated Approach, Fourth Edition, Prentice Hall, 2010.
S. Suresh, Fatigue of Materials, Cambridge University Press, Second Edition, Cambridge, U.K., 1998.

ME 431 FLEXIBLE MANUFACTURING SYSTEMS (3-0-0) 3

Automation In Production Systems, Automation Principles and Strategies, Industrial Control Systems, Applications of Sensors and Actuators, ADC/DAC, CNC Technology, Robot Intelligence, Material Handling and Transport Systems, Storage Systems, Manufacturing Cells, Group Technology and Cellular Manufacturing, FMS Components, Quantitative Analysis Of FMS Systems, Petri Networks, Automated Assembly And Inspection.

A.Dashchenko, Manufacturing technologies for machines of the future, Springer publ, 2003
Groover, M.P., Fundamentals Of Modern Manufacturing, materials , process and systems, Wiley publ, 1996
Luggen, W.W, Flexible Manufacturing cells and systems, Prentice hall, 1991.
Groover, M.P.,Automation production systems and computer integrated manufacturing ,PHI, 2010

ME 432 DESIGN OF SOLAR ENERGY SYSTEMS (3-0-0) 3

Introduction, Solar geometry , Measurement of Solar Radiation, Solar collectors design - flat plate & focusing type, storage of solar energy, solar heating, cooling, passive and active systems, green buildings, applications of solar energy in various fields, water heating, air heating, drying, pumping etc, Economic viability of solar systems, Thermal modeling of solar devices – Case study based assignment.

Duffie J.A. and Beckman W.A., Solar Thermal Processes, John Wiley, New York, 1974.
Garg H.P, J. Prakash, Solar Energy, TMC, 1997.
Sukhatme S.P, Solar Energy Principles of Thermal Collection and Storage, 2nd Ed., Tata Mc Graw-Hill, New Delhi, 1996.
C. S. Solanki, Renewable Energy Technology, Prentice Hall, New Delhi, 2008.

ME 433 ENERGY AUDIT AND MANAGEMENT (3-0-0) 3

Energy Sources, Energy management program, Energy auditing, Instruments used, case studies, Energy Economics, Thermodynamics of energy conservation, Energy conservation in boilers, furnaces, in steam and condensate system, Cogeneration Concepts, Heat Transfer Equipment, Waste heat recovery, Electrical energy conservation, Space Heating and cooling.

W.R. Murphy and G Mutrey, Energy Management, Butterworth-Heinemann, 2007.
Larry C. Witte, Schmidt & Brown, Industrial energy management and utilization. Hemisphere publishing, Co. New York, 1988.
Wayne. C Turner, Energy management handbook, Wiley Inter-science publications. New York, 1982.
D. A. Reay, Industrial Energy Conservation – Pergamon Press, 1980.
T.L. Boten, Thermal energy recovery, Wiley, 1980.

ME434 EXPERIMENTAL STRESS ANALYSIS (3-0-0) 3

Review of Elementary Elasticity and Fracture Mechanics, Strain measurement methods and related instrumentation, Optical methods of stress analysis, Coating methods, Applications of statistics.

J.W. Dally and W.F. Riley, Experimental Stress Analysis, Mc Hill International Editions, New York, 1991.
L.S. Srinath et al., Experimental Stress Analysis, Tata Mc Hill, NewDelhi, 1984.
A.W. Hendry, Elememts of Experimental Stress Analysis, Pergamon Press, New York, 1977.
A. J. Durelli, Applied Stress Analysis, Prentice-Hall Inc., New Jersey, 1967.

ME435 MODELING AND SIMULATION OF ENGINEERING SYSTEMS (3-0-0) 3.

Basic Component models, System model and its solution, State space equation and analysis of linear and non-linear systems, multidomain systems-mechanical, mechatronic and thermo fluidic systems, modeling and simulation of hybrid systems simulation tools.

Robert L. Woods, Kent L. Lawrence, Modeling and Simulation of Dynamic Systems, 1st Edition, , Prentice Hall, 1997.
Katsuhiko Ogata, System Dynamics, 4th Edition,Pearson Prentice Hall, 2004.
Karnopp D C, Margolis D L and Rosenberg R C, Modeling and Analysis of Mechatronic Systems, Wiley Interscience, 3rd Ed, 1999.
Doebelin E O, System Dynamics: Modeling, Analysis, Simulation and Design, Marcel Dekker 1998
Modeling, Identification and Simulation of Dynamical systems, by P.P.J. Van Den Bosch, A.C. Van Der Klauw, ISBN: 0849391814.
Dynamic Modeling and Control of Engineering Systems by J. L. Shearer, B. T., Kulakowski, and J. F. Gardner, Sec. Ed., Prentice Hall, 1997.

ME436 DATABASE MANAGEMENT SYSTEMS (3-0-0) 3

Introduction; E-R Models, Relational Models, Relational Algebra & Calculus, SQL Queries, programming and triggers, Data Storage, File Handling, Security, Parallel & distributed data, Internet database, Data Mining, Object Database systems, Real Time Database systems, Case studies in Mechanical Engineering.

R. Ramaksrishnan & Johannes G, Database Management System, 2nd Edition, WCB/ McGraw Hill Publishers, 2000.
J.D. Ullman , Principles of Database systems, 2nd Edition, Galgotia Publishers, 1999.
Stamper, D & Price, W, Database Design and Management- An Applied Approach, McGraw Hill, 1990.

ME437 PRODUCTION AND OPERATIONS MANAGEMENT (3-0-0) 3

Introduction, Economic Analysis, Process Analysis, Work Study, Productivity, Value Analysis, Break Even Analysis, Layout and Location of Facilities, Balancing, Forecasting, Inventory Control, MRP, Aggregate Planning, Scheduling.

R. Panneerselvam, Production and Planning Management, PHI Learning Pvt Ltd, 2006
Samuel Eilson, Elements of Production Planning and Control, Mc Milan Company, 1962.
Joseph G. Monks, Operations Management -Theory & Problems, McGraw- Hill, 1987.
E.S. Buffa, Modern Production / Operations Management, John Wiley, New York, 1983.

ME440 PRACTICAL TRAINING (2)

This course is a 2 credit course. A student may complete the training before the beginning of 7th semester (or as stipulated by DUGC) and register for it in 7th Semester. The duration and the details shall be decided by the faculty advisor, with approval from DUGC.

ME 441 NUCLEAR SCIENCE AND ENGINEERING (3-0-0) 3

Introduction to nuclear power systems, Reactors, Thermal-hydraulics, Physics of reactor design, Nuclear fuel cycle, Uranium supply, enrichment fuel fabrication, In-core physics and fuel management Reprocessing and waste disposal, Principles of fuel cycle economics, Nonproliferation aspects, disposal of excess weapons plutonium, and transmutation of actinides and selected fission products in spent fuel.

Todreas, Neil E., and Mujid S. Kazimi. Nuclear Systems: Thermal Hydraulic Fundamentals. Vol. 1. New York, Taylor & Francis Inc., 1989.
Henry, A. F. Nuclear Reactor Analysis. Cambridge, MA: MIT Press, 1975.
Lamarsh, John. Introduction to Nuclear Engineering. 3rd Ed. Englewood Cliffs, NJ: 2001.
K. S. Ram, Basic nuclear engineering, Wiley, 1977.

Cochran, R. G, and N. Tsoulfanidis. The Nuclear Fuel Cycle: Analysis and Management. 2nd Ed. LaGrange Park, IL: American Nuclear Society, 1993.
Raymond L. Murray Nuclear Energy, Butterworth and Heinemann, 2000.

ME 442 MICROSYSTEM TECHNOLOGY (3-0-0) 3

Introduction to micro system elements, sensor and actuator fundamentals, scaling issues and materials for micro systems, micromachining, design and analysis of micro systems, CAD approach, micro system packaging.

W. Menz, J. Mohr and O. Paul, Microsystem Technology, Wiley, 2001.
Stephen D. Senturia, Microsystem Design, Springer, 2001.
Mark J Madou, Fundamentals of Microfabrication, CRC Press, 2002.

ME443 PRODUCT DESIGN AND MANUFACTURING (3-0-0)3

Contents: Introduction, Product characteristics, Types of design, Product design practice and industry, DFX, Optimization in design, Role of computers in Product design, new techniques in product design, Steps in product development.

Chitale A. K and Gupta R. C, Product Design and Manufacture, PHI, 2007.
Karl Ulrich and Steven D Eppinger, Product Design and Development, Irwin Mc Graw Hill, 2nd Edition, 2000.
Kristin L. Wood, Kevin N. Otto, Product Design, Pearson, 2000.
Edward Magrab, Integrated product and process design and Development, CRC Press, 2009.

ME444 SOLAR ENERGY (3-0-0)3

Introduction, Solar geometry, Solar Radiation, Measurement, Solar collectors design, flat plate, storage of solar energy, solar heating and cooling systems, Applications of solar energy.

Duffie and Beckman, Solar Thermal Processes, McGraw- Hill, 2nd Edition, 1991.
Garg H.P & J. Prakash, Solar Energy, TMC, 1997.
Sukhatme S.P, Solar Energy Principles of Thermal Collection and Storage, 2nd Ed., Tata Mc Graw-Hill, New Delhi, 1996.
C. S. Solanki, Renewable Energy Technology, Prentice Hall, New Delhi 2008.

ME445 ENERGY MANAGEMENT (3-0-0) 3

General energy problems, Energy use patterns, Energy management program, Energy auditing, Instruments used, case studies, Types of energy audits, Financial approval methods, Thermodynamics of energy conservation, Energy conservation in boilers, furnaces, in steam and condensate system. Cogeneration concepts, Performance evaluation, Waste heat recovery, Electrical energy conservation: Industrial uses of electric power, analysis and improvement methods.

Larry. C. Witte, Schmidt & Brown, Industrial energy management and utilization, Hemisphere publishing Co. New York, 1988.
Wayne C Turner, Energy management handbook, Wiley Inter science publications, New York, 1982.
D. A. Reay, Industrial Energy Conservation, Pergamon Press, 1980.
T.L. Boten, Thermal energy recovery, Wiley, 1980.

ME490 SEMINAR (0-0-2) 1

This course Is a 1 credit course to be completed during 7th / 8th semester. The student will make presentations on topics of academic interest.

ME449 MAJOR PROJECT - I (0-1-3) 3

ME499 MAJOR PROJECT - II (0-1-9) 7

Basic Science Core (BSC)

MA110	Engineering Mathematics – I	(3-0-0) 3
PH110	Physics	(3-1-0) 4
PH111	Physics Lab	(0-0-2) 1
MA111	Engineering Mathematics – II	(3-0-0) 3
CY110	Chemistry	(3-0-0) 3
CY111	Chemistry Lab	(0-0-3) 2

Engineering Science Core (ESC)

AM110	Engineering Mechanics	(3-0-0) 3
EE110	Elements of Electrical Engg.	(3-0-0) 3
ME110	Elements of Mechanical Engg.	(3-0-0) 3
CO110	Computer Programming	(3-0-0) 3
CO111	Computer Programming Lab	(0-0-3) 2
EC110	Elements of E &C Engg.	(3-0-0) 3
ME111	Engineering Graphics	(0-3-0) 3
AM200	Mechanics of Materials	(3-0-0) 3
CY206	Instrumental Analysis Lab	(0-0-4) 2
ME200	Workshop	(0-0-2) 1
ME328	Machine Design	(3-1-0) 4

Humanities and Social Science Core (HSC)

HU110	Professional Communication	(3-0-0) 3
HU300	Engineering Economics	(3-0-0) 3
HU302	Principles of Management	(3-0-0) 3

Programme Core (PC)

MT200	Mechanical Testing	(2-0-0) 2
MT201	Metallurgical Thermodynamics	(3-1-0) 4
MT202	Physical Metallurgy	(3-1-0) 4
MT203	Polymer Science & Technology	(3-0-0) 3
MT204	Mineral Dressing	(3-0-0) 3
MT250	Process Engineering	(3-1-0) 4
MT251	Phase Diagrams	(3-1-0) 4
MT252	Principles of Extractive Metallurgy	(3-1-0) 4
CH263	Mineral Dressing Lab	(0-0-3) 2
MT299	Testing of Materials Lab	(0-0-2) 1
MT300	Production of Iron and Ferro Alloys	(3-0-0) 3
MT301	Heat Treatment	(3-1-0) 4
MT348	Physical Metallurgy Lab	(0-0-3) 2
MT349	Extractive metallurgy Lab	(0-0-3) 2
MT350	Production of Steel	(3-0-0) 3
MT351	Ceramics Engineering	(3-0-0) 3
MT397	Metallographic Lab	(0-0-3) 2
MT398	Ceramics and Polymers Lab	(0-0-2) 1
MT399	Heat Treatment Lab	(0-0-3) 2
MT400	Foundry Technology	(3-0-0) 3
MT447	Metal finishing lab	(0-0-3) 2
MT448	Foundry Technology Lab	(0-0-2) 1
MT498	Metal Processing Lab	(0-0-2) 1

Programme Specific Electives (PSE)

MT253	X-rays and Electron Metallography	(3-1-0) 4
MT254	Electronic Properties of Materials	(3-0-0) 3
MT255	Instrumental Methods of Analysis	(3-0-0) 3
MT256	Measurements and Control	(3-0-0) 3
MT302	Corrosion Engineering	(3-0-0) 3
MT303	Fatigue, Fracture and Creep	(3-0-0) 3
MT304	Fuels, Furnaces and Refractories	(3-0-0) 3
MT352	Powder Met. and Joining of Metals	(3-0-0) 3
MT353	Metal Forming	(3-0-0) 3
MT354	Aerospace Materials	(3-0-0) 3
MT401	Phase Transformations	(3-0-0) 3
MT402	Extraction of Nonferrous Metals	(3-0-0) 3
MT403	Secondary Refining of Steels	(3-0-0) 3
MT404	Non Destructive Testing	(3-0-0) 3
MT450	Advanced Engineering Materials	(3-0-0) 3
MT451	Composite Materials	(3-0-0) 3
MT452	Advanced Welding Technology	(3-0-0) 3
MT453	Surface Engineering	(3-0-0) 3
MT454	Modelling and Simulation in Material Processes	(3-0-0) 3
MT455	Science &Technology of Nanomaterials	(3-0-0) 3
MT456	Advanced Microscopic Techniques	(3-0-0) 3

Open Electives (OE)

MT405	Process Plant Materials	(3-0-0) 3
MT408	Nuclear Materials	(3-0-0) 3
MT409	Fracture of Engineering Materials	(3-0-0) 3
MT457	Smart Materials and Sensors	(3-0-0) 3

Programme Major Project (PMP)

MT449	Major Project – I	(0-0-6) 3
MT499	Major Project – II	(0-0-9) 6

Mandatory Learning Courses (MLC)

CV110	Environmental Studies	(1-0-0) 1
HU111	Professional Ethics and Human Values	(1-0-0) 1
MT422	Practical Training	2
MT480	Seminar	(0-0-2) 1
MT390	Professional Practice	1

Suggested Plan of Study:

Semester →	III	IV	V	VI	VII	VIII
1	MT 200	MT 250	MT 300	MT 350	MT 400	MT 490
2	MT 201	MT 251	MT 301	MT 351	MT440	MT 498
3	MT 202	MT 252	ME328	MT390	MT 447	MT 499
4	MT 203	MT 299	MT 348	MT 397	MT 448	Elective
5	MT 204	CH 263	MT 349	MT 398	MT 449	Elective
6	AM200	Elective	HU 301	MT 399	Elective	Elective
7	CY 206	Elective	Elective	HU 300	Elective	
8	Elective	Elective	Elective	Elective	Elective	
9		ME 200	Elective	Elective	Elective	
10				Elective		

Degree Requirements:

Category of Courses	Minimum credits to be Earned
Foundation Courses (FC) [Including Basic Science Core (BSC)-16, Engineering Science Core (ESC)-30 and Humanities and Social Science Core (HSC)- 9]	55
Programme Core (PC)	60
Electives (PSE and OE)	50
Programme Major Project (PMP)	09
Mandatory Learning Courses (MLC)	06
Total	**180**

Department of Metallurgical and Materials Engineering

MT 200 MECHANICAL TESTING (2-0-0)2

Cohesion between atoms: bonds, potential energy Vs interatomic distance curves, prediction of physical properties based on these curves; crystal systems: fundamentals of crystal structure of metals; tension testing: tensile properties, strain aging, ductile and brittle materials; Erichson cupping test, directionality; torsion test: specimen behaviour under torsion; hardness test: Brinell, Rockwell and Vickers test, relation between hardness and tensile strength, microhardness testing; creep test: creep curve, stress rupture test; fatigue test: S-N curve, statistical nature, effect of mean stress; impact test: Charpy and Izod test, transition temperature; structures & properties of engineering materials.

V.S.R. Murthy, A.K. Sema, K.P. Gupta, G.S. Murthy, Structure & Properties of Engg Materials, Tata McGraw Hill, ND, 2003.

Dieter G.E. Mechanical Metallurgy, McGraw Hill 1988 (SI Metric).

MT 201 METALLURGICAL THERMODYNAMICS (3-1-0)4

Review of first and second laws of thermodynamics, Maxwell's relations; free energy concept and applications, general strategy of deriving thermodynamic relations; third law of thermodynamics; related problems from Dube & Upadhyaya. Solutions, partial molar properties, Gibbs-Duhem equation, fugacity, activity, equilibrium constant; regular solutions, integration of G-D equation, dilute solutions, interaction parameter; equilibrium in thermodynamic systems, structure of unary phase diagrams in (P,T) space, Clausius -Clapeyron equation, triple point, alternative representation of unary diagrams; Gibbs phase rule, Free energy-composition diagrams, Ellingham diagrams; activation energy, effect of activation energy on reaction rate, chemically controlled reactions (both ideal and non-ideal systems).

Robert T. DeHoff, Thermodynamics in Materials Science, McGraw Hill International, 1993 David R Gaskell, Introduction to Metallurgical Thermodynamics, McGraw Hill International, 1973

G.S.Upadhyaya and R.S.Dube, Problems in Metallurgical Thermodynamics and Kinetics, Pergamon, 1977

Ahindra Ghosh, Textbook of Materials & Metallurgical Thermodynamics, PHJ, 2003.

Hem Shankar Roy, Kinetics of Metallurgical Reactions, Oxford, BH, 1993.

MT202 PHYSICAL METALLURGY (3-1-0) 4

Structure of metals, space lattice, unit cells, crystal systems, metallic crystal structures, packing efficiencies, planes and directions, voids, imperfections in crystalline solids, dislocations and plastic deformation, theoretical shear strength, concept of dislocations, types of dislocations, Burgers vector, strain field associated with dislocations, dissociation of dislocations, climb and cross slip, dislocation interactions, plastic deformation by twin, yield point phenomenon, strain ageing, work hardening in single and polycrystalline materials, effect of temperature, composition and grain size on strain hardening, recovery, recrystallisation and grain growth, high temperature deformation of crystalline materials, diffusion in solids, applications of diffusion concepts, solidification of metals, freezing of alloys, Scheil equation,

dendritic freezing in alloys, freezing of ingots, segregation, homogenization, porosity, eutectic freezing, growth of single crystals.

R.yllebus E.Reed-Hill and R. Abbaschian, Physical Metallurgy Principles, PWS Publishing Co., 1994.

G. E. Dieter,Mechanical Metallurgy, McGraw-Hill Book Co., 1988.

W.G.Moffat, G.W.Pearsall & I.Wulff, The Structure & Properties of Materials, Vol. I Structure-Wiley Eastern, 1968.

G. W. Hayden, W.G.Moffat and I.Wulff, The Structure & Properties of Materials, Vol.III Mechanical Behaviour,Wiley Eastern Pvt. Ltd, 1968.

MT203 POLYMER SCIENCE AND TECHNOLOGY (3-0-0) 3

Polymer structure: polymer conformation and chain dimensions, thermodynamics of polymer solutions; phase equilibria, determination of the interaction parameter, predictions of solubilities, the amorphous state, glass transition, secondary relaxation; crystalline state, thermal transitions and properties; mechanical properties & effect of temperature, fatigue, creep in polymers, mechanisms of deformation, basic processing operations, introduction to polymer rheology, constitutive equations, elastic properties of polymeric fluids, analysis of simple flows: introduction to modelling of polymer-processing operations, membrane applications of polymeric materials, mechanisms of transport, membrane preparation, biomedical applications, artificial organs, controlled drug delivery, hemodialysis and hemofiltration; applications in electronics.

I. Joel R. Fried, Polymer Science and Technology, Prentice-Hall of India Private Limited, New Delhi, 2002
Herman, Herman S. Kaufman and Joseph J. Falcetta, Introduction to Polymer Science and Technology, Wiley Interscience, 1977
I. Ghosh, P, Polymer Science and Technology of Plastics and Rubbers, TMH, New Delhi , 2004
Peter C. Powell, Engineering with Polymers, Chapman & Hall, 1983

MT204 MINERAL DRESSING (3-0-0) 3

General and Dynamic Geology, Crystallography, Minerology, Economic Geology. Scope of Mineral Dressing in Metallurgy. Crushing and grinding. Sampling and Particle size analysis. Gravity concentration methods. Forth Floatation. Magnetic and Electrical Separation. Cyclones, Filters, Solids conveyance and storage.

Parbin Singh, General and Engineering Geology, 4th Ed., Kaston Publishing House, 1987.
A. M. Gaudin, Principles of Mineral Dressing. TATA McGraw Hill 1974.

MT250 PROCESS ENGINEERING (3-1-0) 4

Units and dimensions, applications of transport phenomena, properties of fluids, laminar and turbulent fluid flow, Stoke's Law, flow past submerged bodies, flow through packed and fluidized beds, Bernoulli's Equation, dimensional analysis, flow of compressible fluids, Fourier's law, conduction in solids, liquids and gases, concept of heat transfer coefficient; introduction to solidification, heat transfer, heat transfer in packed and fluidized beds; diffusion in solids, liquids and gases, Knudsen's diffusion, solution to diffusion problems in microelectronics, diffusion processing and homogenization of alloys, unsteady state mass transfer, concept of mass transfer coefficient, diffusional operations, staged operations, similarity criteria, introduction to model and pilot plant studies.

D. R. Poirier and G. H. Geiger, Transport Phenomena in Materials Processing, TMS, Warrendale, 1994.
N.J. Themelis, Transport and Chemical Rate Phenomena, Gordon Breach, New York, 1995.
R.I.L. Guthrie, Engineering in Process Metallurgy, Oxford Science Publications 1989.

MT251 PHASE DIAGRAMS (3-1-0) 4

Introduction: types of solid solutions, Hume Rothery rules, intermediate phases, binary isomorphous system; phase rule and lever rule, miscibility gaps, eutectic systems, phase diagrams with intermetallic compounds; monotectics, syntetic, eutectoid, peritectic and peritectoid reactions in binary systems and solidification behaviour of typical alloys in these systems; ternary phase diagrams: isothermal sections and isopleths; ternary systems involving binary reactions, ternary reaction, experimental techniques of phase diagram determination: Fe-Fe_3C phase diagram, introduction to steels and cast irons, other commercially important binary systems.

F.N.Rhines, Phase Diagrams in Metallurgy, McGraw Hill, N.Y.1956.
A. Prince, Alloy Phase Equilibria, Elsevier, Amsterdam, 1966. .
D.R.F West, Ternay equilibrium diagrams, 2nd Edn., Chapman and Hall, London, 1982.
A.H. Cottrell, Theoretical Structural Metallurgy, ELBS & Edward Arnold Ltd., London, 1964.
S.H.Avner, Introduction to Physical Metallurgy, McGraw Hill Book Co., NY., 1974
V.Raghavan, Materials Science & Engineering, 4th Edition, Prentice Hall of India, New Delhi, 1998.

MT252 PRINCIPLES OF EXTRACTIVE METALLURGY (3-1-0) 4

Sources of metals, unit processes, pyrometallurgical processes, halides in extractive metallurgy, refining processes, stoichiometric calculations, hydrometallurgical processes, recovery of metal values from leach solution, electrometallurgical processes, electrorefining and electrowinning, nickel: sources, extraction from sulphide ores, carboxyl and electrolytic refining of nickel, extraction of nickel from oxide ores; copper: sources of copper, extraction from sulphide ores, refining, newer processes for copper extraction, hydrometallurgy of copper; zinc: sources, pyrometallurgical extraction, hydrometallurgical extraction, recovery of byproducts (cadmium); Imperial Smelting Process (ISP); lead: sources, extraction of lead, lead blast furnace, refining, modern developments in lead smelting, aluminium and magnesium extraction.

Ray, Sridhar and Abraham - Extraction of nonferrous metals, EW.P., New Delhi 1985.

R.D.Pehlke - Unit Processes of extractive metallurgy, 1975, American Elsevier, New York

Sevmkov N. - Nonferrous Metallurgy, 1975, Mir, Moscow

MT253 X-RAY AND ELECTRON METALLOGRAPHY (3-0-0) 3

Stereographic projections, generation, absorption and detection of X-rays; intensity of diffracted beam, - Scherrer formula; Laue, rotating, powder methods, Debye-Scherrer technique, focusing technique, pin hole technique, diffractometer, crystal structure, indexing cubic and non-cubic patterns, precise lattice parameter, single crystal orientation; order-disorder transformation, grain size, texture, solvus line, chemical analysis: qualitative, quantitative; TEM Vs optical microscope, electron - matter interaction, image formation, specimen preparation, reciprocal lattice, indexing SAD patterns; SEM: modes, magnification, contrast, EPMA, FIM, STM, EDAX.

B D.Cullity, Elements of X-Ray Diffraction, Addison Wesley, 1977

R. E. Smallman & K. M.B. Ashbee, Modern Metallography, 1966

MT254 ELECTRONIC PROPERTIES OF MATERIALS (3-0-0) 3

Free electron theory, Fermi-Dirac statistics; density of energy states, Fermi energy, electrons in a periodic field of a crystal, Kronig Penny model, Brilluoin zone theory, classical theory of specific heat, thermal conductivity, photon conductivity, phonon conductivity, thermal expansion of metals, polymers and ceramics, resistivity variation, intrinsic & extrinsic semiconductors, semiconducting compounds, production of transistors, integrated circuits, zone refining and single crystal growth, dielectric materials, ferroelectric materials, superconductors, magnetic materials, applications, ferrites, zone theory, opacity, luminescence, translucency, laser modulation and amplification, LED, optical storage and optical computer, optical fibres; Lasers.

W. Hume Rothery and B R Coles, Atomic Theory for Students of Metallurgy, Institute of Materials, London, 1988.

G.V. Raynor, An Introduction to Electron Theory of Metals, Institute of Materials,London, 1988.

Rolf E Hummel, Electronic Properties of Materials, 2nd Edition, Narosha Publishing House, 1995.

Manas Chanda, Science of Engineering Materials, Vol. 3, Engineering Properties, McMillan, 1980.

S. O. Pillai, Solid State Physics, New Age International Pvt. Ltd., India 2002.

B. M. Srivatsava and C. Srinivasan, Science of Engineering Materials New Age International Pvt. Ltd. 1999.

John Wulff et al. Electronic Properties, Vol. IV John Wiley and Sons, 1964.

MT255 INSTRUMENTAL METHODS OF ANALYSIS (3-0-0) 3

Electroanalytical methods, indicator and reference electrode, potentiometric titrations, polarography, amperometric titrations, spectroanalytical methods: IR spectroscopy, Beer-Lamberts' law, atomic absorption and flame emission spectroscopy, emission spectroscopy based on plasma sources, electron microscopy, thermal analysis: thermogravimetry, thermogram, derivative thermogravimetry; differential thermal analysis, differential scanning calorimetry, solvent extraction, chromatography.

D.A.Skoog, J.J.Leary, Principles of Instrumental Analysis, 4th Edn. Saunders College Publishers, 1992
Vogel's Textbook of Quantitative Chemical Analysis, 5th Edn., LBS Longman, 1991
Willard, Merrit & Dean, Instrumental Methods of Analysis, 6th Edn., CBS, 1981
J.W.Robinson, Undergraduate Instrumental Analysis, 4th Edn., Marcel Dekker Inc.,New York, 1987
C.N.Banewell, Fundamentals of Molecular Spectra, TMH Edn., Tata McGraw Publishers, 1983
G. Chatwal and S.Anand, Instrumental Methods of Chemical Analysis, Himalaya Publishing House, 2008

MT 256 MEASUREMENTS AND CONTROL (3-0-0)3

Characteristics of measurement system, Sensors for various signals, Data converters and acquisition systems, Transfer of signals, Display and recording units; Measurement systems for Temperature, displacement, velocity, pressure, vacuum, fluid head, density, specific gravity, viscosity; Flow metering of compressible and incompressible fluids, dry materials; Measurement of force, torque, strain and vibrations; Measurement of current and voltage of different scales; Controls, their action; Implementation of control action; Use of PC assisted measurement and control of industrial activity.

Instrumentation for engineering measurements: J W Dally, W.F. Riley, K.G. McConnel, John Wiley Publ., 1995.
Industrial instrumentation-Al Sutko, J.D. Faulk, Cengage Learning, 1996.
Principles of Industrial Instrumentation- D. Patranabis, McGraw, 1996.
Industrial Instrumentation, D.P. Eckman, John Wiley, 1951.

CH263 MINERAL DRESSING LAB (0-0-3)2

Experiments based on Mineral Dressing Theory

MT299 TESTING OF MATERIALS LAB (0-0-2) 1

Mechanical testing: impact test, transition temperature, study of fractures, hardness test - Brinell, Rockwell, Poldi, rebound hardness, microhardness testing, Hounsefield tensometer - cylindrical specimen, wire and sheet specimen; hardness testing, Instron testing machine, non-destructive testing: dye penetrant, magnetic particle test, radiograph, ultrasonic flaw detection, spark test, creep test.

MT300 PRODUCTION OF IRON AND FERRO ALLOYS (3-0-0)-3

History of Iron Making, Traditional Iron Making, Evolution of Blast Furnace, Iron Making in India. Iron ores of the world: Distribution; Indian iron ores, limestones and coking coal deposits, problems associated with Indian raw materials. Iron ore beneficiation and agglomeration, theory and practice of sintering and pelletising, Testing of burden materials, Blast Furnace Reactions, Thermodynamics and Kinetics, Fundamental studies, Blast furnace design, other auxiliary units, plant layout, recent developments in the design & operation of blast furnace, irregularities in operation and their remedies, Blast furnace refractories and instrumentation; Blast furnace slag & gas: importance, formation and use. Direct reduction methods, Details of some commercial processes like Rotary Kiln, Electric Pig Iron Furnace, HYL, Midrex, FluIDISED Bed, Corex Process, Pyrophoricity of DRI, Ferroalloy Furnaces, Production of FeSi, FeMn and FeCr, Nitrided Ferroalloys.

Making, Shopping and Treating of Steel, 10th Edition, Edited by United States Steel, 1985; or 11th Edition Edited by the Association of Iron and Steel Engineer, 1999

Ghosh and A. Chatterjee, Ironmaking and Steelmaking: Theory and Practice, PHI Learning (P) Ltd., New Delhi, 2008
A. K. Biswas, Principle of Blast Furnace iron making, SBA Publications, Calcutta, 1981
Kurt Meyer, Pelletizing of Iron Ore
Strasburger, Brown, Stephenson & Dancy, B.F. Theory and Practice, Vol. I & II, 1969, Gordon & Reach, New York.
K.K.Prasad & H.S. Ray, Advances in Rotary Kiln Sponge Iron Plant
Robert L. Stephenson, Direct reduced iron – Technology & Economics of production and use, 1980, Iron & Steel Society of AMIE.
C.K.Gupta and A.K.Suri, Ferroalloys Technology in India, C.K. 1982, Milind Pub., New Delhi.

MT301 HEAT TREATMENT (3-1-0) 4

Nucleation and growth of austenite, pearlitic transformation, TTT diagrams, formation of martensite, annealing, normalizing, hardening and tempering, hardenability, heat treatment furnaces, austempering, martempering, ausforming; thermomechanical treatments; surface hardening of steels; effect of alloying elements on Fe-C diagram, structure and properties of steels; carbon and alloy tool steels, stainless steels, HSLA steels, maraging steels, dual phase steels; cast irons and their heat treatment, alloy cast irons, aluminium and its alloys.

R.E. Reed Hill, Physical Metallurgy Principles, Van Nostrand, East West Press, New Delhi, 1973.
S.H.Avner, Introduction to Physical Metallurgy, McGraw Hill, 1974
D.S.Clark & W.R Varney, Physical Metallurgy for engineers, East West Press, New Delhi, 1962 T.V.Rajan and G.P.Sharma, Heat treatment (Principles & Techniques), Prentice Hall of India, 1995

MT302 CORROSION ENGINEERING (3-0-0) 3

Definition of corrosion, corrosion damage, classification of corrosion, electrochemical aspects, electrochemical reactions, mixed potential theory, polarisation, passivity, environmental effects, effect of oxygen and oxidisers, effect of temperature, effects of corrosive concentration, effect of galvanic coupling using mixed potential theory, corrosion testing, standard expressions for corrosion rate, galvanic corrosion, erosion corrosion, crevice corrosion, intergranular corrosion, pitting, stress corrosion. Tafel and linear polarisation, AC impedance, small-amplitude cyclic voltammetry. Paint tests, sea water tests. Interpretation of results, Corrosion prevention; materials selection, alteration of environment, design, cathodic and anodic protection, coatings, high-temperature corrosion and mechanisms and kinetics, high- temperature materials

Mars G. Fontana, Corrosion Engineering, McGraw-Hill Book Company, 1986
David Talbot and James Talbot, Corrosion Science and Technology, CRC Press, New York, 1998
Denny A. Jones, Principles and Prevention of Corrosion, Maxwell Matemillar 1992.

MT303 FATIGUE, FRACTURE AND CREEP (3-0-0) 3

Fatigue test: S-N curve, statistical nature, effect of mean stress, Goodman diagram, effect of surface finish, size, residual stress and temperature; effect of metallurgical variables, suppression of fatigue, fracture mechanics: type of fracture in metals, theoretical cohesion strength, Griffith theory, dislocation theory of fracture, plane strain fracture toughness and its evaluation, instrumented impact testing, comparison of fracture toughness of various materials, embrittlement of steels, creep and stress rupture, creep curve, stress rupture test, determination of fracture at higher temperature, presentation of engineering creep data, prediction of long time practices, theories of creep, effect of metallurgical variables.

Dieter G.E., Mechanical Metallurgy, McGraw Hill 1988 (SI Metric)
Thomas H. Courtney, Mech. Behaviour of Metals, McGraw Hill 1990

MT304 FUELS, FURNACES AND REFRACTORIES (3-0-0) 3

Classification of fuels, properties and tests, coal origins, carbonization and gasification. Other solid fuels. Liquid fuels – Types, testing, properties, Gaseous fuels, Introduction to nuclear fuels, Indian fuel deposits. Principles of theory of combustion, Combustion calculations, Waste heat utilization. Classification of furnaces – various methods including Glinkov's. Thermal characteristics of furnace operation. Heat Balance.

O.P.Gupta, Elements of fuels, furnaces and refractories, 2011
J. D. Gilchrist, Fuels, Furnaces and Refractories, 1977
V. A. Krivandin, B. L. Markov, Metallurgical Furnaces, 1980

MT348 PHYSICAL METALLURGY LAB (0-0-3) 2

Temperature measurement: calibration of thermocouples, use of optical and radiation pyrometer, metallography, study of metallurgical microscope, specimen preparation for metallography, etching technique, image analyzer, quantitative metallography, phase diagram by cooling curve, phase transformation study by dilatometer, diffusion studies of solidification structure.

MT349 EXTRACTIVE METALLURGY LAB (0-0-3) 2

Study of temperature distribution in a tubular furnace, oxidation and reduction roasting, pelletisation and sintering of iron ore fines, leaching studies, flotation of sulphide ores, oxidation of metals and alloys, cementation of copper, reducibility of ores, proximate analysis of coal, calorific value of solid fuels and gaseous fuels, flash and fire point determination using Cleveland's open cup and Pensky Marten's closed cup testers, determination of viscosity of liquids using Redwood viscometer and Brookfield viscometer, Orsat apparatus for gas analysis.

MT350 PRODUCTION OF STEEL (3-0-0) 3

History of steel making, major steel making processes, principles of steel making, physical chemistry of steel making, deoxidation, tapping and teeming, slags in steel making. Basic oxygen steelmaking processes, top and bottom blown processes, combined blowing/Hybrid processes, LD/BOF, Q-BOP/ OBM, LD-AC/OLP, Kaldo Rotor; Requirement of Metallic Coolant, Energy Optimizing furnace (EOF), Inputs required in oxygen steel making, yields from metallic inputs. Alloy and stainless steel making, continuous steel making, steelmaking in electric arc furnace, steel making in induction furnace, conarc process. Secondary steel making processes, steel degassing processes, casting pit practice, continuous casting of steel, moulds used for continuous casting; use of casting powder, Electromagnetic stirring, defects in continuous cast product.

Making, Shaping and Treating of Steel, 10th Edition, Edited by United States Steel, 1985; or 11th Edition, Edited by the Association of Iron and Steel Engineers, 1999
A. Ghosh and A. Chatterjee, Ironmaking and Steelmaking: Theory and Practice, PHI Learning (P) Ltd., New Delhi, 2008
A.K. Chakravarty, Steelmaking, PHI (P) Ltd., New Delhi, 2007
R. H. Tupkary, Modern Steel Making, 1982, Khanna Pub, New Delhi, 2008
C. Bodsworth, Physical Chemistry of Iron and Steelmaking
T. Rosenqvist, Principles of Extractive Metallurgy
R.G. Ward, An Introduction to the Physical Chemistry of Iron and Steel making, ELBS, London

MT351 CERAMICS AND REFRACTORIES (3-0-0) 3

Ionic bond, Madelung constant, Pauling's rules, rocksalt, zinc blende, CsCl, flourite & antifluorite, perovskite, spinel, ilmenite, rutile and alumina structures, structure of silicates, glasses, defects in ceramics, ceramic microstructures, production of ceramic powders, forming processes, thermal treatment, calcination, sintering, glazing, tensile and compressive strengths, thermal stresses, creep, fatigue and fracture,

toughening mechanisms, classification, production, characteristics and uses of silica, alumina, alumino-silicate, chrome-magnesite, carbon & insulating refractories.

Michel Baersoum, Fundamentals of ceramics, McGraw Hill, 1997
W.D.Kingery, Introduction to Ceramics, Wiley Interscience, 1976
D.W.Richerson,Modern Ceramic Engg., Marcel Decker Inc. New York and Basel, 1984
A. R. Chesti, Refractories, Manufacture, propestics & application

MT352 POWDER METALLURGY & JOINING OF METALS (3-0-0) 3

Historical development of Powder Metallurgy, reasons for using powder metallurgy. Metal powder manufacturing techniques and powder characterization, Powder conditioning, Compaction and shaping, Sintering, Sintering atmospheres and equipments Secondary operations, testing, standards and quality controls, Apllications. Classification of welding methods; electrodes, gas welding, MMAW, TIG, MIG, EBW, LBW, plasma welding, SAW, ESW, thermit welding, arc characteristics & metal transfer, equipment for welding, friction welding, ultrasonic welding, explosive welding, induction pressure welding, electrical resistance welding, production of tubes, diffusion bonding, welding of plain carbon steels, alloy steels, stainless steels and tool steels, cast iron and wrought iron, copper, aluminium, magnesium, titanium & super alloys, welding of dissimilar metals, underwater welding, welding in vacuum, welding at low temperature (cryogenic welding), welding in space robotic welding, flame cutting, powder cutting, plasma cutting, laser cutting, electron beam cutting, fluxes, filler materials, solidification, micro & macrostructure, weldability and hardenablity, residual stresses, inspection and testing of welds, design of weldments, numerical problems in welding, use of computers in welding. Brazing & Soldering.

An introduction to powder Metallurgy, F. Thummler and R. Oberäcker, The Institute of Materials, 1993
ASM Handbook, powder Metallury Technologies and Applications, vol.7, ASm International, 1998.
N. K. Srinivasan, Welding Technology, Khanna Publishers, 1997 Richard Little, Welding & Welding Technology, Tata McGraw Hill, 1998. A.C.Davies, Welding, Cambridge University Press 1996

MT353 METAL FORMING (3-0-0) 3

Elasticity and plasticity, yield criterion theories of metal forming, hot, warm and cold working, ring compression test, temperature rise in deformation zone, superplasticity and explosive forming, force- stroke diagrams in forming, friction and lubrication in metal working processes, forging, CAD & CAM in forging, extrusion, mannesmann mill, rolling, drawing of rods, wire and tubes, dies, optimum die angle, bulk forming and sheet metal forming, deep drawing, redrawing, limiting draw ratio, forming limit diagram, role of texture defects in sheet metal working, bending, shearing, rubber pad forming, stretch forming, electro hydraulic forming, electromagnetic forming and high energy rate forming, numerical problems and design aspects in forming.

G. E. Dieter and David Bacon, Mechanical Metallurgy, McGraw-Hill, 1988, 3 Edition (SI Metric)
Kurt Lange, Handbook of Metal Forming McGraw-Hill 1985.
W. F. Harsford & R M Caddell, Metal Forming Mechanics & Metallurgy, Prentice Hall, USA, 1993, Second Edition
B. Avitzur, Handbook of Metal Forming Processes, John Wiley, New York, 1983
Metals Handbook Vol. 14, Forming and Forging, ASM Metals Park, Ohio, 1988
T Altan, Metal Forming-Fundamentals and Applications, ASM Metals Park, Ohio, 1983.

MT354 AEROSPACE MATERIALS (3-0-0) 3

Carbon-carbon composites, production, properties and applications, inter metallic matrix composites, ablative composites based on polymers, ceramic matrix, metal matrix composites based on aluminium, magnesium, titanium and nickel based composites for engines, superalloys, aluminum alloys, magnesium alloys and titanium alloys, materials for plasma engines, intermetallic aluminides, ceramics and polymeric materials.

H. Buhl, Advanced Aerospace Materials, Springer Verlag, Berlin 1992.
Balram Gupta et.al Aerospace Materials Vol I, 2, 3 ARDB, S. Chan & Co. 1996.

MT397 METALLOGRAPHY LAB (0-0-3) 2

Microstructure of cast iron, plain carbon steel, brasses, bronze and babbits, aluminum silicon alloys, aluminum copper alloys, image analysis, inclusion studies, macro-microstructure of forged, rolled, cast and welded structures.

MT398 CERAMICS AND POLYMERS LAB (0-0-2) 1

Ceramics: thermal spalling resistance, tensile properties of ceramics, specific gravity of ceramics, coefficient of thermal conductivity, specific heat, porosity and bulk density, preparation of glazed tiles and their property determination, thermal conductivity measurement, polymers: molecular weight and identification using chromatography, melt flow index, viscosity using viscometer, glass transition temperature determination, molecular weight-viscometric/end group analysis method, softening point determination by Vicat softening point apparatus, water permeability, water absorption, density determination, refractive index of liquid polymer, estimation of free phenol and formaldehyde in phenol formaldehyde resin.

MT399 HEAT TREATMENT LAB (0-0-3) 2

Full annealing, normalizing, hardening and tempering of plain carbon steels Jominy end quench test, pack carburizing, precipitation hardening, diffusion studies, recrystallisation and grain growth, heat treatment of high speed steel and stainless steels.

MT400 FOUNDRY TECHNOLOGY (3-0-0) 3

Patterns, sand moulds, moulding processes, special casting process, evaluation and characterization of moulding materials, cores and core materials, mould production, core production, sand compaction, foundry machines, moulding equipments, foundry layouts, mechanization & automation, different types of foundries, solidification, growth structures in pure metals, applications of constitutional super cooling to castings, cast structures, gases & inclusions in castings, segregation, defects related to solidification, design of risers, runner systems and design of runners, elements of casting designs, foundry metallurgy of cast irons, production of S.G. iron and malleable iron, classification of gray cast iron, inoculation practice, ADI, steel foundry practice, melting practice, cupola, induction melting, melting of aluminum and copper alloys.

J. Campbell, Castings, Butterworth, 1991, London
Heine and Rosenthal, Principles of Metal Casting, 1955, McGraw Hill, NY.
Solidification of Metals, W. C. Winegard, Institute of Metals 1964.

MT401 PHASE TRANSFORMATIONS (3-0-0) 3

Thermodynamic concepts, homogeneous and heterogeneous transformation, nucleation and growth, growth kinetics, Johnson-Mehl and Avrami models, precipitation hardening, modern theories of precipitation hardening, crystallography and morphology of precipitates, typical age hardening alloys, martensitic transformation, morphological features, crystallographic features, kinetic features, phenomenological theories of martensitic transformation, martensitic transformation in-Tl, Fe-Ni and Fe- C alloys, pearlitic transformation, order-disorder transformation, short range order, long range order, degree of order, experimental methods to study ordering, dependence of order parameter on temperature, change of property with ordering, recovery, recrystallisation and grain growth, secondary recrystallisation, anelasticity and internal friction, thermo-elastic effect, interstitial diffusion, Snoek effect, Kahn's torsion pendulum, relaxation time, measurement of damping capacity.

R.E.Reed-Hill and R. Abbaschian,Physical Metallurgy Principles, PWS Publishing Co., 1994.
V. Raghavan, Solid State Phase Transformations, Prentice Hall of India Pvt. Ltd, 1987.

D.A.Porter and KE.Easterling,Phase Transformation in Metals and Alloys, Chapman and Hall, 1992.

MT402 EXTRACTION OF NON-FERROUS METALS (3-0-0) 3

Silver: sources, extraction by cyanidation, refining; gold: sources, concentration methods, gold recovery, refining; chromium: occurrence, production; cadmium: sources, extraction, recovery from secondary sources; mercury: sources, extraction from cinnabar; uranium: ores, processing of uranium ores, solvent extraction, reduction, production in India; thorium - sources, extraction and its purification; beryllium: types of ore, production, zirconium: sources, extraction and its refining, separation of Zr and Hf, fabrication of zirconium, production of zirconium in India; titanium: sources, beneficiation methods of illmenite, production of titanium tetrachloride, the Kroll process; molybdenum: production of powder and ductile Mo; tungsten: ores, concentration methods, production of tungsten trioxide; production of tungsten powder and ductile tungsten; tin: types, smelting of tin concentrates, refining of tin.

H.S.Ray, A.Sridhar and K.P.Abraham, Extraction of Nonferrous Metals, 1985, EWP, New Delhi.
Sevryukov N., Nonferrous Metallurgy, 1975, Mir, Moscow.
W.H.Dennis - Metallurgy of the Non-Ferrous Metals, Ed.2, 1966, Pitman, London.

MT403 SECONDARY REFINING OF STEELS (3-0-0) 3

Introduction, unit processes in secondary steelmaking viz stirring, slag control, refractories and atmosphere control: ladle furnace method; ladle injection metallurgy, vacuum treatment of liquid steel: priniciples, processes viz ladle, stream and circulation degassing methods, stainless steel making technology - VOD, AOD and CLII processes, remelting, refining processes - ESR and VAR processes.

R.H.Tupkary, Modern Steelmaking, Khanna Publishers, New Delhi, 1996
R.G.Ward, An Introduction to the Physical Chemistry of Iron and Steel making, ELBS, London, 1962
V.Kudrin, Steel Making, Mir Publication, Moscow, 1985

MT404 NON-DESTRUCTIVE TESTING (3-0-0) 3

Terms, definition, value of NDT, X -ray radiography: production of X -rays, absorption, scattering, X-ray film processing; industrial radiographic practice, micro-radiography, Gamma radiography: radioactivity, gamma ray sources; Industrial Computed Tomography: principles and applications; ultrasonics: types of waves, production of ultrasonic wave, techniques, thickness measurement, types of scanning, types of indication, welding inspection, tube inspection, test standards, determination of elastic constants; magnetic methods: magnetisation guides in application, limitation, standards; penetration methods: surface flaw detection, application.

McGonnangle, W.J., Nondestructive Testing, Gorden and Breach, New York, 2nd edn.
Baldev Raj, T. Jayakumar, M. Thavasimuthu, Nondestructive Testing, Narosa Publishing House, 1997

MT405 PROCESS PLANT MATERIALS (3-0-0) 3

Selection of process materials, fabrication, mechanical properties and strength of materials, effect of temperature on mechanical properties, testing and inspection of materials, properties and uses of ferrous metals, cast iron, plain carbon steels, thermal and electrical insulating materials, non ferrous metals and alloys, general properties and fields of application of non ferrous metals, plastics as materials of construction for chemical plant, corrosion resistance, uniform corrosion, galvanic corrosion, pitting, intergranular corrosion, effect of stress, erosion corrosion, high temperature oxidation, hydrogen embrittlement, selection for corrosion resistance, corrosion charts, design for corrosion resistance.

William F. Smith, Principles of Material Science and Engineering, McGraw Hill Book Co,1990
Vernon John, Engg Materials, 3rd Edition, Macmillan, 1992.
William D. Callister, Materials Science & Engg., 4th Edition, John Wiley, 1997.

MT408 NUCLEAR MATERIALS (3-0-0) 3

Structure of a nuclear power plant, requirements of reactor materials, fuel materials, plutonium uranium and thorium and their alloys & compounds, core materials: beryllium, graphite, control and shielding materials, magnesium & its alloys, aluminium & its alloys, zirconium & its alloys, austenitic stainless steel; materials for reactor vessel and other components, pearlitic steels, ferritic, chromium stainless steels, copper alloys, titanium and its alloys, coolants used in reactors: radiation embrittlement, corrosion of reactor materials, mechanical properties of materials.

V.Gerasimov & A. Monakhov, Nuclear Engineering Materials, Mir Publishers, Moskow, 1983.
D.S.Clark & W.R Varney, Physical Metallurgy for engineers, East West Press, New Delhi, 1987
C.M.Srivatsava & C.Srinivasan, Science of engineering Materials, 1997, New Age International.

MT409 FRACTURE OF ENGINEERING MATERIALS (3-0-0) 3

Failure and their causes - techniques of failure analysis, conventional design concepts, inadequacies of conventional design, mechanics of fracture, theoretical cohesive strength, Griffith theory of fracture, Irwin - Orowan modification, concepts of G and R, relation between G and rate of change of compliance, crack tip stress fields, stress intensity factors, relation between G and K, fracture toughness: determination of fracture toughness, ASTM standards; crack tip plasticity, plastic enclaves and their effect on energy release rate, concept of plastic zone criterion, R curve concept, J Integral, COD criterion, brittle and ductile fractures, fatigue crack growth and fracture mechanics, stress corrosion cracking, liquid metal embrittlement, hydrogen embrittlement, microscopic aspects of cleavage crack propagation, plastic relaxation at crack tip, nucleation of cleavage cracks by plastic deformation, crystallographic mechanism, initial growth and propagation, ductile - brittle transition; designing and testing for fracture resistance, principles of fracture safe design, testing procedure, designing steels for fracture resistance, improved toughness in ceramics, composites, case studies in failure analysis.

D. Broek,Elementary Engineering Fracture Mechanics, Marinus Nijhoff, Dordredet, 1986.
J.F.Knott, Fundamentals of Fracture Mechanics, Butterworths 1973.
S.Teteleman & A.J.McEvily, Fracture of Structural Materials, John Wiley and Sons, 1961.

MT447 METAL FINISHING LAB (0-0-2) 1

Cleaning base metal: (Steel specimens) buffing, brushing, polishing, degreasing, acid dip - water wash, common metal plating: Zn, Ni, Cd, Cr, Cu - acid baths, Zn, Cd, Cu - cyanide baths, post plating, drying, passivity, lacquering, phosphating, test on deposit: corrosion resistance test - by salt spray chamber, hardness, ductility by bending test, photo micrographs.

MT448 FOUNDRY TECHNOLOGY LAB (0-0-2) 1

Sand testing: moisture content, clay content, permeability, sieve analysis of base sand, strength properties of molding sand, shatter index, mold hardness; clay testing: gelling index, gelling time, pH measurement, acid demand value, design of casting: selection of parting line, design of patterns, full mold process, CO2 molds, melting and pouring of aluminium alloy, defect analysis; computer aided designs.

MT449 MAJOR PROJECT - I (0-0-6) 4

MT450 ADVANCED ENGINEERING MATERIALS (3-0-0) 3

Metals for high temperature service, Ti and Zr alloys, Ni and Co based super alloys, rapid solidification, metallic glasses, production, properties and applications, liquid crystals: production, properties and applications, composite materials, mechanics of composite materials, dispersion strengthening, metal

matrix composites, special steels, maraging steels, trip steels, patenting, interstitial free steels, smart materials, shape memory effect, principles, pseudoelasticity, applications, nano technology, nano materials.

R. E. Reed Hill & Reza Abbaschian, Physical Metallurgy Principles, 3rd Edition, 1994
PWS Publishers USA.
W. E. Smith Structure & Properties of Engineering Alloys McGraw Hill, 1993
F.L. Matthews & R. D. Rawlings, Composite Materials Engg. & Science, 1994
K. K. Chawla, Composite Materials, 2nd Edition, Springer - Verlag 2001

MT451 COMPOSITE MATERIALS (3-0-0) 3

Reinforcements, whiskers, matrix materials, polymers, metals, ceramics, interfaces: wettability, crystallographic nature, interactions, types of bonding: processing, thermoset matrix composites, thermoplastic matrix composites, structure and properties, structural defects, mechanical properties applications, processing: liquid-state processes, solid state processes, properties, thermal characteristics, aging, fatigue and creep applications, electronic-grade MMCs, ceramic matrix composites: processing, infiltration, directed oxidation properties, toughness, thermal shock resistance, applications- cutting tool inserts, ceramic composite filters

Krishnan K. Chawla, Composite Materials, Springer, New York, 1998
Mallick, P.K, Composite Materials Technology: Process and Properties, Hanser, New York, 1990
D. Hull and T.W.Clyne, An Introduction to Composite Materials, Cambridge University Press, 1996

MT452 ADVANCED WELDING TECHNOLOGY (3-0-0) 3

Arc characteristics and metal transfer, arc temperature, coated electrodes, hardfacing electrodes, stainless steel, and cast iron electrodes, inconel electrode, special welding techniques: gas tungsten arc welding, developments in TIG welding, CO_2 welding, electroslag welding, plasma arc welding, electron beam welding, laser welding, ultrasonic welding, under water welding; weldability of steel, welding of low alloy steels, welding of stainless steel, welding of C.I., welding of dissimilar metals, weld test, solidification of weldments, heat treatment of welds, stresses in weldments, weld defects, design of weldments, fracture and failure of welds, welding equipments.

Richard L. Little, Welding and Welding Technology, Tata McGraw Hill, 2004
V. Tsegelsky, The Electric Welder, Mir Publishers, Moscow, 1968
J.F.Lancaster, Metallurgy of welding, Allen & Unwin, London, 1980

MT453 SURFACE ENGINEERING (3-0-0) 3

Current status of surface engineering, fundamentals of electrode position, electroless plating, metalliding, hard anodizing, carburizing, nitriding, carbonitriding, flame hardening, induction hardening, thermal evaporation, sputter coating, ion plating electron-beam surface treatments, electron-beam hardening, laser hardening, ion implantation, hardfacing processes: shielded metal arc welding, gas tungsten arc welding, gas metal arc welding, flux cored arc welding, submerged arc welding, plasma arc welding, oxyacetylene welding, furnace fusing, thermal spray processes.

Kenneth G.Budinsk, Surface.Engineering for Wear Resistance, Prentice Hall, New Jersey, 1988 P.K.Datta & lS.Gray, Surface Engineering, Vol. I, II, & III, Royal Society of Chemistry; 1993 J.S.Burnell-Grayand, P.K.Datta, Surface Engineering Casebook- Solutions to Corrosion and Wear- related Failures, Woodhead Pub., 1996

MT454 MODELLING AND SIMULATION IN MATERIALS PROCESSES (3-0-0) 3

Introduction to modeling, simulation models, Casting process: modeling of heat transfer, direct heat conduction modeling, one-dimensional and multidimensional inverse modeling, fluid flow and heat transfer model, thermodynamics of solidification, metal/mold interfacial heat transfer, deformation and stresses in castings, thermo-mechanical modeling in casting, determination of heat transfer coefficient and air gap width in permanent mould castings, continuous casting and DC casting process, Welding process:

weld heat -source models, thermal analysis with-microstructure, transient fluid flow, residual stresses in welds, Heat treatment: metal quenchant, interfacial heat transfer, diffusion model, microstructure model, carburization model, quench crack simulation, creep simulation, Modeling of rolling, forming and extrusion processes, Artificial Neural Net works in materials processing, Phase-field modeling and Monte-Carlo simulations, introduction to commercially available softwares - Solid Cast, FlowCast, OptiCast,.Deform HT, ProCast, MagmaSoft, Design of experiments and factorial designs.

Modeling in Welding, Hot Powder Forming and Casting (Eds. L. K-arlsson), ASM, MaterialsPark,OH, 1997.

Szekely,J.,Evans, J.E.and Brimacombe, J.K., The Mathematical and Physical Modelling of PrimaiyMetal processing Opetations, Wiley, 1988.

Numerical Recipes: The Art of Scientific Computing, Cambridge Univ. Press, N.Y., 1988.

D.R. Poirier and G.H. Geiger: Transport Phenomena in Materials Processing, TMS, warrendate 1994.

R.I. L. Guthrie: Engineering in Process Metallurgy, Oxford Science Publications (1989)

MT455 SCIENCE & TECHNOLOGY OF NANOMATERIALS (3-0-0)3

Introduction: Synthesis: Top-down and bottom-up approaches, Plasma arcing , Chemical vapor deposition, Electro-deposition, Sol-gel synthesis, High energy ball milling, Nanolithography , Self assembly , Langmuir-Blodgett films, Electrospinning.

Characterization: Particle size and surface area determination, Spectroscopy, Microscopy, Atomic force microscopy

Properties : Electrical, Physical, Optical, Chemical. Applications, Society and nanotechnology

D. L. Schodek, P. Ferreira and M. F. Ashby, Nanomaterials, Nanotechnologies and Design, Butterworth-Heinemann, Oxford, 2009.

M. Wilson, K. Kannangara, G. Smith, M. Simmons and B. Raguse, Nanotechnology: basic science and emerging technologies, CRC press, Boca Raton, 2002.

C. P. Poole, Jr., and F. J. Owens, Introduction to Nanotechnology, Wiley-Interscience, New Jersey, 2003.

MT 456 ADVANCED MICROSCOPIC TECHNIQUES (3-0-0) 3

SEM-Review of electron optics, Electron specimen interactions, image formation and interpretation, High resolution imaging, WDS and EDS, Quantitative x-ray analysis, compositional mapping, Sample preparation for inorganic, organic, hydrated and biological materials.

TEM-Review of electron optics, reciprocal space and electron diffraction, sample preparation, diffraction from crystals and small volumes, diffraction patterns and their indexing, Kikuchi diffraction, CBED, Amplitude contrast and phase contrast, Thickness and bending effects, defects and their visualisation, High resolution TEM, Quantitative analysis using TEM.Concept of EELS, STEM, XPS, Auger microscopy, SIMS, etc.

Scanning electron microscopy and X-ray analysis: J.I Goldstein et al. Plenum press, (Second or higher ed), 1992

Transmission electron microscopy: D.B. Williams & C B Carter, Springer, 2009

Electron microscopy- S. Amelincky et al. VCH publ., 1997.

MT457 SMART MATERIALS AND SENSORS (3-0-0) 3

Inorganic: solid electrolyte sensor, oxygen sensors, hydrogen sensors, sulfur and sulfur containing gas sensors, humidity sensors, gas sensitive resistors, surface acoustic wave sensors, catalytic gas detectors, semi conductor junction devices, organic: semi conductor gas sensors, surface plasm resonance sensors, mass-sensitive sensors optical chemical sensors, electro chemical sensors, future prospects, automotive sensors: ceramic sensors, silicon sensors, chemical sensors for hostile environments, Piezoelectric sensors, actuator materials, micromechanics, chiral materials, conducting and chiral polymers, electrochromic

materials, liquid crystals, molecular level smart materials, bio materials, composites, ceramics processing and fabrication, interface science, optical fibers, optical mirrors, smart skins for drag and turbulence control, other applications in aerospace / hydrospace structures, transportation vehicles, manufacturing equipment.

J. of Smart, Materials and Structures, Back volumes, Institute of Physics, Polishing Bristol, U.K.
L.Dai, Intelligent Macromolecules for Smart Devices, Springer, 2002.

MT498 METAL PROCESSING LAB (0-0-2) 1

Powder Metallurgy: powder production, powder characterization, sieve analysis, optical microscopy, particle microstructure, flow rate, apparent density; powder compaction: determination of compressibility curve, porosity determination, specimen preparation for tensile test, sintering of green compacts, tests for sintered properties: shrinkage/growth, sintered density, porosity, tensile strength, hardness using Hounsefield tensometer, microstructure; welding: welded specimens by shielded metal arc welding, oxy fuel gas welding, TIG welding and MIG welding, testing and examination of welded specimens - Rockewell hardness, tensile strength (transverse and reduced section), yield strength (transverse and reduced section), nickbreak test, microstructures of weld zone, heat affected zone and parent metal, deposition efficiency in shielded metal arc welding, welder qualification tests.

MT499 MAJOR PROJECT - II (0-0-9) 6

Mandatory Learning courses (MLC):

MLC1 Environmental Studies (1-0-0) 1
MLC2 Professional Ethics, Human Values (1-0-0) 1

MT390 PROFESSIONAL PRACTICE 1

This course is a 1 credit course during 5th and 6th semester. It consists of atleast 4 special lectures spread over entire year, arranged or suggested by the hosting department and approved by DUGC.

MT440 PRACTICAL TRAINING 2

This course is a 2 credit course. A student may complete the training before the beginning of 7th semester (or as stipulated by DUGC) and register for it in 7th Semester. The duration and the details shall be decided by the faculty advisor, with approval from DUGC.

MT490 SEMINAR (0-0-2) 1

This course is a 1 credit course to be completed during 7th / 8th semester. The student will make presentations on topics of academic interest.

Annexure X

Department of Mining Engineering (MN)
Bachelor of Technology in Mining Engineering

Basic Science Core Courses (BSC)	16
MA110 Engineering Mathematics-I	(3-0-0)3
PH110 Physics	(3-1-0)4
PH111 Physics Laboratory	(0-0-2)1
MA111Engineering Mathematics-II	(3-0-0)3
CY110Chemistry	(3-0-0)3
CY111 Chemistry Laboratory	(0-0-3)2

Engineering Science Core Courses (ESC)	30
EC 110 Elements of Electronics & Communication Engg.	(3-0-0)3
EE110 Elements of Electrical Engg	(3-0-0)3
ME110 Elements of Mechanical Engg	(3-0-0)3
CO110 Computer Programming	(3-1-0)4
CO111 Computer Programming Lab	(0-0-2)1
AM110 Engineering Mechanics	(3-0-0)3
ME200 Workshop	(0-0-2)1
ME270 Thermodynamic & Fluid Mechanics	(3-1-0)4
CV203 Mining Geology	(3-0-0)3
CV218 Mining Geology Lab	(0-0-3)2

Humanities and Social Science & Mgt. Core (HSC)	9
HU110 Professional Communication	(3-0-0)3
HU300 Engineering Economics	(3-0-0)3
HU302 Principles of Management	(3-0-0)3

Programme Specific Core (PSC)	60
MN201 Development of Mineral Deposits	(3-1-0)4
MN202 Mine Surveying	(3-1-0)4
MN203 Mine Surveying Lab	(0-0-3)2
MN204 Mining Machinery	(3-1-0)4
MN251 Mine Environmental Engineering - I	(3-1-0)4
MN252 Mine Environmental Engineering- I Lab	(0-0-3)2
MN253 Applied Mine Surveying Lab	(0-0-3)2
MN301 Surface Mining	(3-1-0)4
MN302 Mine Environmental Engineering - II	(4-0-0)4
MN303 Underground Coal Mining	(3-1-0)4
MN351 Underground Metal Mining	(3-1-0)4
MN352 Rock Mechanics	(3-1-0)4
MN353 Rock Mechanics Lab.	(0-0-3)2
MN354 Mine Systems Engineering	(3-1-0)4
MN355 Mine Camp	(0-0-0)1
MN401 Mineral Processing	(4-0-0)4
MN402 Mineral Processing Lab.	(0-0-3)2
MN451 Mine Legislation	(4-0-0)4
MN 452 Professional Practice	(0-0-1)1

Programme Specific Elective (PSE)	
MN210 Drilling & Blasting Engineering	(3-1-0)4
MN211 Seabed Mining	(3-0-0)3
MN260 Rock Excavation Engg.	(3-0-0)3
MN261 Applied Mine Surveying	(3-0-0)3
MN262 Electric Machinery in Mines	(3-0-0)3
MN310 Noise Pollution & Control Engg.	(3-0-0)3
MN311 Mine Mechanization	(3-0-0)3
MN312 Rock Reinforcement Engg.	(3-0-0)3
MN313 Mine Power Systems	(3-0-0)3
MN360 Advanced Underground Coal Mining	(3-0-0)3
MN361 Advanced Surface Mining Technology	(3-0-0)3
MN362 Production Drilling for oil wells	(3-0-0)3
MN410 Rock Fragmentation Engineering	(3-0-0)3
MN411 Strata Mechanics	(3-1-0)4
MN412 Mine Health and Safety Engg.	(3-0-0)3
MN413 Rock Slope Engineering	(3-0-0)3
MN460 Coal Washing and Handling	(3-0-0)3
MN461 Planning of Surface Mining Projects	(3-0-0)3
MN462 Planning of Underground Coal Mining Projects	(3-0-0)3
MN463 Planning of Underground Metal Mining Projects	(3-0-0)3
MN464 Computer Applications in Mining	(3-0-0)3
MN465 Environmental Management & Sustainable Development	(3-0-0)3
MN466 Mine Economics	(3-0-0)3

Open Elective (OE)	
MN314 Maintenance and Reliability Engg.	(3-0-0)3
MN315 Financial Engineering	(3-0-0)3
MN363 Tunneling Engg.	(3-0-0)3
MN414 Numerical Modeling Techniques	(3-0-0)3
MN415 Industrial Engineering & Management	(3-0-0)3
MN467 Technology Management	(3-0-0)3
MN 468 Knowledge Management	(3-0-0)3

Programme Major Project (PMP)	
MN449 Programme Major Project-I	(0-0-6)4
MN499 Programme Major Project-II	(0-0-9)5

Mandatory Learning Courses	
CY100 Environmental Studies	(1-0-0)1
HU111 Professional Ethics and Human Values	(1-0-0)1
MN254 Industrial Training –I	(0-0-0)1
MN304 Industrial Training -II	(0-0-0)1
MN403 Industrial Training -III	(0-0-0)1
MN490 Seminar	(0-0-2)1

Suggested Plan of Study:

Semester →	III	IV	V	VI	VII	VIII
1	MN201	MN251	MN301	MN351	MN401	MN451
2	MN202	MN252	MN302	MN352	MN402	MN452
3	MN203	MN253	MN303	MN353	MN403	MN490
4	MN204	MN254	MN304	MN354	MN449	MN499
5	CV203	ME200	HU302	MN355	Elective	Elective
6	CV218	ME270	Elective	HU300	Elective	Elective
7	Elective	Elective	Elective	Elective	Elective	Elective
8	Elective	Elective	Elective	Elective	Elective	Elective

Degree Requirements:

Category of Courses	Minimum Credits to be Earned
Basic Science Core(BSC)	16
Engineering Science Core(ESC)	30
Humanities and Social Sciences Core(HSC)	09
Programme Core (PC)	60
Electives	50
Programme Major Project (PMP)	09
Mandatory Learning Courses (MLC)	06
Total	**180**

MN 201 DEVELOPMENT OF MINERAL DEPOSITS (3-1-0)4

Methods of shaft construction Widening and deepening of shafts. Special methods of shaft sinking under difficult conditions. Methods of raising. Drivage of horizontal openings. Tunneling under difficult conditions. Supports: supporting roadways and mine faces.

Deshmukh, D. J., Elements of Mining Engineering, Vol. I, Central Techno Publications, Nagpur, 1998.
Onika D. Design of Mine Excavations. Mir Publishers, Moscow, 1973.
Pokrovskiy. Driving of Horizontal Workings. Mir Publishers, Moscow, 1992.

MN 202 MINE SURVEYING (3-1-0)4

Principles of mine surveying and its scope. Plane and geodetic surveying. Compass surveying. Leveling. Theodolites: Construction and operation. Tests and adjustments. Angle measurement. Errors in measurement. Traversing. Balancing of traverse. Calculation of coordinates and plotting. Contouring, Interpolation of contours. Calculation of areas and volumes. Dip, fault and borehole problems.

Punmia,B. C. Surveying Vol- I & II, Laxmi Publishers, New Delhi, 2008.
Kanetkar,T.P. Suveying, Vol- I & II, Tata McGraw Hill, New Delhi, 2007.
Ghatak, S. Mine Surveying and Levelling – Vol I, II & III, Coal Field Publishers, Asansol, 2005.

MN 203 MINE SURVEYING LAB (0-0-3)2

A total of 10 to 12 experiments shall be carried out pertaining to the subject.

MN 204 MINING MACHINERY (3-1-0)4

Basic principles of transport of men, materials and mineral in underground mines. Techno-economic indices of transportation systems. Pit top and pit bottom lay outs. Motive power used in mines. Types of compressors used in mines. Wire ropes: construction, classification, application, inspection, maintenance and calculations. Capping and slicing of ropes. Suspension gear for drum and Koepe winding. Rope haulages: Types, principle of operation, suitability, safety appliances, calculations. Winding: Drum winding and Koepe winding, Braking systems – mechanical and electrical. Drainage and Pumping. Sumps.

Ramlu M.A. Mine Hoisting. Oxford & IBH. New Delhi 1996.
Walker S.C. Mine Winding and Transport. Elsevier, Amsterdam 1988.
Deshmukh D.J. Elements of Mining Technology Vol. III; Vidyasewa Prakashan, Nagpur, 1994

MN 210 DRILLING & BLASTING ENGINEERING (3-1-0)4

Applications of drilling in mining industry. Classification and mechanism of rock drilling methods. Different types of drill machines. Alignment and deviation of bore holes. Factors influencing drilling in percussive and rotary methods. Developments in explosives and initiating devices. Properties of explosives. Safety aspects. Exploders & Circuit testers.

Das, S. K., Explosives and Blasting Practices in Mines, Lovely Prakashan, Dhanbad, 2001.
Pradhan, G. K. & Sandhu, M. S., Blasting Safety Manual, 2002
Deshmukh D.J. Elements of Mining Technology Vol. I; Vidyasewa Prakashan, Nagpur, 1994
Chug, C. P. Manual of drilling Technology, Oxonian Press Pvt. Ltd., Delhi, 1985.

MN 211 SEABED MINING (3-0-0)3

Resources from the seabed, exploring and exploiting minerals from seabed, comparison of seabed mining with traditional in-land mining. Mining systems- hydraulic mining, continuous line bucket (CLB) mining, modular or shuttle mining systems. Alternative systems for deep sea mining, transport and processing. Ore transfer technology. Environmental impact of seabed mining. Economics. Indian scene- phase wise development of seabed mining, vessels for conducting survey and research, possible ore reserves.

-148-

Hartman, H.L., Introductory Mining Engineering; Wiley Interscience, New York, 1987.
Manjula, R. Shyam, Metals from the seabed: Prospects for Mining Polymetallic Nodules of India. Oxford & IBH Publishing Co., New Delhi, 1982.

MN 251 MINE ENVIRONMENTAL ENGINEERING – I (3-1-0)4

Mine gases. Mine illumination. Heat and humidity. Cooling power of mine air. Air conditioning. Airflow in mines. Natural and mechanical ventilation. Ventilation networks. Computer aided design of ventilation systems.

Mishra, G.B. – Mine Environment and Ventilation; Oxford University Press, Delhi, 1986.
Vutukuri, V.S. & Lama, R.D. – Environmental Engineering in Mines; Cambridge University Press, Cambridge, 1986.

MN 252 MINE ENVIRONMENTAL ENGINEERING- I LAB (0-0-3)2

A total of 10 to 12 experiments shall be carried out pertaining to the subject.

MN 253 APPLIED MINE SURVEYING LAB (0-0-3)2

A total of 10 to 12 experiments shall be carried out pertaining to the subject.

MN 254 INDUSTRIAL TRAINING-1 (0-0-0)1

Industrial training should be taken up at the end of III semester, preferably in surface mines. Relevant information pertaining to the development and extraction of mineral deposits by surface mining methods, details of different equipments, layouts and other techno-economic data should be collected. Information regarding safety aspects, man-power, production and productivity, management practices and environmental protection measures should also be included in the report.

MN 260 ROCK EXCAVATION ENGINEERING (3-0-0)3

Rock excavation by different methods and different machines in mining and civil projects. Application of rock mechanics in selection of equipment. Excavation in sensitive areas. Equipments. TBMs. Project management. Arbitration. Practical examples in mining projects, ports, tunneling projects, pipeline excavations, canal excavation projects, hydel projects etc. Environmental planning, environmental impact assessment.

Stack, B., Mining and Tunneling Machine, 1978.
Martin, J. W., Martin T. J., Bennett, T. P. & Martin, K. M. Surface Mining Equipment, Martin Consultants Inc., USA, 1982.

MN 261 APPLIED MINE SURVEYING (3-0-0) 3

Triangulation: Station marks, signals and towers. Satellite station and reduction to center. Tacheometry: Tangential method and movable bar method. Curve ranging: Different methods of curve ranging. Laying of curves in underground. Theory of errors, Aerial photogrammetry, Field astronomy, Correlation survey: Connection of underground and surface survey. Total station.

Punmia, B. C. Surveying Vol- I & II, Laxmi Publishers, New Delhi, 2008.
Kanetkar, T.P. Suveying, Vol- I & II, Tata McGraw Hill, New Delhi, 2007.
Ghatak, S. Mine Surveying and Levelling – Vol I, II & III, Coal Field Publishers, Asansol, 2005.

MN262 ELECTRIC MACHINERY IN MINES (3-0-0)3

Magnetic circuits, three-phase circuit analysis, power transformers, transformer losses, tests on transformers, auto-transformers, electromechanical energy conversion principles, direct current motors and generators, poly-phase induction motors, synchronous motors and generators, electronic control of speed and torque of DC and AC motors.

Fitzgerald, A. E., Charles Kingsley Jr.& Umans, S. D., Electric Machinery, 6th Edition, McGraw Hill, 2002.
Gross, C. A., Electric Machines, 1st Edition, CRC Press, 2006.

MN 301 SURFACE MINING (3-1-0)4

Status and scope of surface mining. Elements of surface mining. Drilling and blasting operations. Details of principal production equipment. Layout of workings and waste dumps. In-pit crushing and conveying. Environmental management and reclamation in mines. Operational details of major surface mines with special reference to coal, lignite, iron, limestone etc. Selective mining. Hydraulic Mining. Techno-economic evaluation of surface mining projects.

S.K. Das, Surface Mining Technology, Lovely Prakashan, Dhanbad, 1984.
Misra, G.B., Surface Mining, Dhanbad Publishers, Dhanbad, 1994.
Deshmukh, D. J. Elements of Mining Technology, Vol. I, II & III, Central Techno Publishers, Dhanbad, 1988.

MN 302 MINE ENVIRONMENTAL ENGINEERING – II (4-0-0)4

Spontaneous combustion. Surface and underground fires. Fire extinguishers. Isolation/Explosion proof stopping. Reopening of sealed off areas. Mine explosions. Inundation. Approaching water logged areas and old workings. Water dams and design. Rescue organization. Examples of major disasters.

Ramlu, M.A. Mine Fires, Explosions, Rescue, Recovery & Inundations; Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 1991.
Rakesh & Lele, M.G. Inundation in Mines; Mrs. Asha Lata, Varanasi, 1970.

MN 303 UNDERGROUND COAL MINING (3-1-0)4

Status and scope of underground coal mining. Classification of coal reserves. Opening up of deposit. Horizon mining. Basic coal mining methods. Bord and pillar mining/ Room & pillar mining - development & depillaring. Longwall mining. Thick-seam extraction. Special methods. Hydraulic Mining. Underground gassification of coal.

Singh, R.D. Principles and Practices of Modern Coal Mining, 1997.
Singh, T.N. Underground Mining of Coal, Oxford & IBH, 1992.

MN 304 INDUSTRIAL TRAINING - II (0-0-0)1

Industrial Training – II should be taken up at the end of IV semester, preferably in underground coal mines. Relevant information pertaining to the development and extraction of coal by underground mining methods, details of different equipments working in the mines and their operational information, layouts and other techno-economic data, information regarding safety aspects, man-power, production and productivity, management practices and environmental protection measures should be included.

MN 310 NOISE POLLUTION AND CONTROL ENGINEERING (3-0-0)3

Sound behaviour: Causes of sound production. Low and high frequencies sound. Sound attenuation in air. Sound from vibrating plates: size and thickness. Sound production in air and flowing liquids. Reactive and dissipative mufflers. Sound from vibrating machines. Statutory provisions pertaining to noise. Noise measurement practice for individual noise sources. Noise measurement in community and industry. Noise prediction and modeling. Noise impact prediction and assessment. Noise abatement measures- sound absorption, acoustic barrier, vibration isolation, vibration damping, muffling and green belt- principles and design considerations. Noise pollution and management in industries. Human vibration- Health effects and control measures.

Harris, C.M : Handbook of Noise Control, McGraw- Hill Book Company, 1979.
Albert Thumann & Richard K. Miller : Secrets of Noise Control, The Fairmont Press, Georgia, 1976.
Harsha Vardhan, Noise Spectrum based Maintenance Guidelines for HEMM, Lambert Academic Publishing, 2012.

MN 311 MINE MECHANIZATION (3-0-0)3

Locomotive haulage, Rolling stocks, Conveyors, Belt conveyor calculations, Safety devices for conveyors, Face machinery, Calculation of productivity of loading machines, Aerial ropeways, Aerial ropeway calculations, Equipment for hydraulic and pneumatic stowing, Roof bolting machines, Concepts of intrinsically safe and flame-proof equipment. Mine cables, Power distribution in underground and surface mines. Concepts of variable and thyristor drives, Remote control, monitoring and automation of mining processes.

Ramlu M.A. Mine Hoisting. Oxford & IBH. New Delhi 1996.
Walker S.C. Mine Winding and Transport. Elsevier, Amsterdam 1988.
Deshmukh D.J. Elements of Mining Technology Vol. III; Vidyasewa Prakashan, Nagpur, 1994.

MN 312 ROCK REINFORCEMENT ENGINEERING (3-0-0)3

Roof bolting. Cable bolting. Shotcreting. Cavability of rocks – effect on supports design. Longwall supports. Lining of tunnels and shafts. Yieldable arches and ring sets. Reinforcement of pillars. Stabilization of slopes. Roof convergence. Stope closure. Back filling, Mechanical behavior and monitoring of various supports. Capital investment for supports, cost control process.

Biron, C and Ariglu, E., Design of Supports in Mines, John Wiley & Sons, 1983.
Britton, S.G., Construction Engineering in Underground Coal Mines, SME, 1983.

MN313 MINE POWER SYSTEMS (3-0-0)3

Electric power in mining, three-phase circuit analysis, components of mine power systems, power flow calculations, control of reactive power flow, grounding systems, ground bed construction, per unit representation, symmetrical components, analysis of symmetrical and unsymmetrical faults on mine power systems, transients and over-voltages, protective equipment and relaying.

Morley, L.A., Mine Power Systems, US Bureau of Mines Information Circular 9258, 1990.
Stevenson, W.D., Grainger, J. J., Power System Analysis, 1st Edition, McGraw Hill, 1994.
Nasar, S. A., Trutt, F. C., Electric Power Systems, 1st Edition, CRC Press, 1998.

MN 314 MAINTENANCE AND RELIABILITY ENGINEERING (3-0-0)3

Maintenance of mining machinery, MIS for maintenance function. Maintenance planning and scheduling. Reliability, availability and maintainability. Concepts of deterministic R and statistical failure of components. Different equipment failure distributions. Estimation of reliability indices for new equipment. Reliability and availability of non-maintained and maintained systems. Systems with preventive and corrective maintenance. Reliability evaluation. Introduction to Markov chains and processes. FMECA (Failure Mode Effect & Criticality Analysis). Fault tree analysis. Application of reliability in engineering systems.

John Davidson (Ed). The Reliability of Mechanical Systems. I Mech E. London 1994.
John P. Bentley. An Introduction to reliability & Quality Engineering. Longman Scientific & Technical, England, 1993.

MN 315 FINANCIAL ENGINEERING (3-0-0) 3

Scope and importance of Financial Engineering, Introduction to Financial Markets and investment instruments. Rate of return on Fixed Income Securities and Shares: Valuation of bonds and bond rating. Valuation models for equity shares. Investment decisions and risks. Asset Pricing Models, Basics of Fundamental and Technical Analysis. Derivative instruments – futures, options and hedging. Theories of Portfolio Management.

Salih N.Neftei and Fam. Principles of Financial Engineering. Elsevier Academic Press, London, 2006.
Yuh-Dauh Lyuu. Financial Engineering and Computation: Principles, Mathematics, Algorithms, Cambridge University Press: Cambridge. 2004.
Paul Wilmott. Paul Wilmott Introduces Quantitative Finance. 2nd Ed., John Wiley & Sons: West Sussex., 2004.
Prasanna Chandr. Investment Analysis and Portfolio Management, 2nd Ed., Tata-McGraw Hill Publishing Co., New Delhi, 2001.
Fisher D.E., and Jordon, R.J). Security Analysis and Portfolio Management. 6th Ed., Prentice Hall of India, New Delhi, 2001.

MN 351 UNDERGROUND METAL MINING (3-1-0)4

Development and opening up of underground deposits. Choice and suitability of entries. Draw points and ore passes. Different methods of stoping. Problems encountered in deep mines and measures to tackle them. Introduction to solution mining and in-situ leaching. Case studies from Indian Mines.

Hartman, H.L. Introductory Mining Engineering. John Wiley & Sons, 1987.
Hustrulid, W.A., SME Handbook on Metalliferous Mining, 1985.

MN 352 ROCK MECHANICS (3-1-0)4

Definition, Analysis of stresses and strains. Differential equations in elastic theory, Mohr's representation of stress and strain. Stress – strain relations in elastic and non-elastic media. Behaviour of rock under stress. Physical properties of rocks, Determination of rock indices, Physico-mechanical properties of rocks, Elastic constants under static and dynamic loading. Determination of in-situ strength properties of rocks, Rheological models, Engineering classification of rock mass, Rock fracture mechanics.

Obert, L. & Duvall, W.I.- Rock Mechanics and design of structures in rock; John Wiley & Sons, New York, 1967.
Wittke, W., Rock Mechanics, Springer-Verlag, Berlin, 1990.

MN 353 ROCK MECHANICS LAB (0-0-3)2
A total of 10 to 12 experiments shall be carried out pertaining to the subject.

MN 354 MINE SYSTEMS ENGINEERING (3-1-0)4

Introduction to systems concept, analysis and systems engineering. Models in system analysis. Basic concepts of statistical decision theory, Network techniques for mining projects. CPM and PERT techniques. Linear programming. Integer programming. Dynamic programming. Transportation and assignment models. Inventory control. Queuing theory. Simulation techniques for equipment selection and production scheduling. Significance of management information systems in controlling and managing the mining activities.

Sharma J.K. Mathematical Models in Operations Research. Tata Mcgraw-Hill, New Delhi, 1989.
Cummins . Mining Engineers Handbook, Vol. II SME, AIME, New York, 1979.

MN 355 MINE CAMP (0-0-0)1
Mine camp to be held at the end of V semester. Relevant information pertaining to the development and extraction by mining methods, details of different equipments working in the mines and their operational information, layouts and other techno-economic data, information regarding safety aspects, man-power, production and productivity, management practices and environmental protection measures should be included in the report.

MN 360 ADVANCED UNDERGROUND COAL MINING (3-0-0)3 PREREQ MN303
Planning considerations for inclines and shafts, considerations for their location and construction. Design of shaft pillar. Bord & pillar mining -design of panel, barrier pillar. Development of district by continuous miners. Depillaring. Extraction of pillars in thick and steep seams with caving and stowing. Planning of longwall panel. Caving characteristics of roof rocks. Thick seam mining- Soutirage method, Komaro method, Wangavalli method, Shield Mining.

Singh, T.N., Thick seam Mining, Oxford & IBH, 1992.
Vorbjev & Deshmukh, Advanced Coal Mining, Tata McGill, 1988.
Mathur, S.P., Advanced Coal Mining, M.S. Enterprises Bilaspur, 1999.

MN 361 ADVANCED SURFACE MINING TECHNOLOGY (3-0-0)3 PREREQ MN301
Classification of surface mining equipment systems vis-à-vis unit operations. Equipment selection criteria and procedures, application and selection. Types, basic operations, maintenance and capacity utilization, applicability and selection considerations. Computations for the capacity and number of machines vis-à-vis mine production.

Amithosh Dey, Latest Development of Heavy Earth Moving Machinery, Annapurna Publishers, Dhanbad, 1995.
Martin, J. W., Martin T. J., Bennett, T. P. & Martin,K. M. Surface Mining Equipment, Martin Consultants Inc., USA, 1982.

MN 362 PRODUCTION DRILLING FOR OIL WELLS (3-0-0)3
Geography of petroleum and natural gas. Characterisation of crude and natural gas deposits. Well logging. Interpretation and use of information in petroleum and natural gas engineering. Drilling technology for mining of crude and gas. Well completion and stimulation.

Chugh, C.P., Drilling Technology Handbook, Oxford & IBH Pub. Co, 1988.
Hartman, H.L., Introductory Mining Engineering; Wiley Interscience, New York, 1987.
Manjula, R. Shyam, Metals from the seabed: Prospects for Mining Polymetallic Nodules of India. Oxford & IBH Publishing Co., New Delhi, 1982.

MN 363 TUNNELLING ENGINEERING (3-0-0)3

Design principles of underground openings. Dimensions, shape, structural behavior and sequence of excavations. Rock conditions and initial state of stresses. Computer aided tunnel design. Tunnel driving techniques. Tunnel supports, automation of supports, Shield tunneling system with road headers. Field instrumentation, Convergence measurement, change in curvature and strain of tunnel lining, stress measurement in tunnel lining. Tunnel stability analysis, Back analysis, Case Histories.

Bieniawski, Z.T., Rock Mechanics and Design in Mining and Tunnelling, Rotterdam : A.A. Balkema, 1984.

Pokorovski, Driving Horizontal Workings and Tunnel, Mir Publishers, 1980

MN 401 MINERAL PROCESSING (4-0-0)4

Scope and objective of mineral processing. Ore handling and storage. Ore sorting, Sampling techniques and devices. Liberation and communition, Laboratory and industrial sizing. Concentration methods. Magnetic and high tension separation. Forth flotation. Classifiers. Coal quality. Coal preparation for coarse and fine coal. Washability curves and washability number. Dewatering devices. Drying and tailings disposal.

Wills, B.A., Mineral Processing Technology ; Pergamon Press – 4th Edition , 1989.

Weiss, N.L. , Mineral processing Handbook – Vol. I & II, S.M.E., 1985

MN402 MINERAL PROCESSING LAB (0-0-3)2

A total of 10 to 12 experiments shall be carried out pertaining to the subject

MN 403 INDUSTRIAL TRAINING - III (0-0-0)1

A detailed report of the industrial training undergone at the end of VI semester, preferably in underground metal mines, should be submitted. The report should consist of all details about opening up of the deposit, development and stoping techniques, specifications and operational details of equipment working in the mine, ventilation scheme, power distribution, safety aspects, management practices and environment protection measures and the relevant lay outs. Current techno-economic indices should be a part of the report.

MN 410 ROCK FRAGMENTATION ENGINEERING (3-0-0)3

Drillability indices. Specific energy. Drilling costs. Determination of drill availability and utilization. Bulk explosive systems. Substitutes for explosives. Blast design. Mechanisms of rock fragmentation due to blasting. Fragmentation prediction and assessment. Theory of shaped charges. Recent advances in blasting techniques in both underground and surface mines. Special techniques of blasting. Underwater blasting. Environmental effects and their control. Controlled blasting techniques. Economic evaluation of blasting operations.

Konya, C.G. Blast design, CRC Press, London, 1989.

Persson, Rock fragmentation. International development Corporation, Sweden, 1986.

MN 411 STRATA MECHANICS (3-1-0)4

Definition and concepts of ground control in mines; State of stress in underground openings- premining and induced stresses, influence of water, time, temperature on stress behaviour. Design of structure in rock, Design of pillars, open pit slopes, waste dumps and embankments. Underground supports: Conventional and powered supports. Rock reinforcement design. Subsidence- Concept, prediction and determination, measurement techniques, subsidence damage and its prevention. Rock bursts and bumps – mechanisms, prediction and estimation of damage.

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Obert L. and Duvall W.I. – Rock Mechanics and The Design of Structures In Rocks; John Wiley & Sons, New York, 1967..
Peng, S.S. Coal Mine Ground Control ; John Wiley & Sons, New York, 1978.
Biron C. and Arioglue E- Design of Supports in Mines; John Wiley & Sons, New York, 1983.

MN 412 MINE HEALTH AND SAFETY ENGINEERING (3-0-0)3
Mine accidents. Planning for safety. Safety analysis. Safety prevention. Information system and safety audits. Hazard Control - engineering approach, systems approach. Hazard analysis. Safety management. Economics of safety and cost-effectiveness. Occupational hazards in mines- occupational hygiene, occupational diseases.

Ridley, J & Channing, J.; Safety at Work; Butterworth-Heinemaan, Oxford, 2001.
Rodgers, W.P.; Introduction to System Safety Engineering; John Wiley & Sons Inc., New York, 1971.
Green, A.R.; Safety in Mines Research; A.A. Balkena; Rotterdam; 1985.

MN 413 ROCK SLOPE ENGINEERING (3-0-0)3
Mechanisms of slope failures. Field investigations. Design of slopes - physical, empirical, probabilistic methods, analytical (limit equilibrium analysis) and numerical (continuum models, discontinuum and crack propagation models) modeling. Stabilization and reinforcement of slopes. Slope failure monitoring.

Hoek, E. and Bray, J.W; Rock Slope Engineering; John Wiley & Sons; New York; 1984
Brawner, C.O; Stability in surface mining, SME of USA; New York, 1982.
Giani, F; Rock Slope Stability Analysis; Balkema; Rotterdam; 1992.

MN 414 NUMERICAL MODELLING TECHNIQUES (3-0-0)3
Development and use of numerical modeling for underground mine design. Finite element (2D and 3D). Boundary element (2D and 3D). Displacement and continuity. Rigid block. Discrete block models. Basic equations for mathematical modeling of rock mass. Formulation of static and dynamic behavior of rock mass. Elastic-linear and non-linear, elastoplastic and time dependent rheological models. Numerical modeling of mine roadways. Convergence prediction for roadways.

Kidybinski A. & Kwasniewski M. (Eds); Modelling of Mine Structures, A.A. Balkema, Rotterdam, 1988.
Kidybinski A. & Dubinski J. (Eds); Strata Control in Deep Mines, A.A. Balkema, Rotterdam, 1990.

MN 415 INDUSTRIAL ENGINEERING & MANAGEMENT (3-0-0)3
Concepts of Management and Organisation. Functions of Management. Organisational Structures, Basic concepts related to Organisation Departmentation. Motivation, Leadership. Group dynamics, Conflict management, Work study, Time study, Job Evaluation, Project management. Network techniques. Human Resource Management.

Khanna, O.P., Rai. D. Industrial Engineering and Management, 2005.
Stoner, Freeman, Gilbert, Management, 6th Ed, Pearson Education, New Delhi, 2005.
Ralph M Barnes, Motion and Time Studies, John Wiley and Sons. 2004.
Chase, Jacobs, Aquilano, Operations Management, TMH 10th Edition, 2003.

MN 449 PROGRAMME MAJOR PROJECT- I (0-0-6)4
A small project of relevance to mining will be taken up by the student

MN451 MINE LEGISLATION (4-0-0)4
Important statuary provisions related to Payment of Wages Act, Provident Fund Act, Mines Act- 1952, Mines Rules- 1956, Coal Mines Regulations-1957, Metalliferrous Mines Regulations-1961, Mines and

Minerals (Regulation and Development) Act, Mineral Conservation and Development Rules, Mineral Concession Rules, Mines Rescue Rules-1984, Vocational Training Rules-1966, Indian Electricity Rules-1956.

Rakesh and Prasad, Legislation in Indian Mines – A critical appraisal, Ashalata Pub., Varanasi, 1986.
Singh, C.P. Occupational Safety and Health in Industries and Mines, Tata McGill, 2004.

MN 452 PROFESSIONAL PRACTICE (0-0-1)1
Comprehensive report about the short visits made to different mines and other industries will be submitted at the end of VIII Semester

MN 460 COAL WASHING AND HANDLING (3-0-0)3
Coking and non-coking coal. Coal washeries, sink and float tests on coal, washability index, optimum degree of washability and washability number, application of jigs, heavy media cyclone, Coal cleaning techniques for fine coal and coarse coal, coal flotation, beneficiation of non-coking coal, automation and quality control in preparation plants. Environmental management in coal preparation. Coal gasification, liquefaction and new products from coal. homogenization and blending systems.

Weiss, N.L., Mineral Processing Handbook- Volume-II, Published by SME, 1985.
Krishnamoorthy, K.K., Modern Ore Testing, Khanna Publishers, Delhi, 1983.

MN 461 PLANNING OF SURFACE MINING PROJECTS (3-0-0)3 PREREQ MN301
Preliminary investigations. Stages of planning. Feasibility Report. Planning inputs. Monitoring of projects. Estimation of mine life. Openpit slope angles. Ultimate pit limit. Interrelation and planning of unit operations. Transport and dumping subsystems. Ore Blending. Equipment selection. Design of haul roads. Extraction methods for beach sand deposits, mining of developed coal seams, selective mining, Estimation of profitability, productivity and quality control.

Rzhevsky, V.V. Opencast Mining Unit Operations, Mir Publisher, 1983.
Rshensky V.V. Opencast Mining Technology and Integrated Mechanisations, Mir Publishers, 1985.

MN 462 PLANNING OF UNDERGROUND COAL MINING PROJECTS (3-0-0)3 PREREQ MN303
Objectives and Stages of Planning. Project report. Determination of mine parameters. Planning of exploitation by Bord and Pillar and Longwall Mining. Selection of face and underground transport equipment. Exploitation of thick coal seams. Planning and design layouts for ventilation, drainage and power supply. Ventilation management. Productivity and quality control; Planning of deep underground coal mines; Automation in underground coal mines.

Peng, S.S. Longwall Mining , Department of Mining Engineering, West Virginia University, 2006
Mathr, S.P. Coal Mining, M.S. Enterprises Bilaspur, 1999.

MN 463 PLANNING OF UNDERGROUND METAL MINING PROJECTS (3-0-0)3 PREREQ MN351
Planning and scheduling of insets, shaft bottoms, winding and transportation systems. Surface lay outs including mill and concentrator plants. Determination of number and dimensions of stopes. Planning and scheduling of a cycle of operations. Concept of ore blending. Overall planning and scheduling of activities in metal mining and processing. Case studies of planning of mining operations.

Agoshkov M., et. Al., Mining of Ores and Non- Metallic Minerals, Mir Publishers, Moscow, 1983.
Hartman, H.L. Introductory Mining Engineering, John Willey & Sons, 2007.

MN464 COMPUTER APPLICATIONS IN MINING (3-0-0)3
Development of algorithm and flow charts related to mining projects. Computer applications in ore reserve estimation, pit limits determination, equipments selection, blast design, ventilation planning, Computer aided production planning and scheduling for surface mines.

Ram, R. V. et. al. Computers in Mineral Industry, Oxford & IBH, 1994
Husterilid, Open Pit Mine Planning and Design, Bulkema, 1995.

MN465 ENVIRONMENTAL MANAGEMENT AND SUSTAINABLE DEVELOPMENT (3-0-0)3
Environmental problems due to mining. Land degradation. Pollution due to mining in terms of air and water. Acid Mine Drainage, Socio-economic impacts. Control measures. Pollution due to noise and vibrations. Reclamation of mined out and subsided areas. Mine closure. Environmental policies. Environmental Management Plan. Environmental Impact Assessment. Risk Analysis. Disaster management plan. Preparation of EMP for various mineral industries. Cost of environmental management. Environmental audit.

Dhar, B.B., Environmental Management of Mining Operations, Ashish Publication House, New Delhi, 1991.
Chadwick et al., Environmental Impacts of Coal Mmining and Utilization, Pergamon Press,1992.

MN 466 MINE ECONOMICS (3-0-0)3
National mineral resources. National mineral policy and strategies for development of mining industry. Resource conservation. Technology import, taxation, royalty and subsidies. Mineral trade. Concept of derivatives in mineral trade. Pricing mechanism of minerals. Sampling. Estimation of reserves. Valuation of mines and mineral properties, Life of a mining project. Project evaluation. Determination of optimum size of mine. Risk analysis in mineral investment decisions.

Alwyn E. Annels, Mineral Deposit Evaluation: A Practical Approach, Chapman Hall, 1991.
Deshmukh R.T. Mine and Mineral Economics, Emdee Publishers, 1986.

MN 467 TECHNOLOGY MANAGEMENT (3-0-0)3
Role and importance of technology management. Status of technological advances; Technology life cycle; Diffusion and growth of technology. Process technology development. Manufacturing practices. Technology development and acquisition; Models of technology transfer; Technology support systems: Financing, Venture capital; Criteria for evaluating R&D projects; Information systems; Organizing for technology at enterprise level. Management of technological innovations. Team approach. Organizational culture; Managerial style and practices supportive of creativity; Role of managerial leadership; Building a learning organization.

Rastogi, P.N. Management of Technology and Innovation: Competing Through Technological Excellence, Sage Publications, New Delhi, 1999.
Drucker Peter, F. Managing for the Future: The 1990s and Beyond, Tata McGraw Hill, New Delhi, 1992.

MN 468 KNOWLEDGE MANAGEMENT (3-0-0)3
Concepts, definitions and taxonomy of knowledge; value of knowledge in an organization. Managing knowledge in organization: need, drivers(knowledge- based, technology- based; process-based and people centric); Approaches for managing knowledge in organizations, Developing a KM frame work; KM system components and implementation strategies; KM models(Boynton and Nonaka);Knowledge Mapping; Knowledge Architecture; Related applications: Competitive intelligence, Environment scanning, knowledge/ information Audit, KM metrics and techniques for measuring knowledge; costs and benefits of KM programs in organizations. Role of knowledge Managers in an organization; case studies of KM in: sevice firms, core industry, IT firms and others

Sudhir Warier E, Knowledge Management, vikas Publishing Hourse Pvt.Ltd., New Delhi,2003
Archana Shukla and R. Srinivasan, Designing Knowledge Management Architecture: How to implement successful knowledge Management Programms, Response books, New Delhi, 2002
Awad E. M Hassan M. Ghaziri, Knowledge Management, Pearson Eduction India, New Delhi, 2004
Davenport, Thomas and Lourence Prusak, How corporations Manage What they know, Boston: Harvard Business School Press, 2002.

MN490 SEMINAR (0-0-2)1

A topic of relevance to the mining industry to be chosen and the seminar be delivered with audio – visual aids. A write up of the same should also be submitted.

MN 499 PROGRAMME MAJOR PROJECT- II (0-0-9)5

The student will work on a topic of relevance to mining in depth and shall submit a report of the same at the end of the semester

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DEPARTMENT OF APPLIED MECHANICS & HYDRAULICS (AM)
NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL
Srinivasnagar, Mangalore - 575 025

AM100 Engineering Mechanics (3-0-0) 3

Fundamental of Force System; Concept of Rigid & Deformable bodies; Free body diagrams; Support Reactions: - Determinate Structures; Support Reactions - Indeterminate Structures; Analysis of Trusses by method of joints; Centroid and moment of Inertia of plane areas; Shear Force and Bending Moment Diagrams Simple stress and strain, Hook's law, Elastic Constants.
Ref: Beer & Johnston, Mechanics for Engineers
Singer, F.L, Strength of Materials

1. Departmental Core courses

a) The departmental core courses AM250, AM300 and AM350 are restructured into the following courses.

AM250 Mechanics of Fluids (3-0-0) 3

Properties and classification of fluids. Basic equation of fluid statics. Manometers. Buoyant force. Kinematics of fluid flow. Continuity equation. Bernoulli's equation. Momentum equation. Flow measurement: Brief introduction. Dimensional analysis. Model laws. Basics of pipe flow. Hagen-Poiseuille equation. Darcy-Weisbach equation. Moody's diagram. Uniform flow in open channels.

P.N. Modi and S.M. Seth, 2009. Hydraulics and Fluid Mechanics, Standard Book House, New Delhi
V.L. Streeter and E.B. Wylie, 1997. Fluid Mechanics, McGraw Hill Book Company, New York
Ven Te Chow, 1959. Open Channel Hydraulics, McGraw Hill, New York.

AM 300 Water Resources Engineering (3-0-0) 3 PREREQ: AM250

Hydrology: Hydrologic Cycle, Water Budget, Catchment, Precipitation types, measurement, intensity, duration, temporal and spatial analysis. Infiltration, soil moisture, evaporation and transpiration, Groundwater. Run-off: Components, factors, hydrographs, unit hydrograph, flood estimation. Irrigation: Objectives, methods, Irrigation water requirements. Components of irrigation system and design principles. Water Power Engineering : Basic principles, types of schemes.

K. Subramanya, 2008. Engineering Hydrology, Tata McGraw Hill, 3rd Edition.
S.K. Garg. 2008. Irrigation Engineering and Hydraulic Structures. Khanna Pub.
Chow, V.T., LW Mays and D.R. Maidment.1988. Applied Hydrology, Tata McGraw Hill.

b) The credits for course AM 200 has been changed from (3-1-0)4 to (3-0-0) 3 without any change in the content and pre-requisite.

2. Elective course

a) The credits for course AM 421 has been changed from (2-0-3) 4 to (1-0-3) 3 without any change in the course content and pre-requisite.

Phone : (0824) 2474050, 2474000 – Extn.3040
Email : appliedmech@rediffmail.com, appmech@nitk.ac.in
Fax : (0824) 2474039
Web : http://appmech.nitk.ac.in

Department of Physics

PH100 PHYSICS (3-1-0) 4

Special theory of relativity. Elements of Quantum Mechanics: Particle properties of waves : Photoelectric effect and Compton effect. Wavelike properties of particles : de Broglie hypothesis, Davisson-Germer experiment, Wave packets, phase and group velocities, uncertainty principle. Schrodinger equations – time dependent and independent and application of Schrodinger's equation to case of free particle, particle in an infinite potential well, particle in a finite potential well, tunneling with examples (only qualitative treatment). Physics of Solids : Ohms' law, Classical free electron theory. Statistical Physics: MB, FD and BE Distribution functions Semiconductors. Electrical conductivity in intrinsic and extrinsic semiconductors, effect of temperature on electrical conductivity, Hall effect, experimental determination of carrier concentration. PN junction. Dielectric Materials : Electrical polarization mechanisms, expression for dielectric constant of monatomic gases, qualitative ideas for dielectric constant of polyatomic molecules, internal fields in solids, dielectric constant of elemental solids (Claussius Mosotti equation only). Ferroelectric and Piezoelectric materials, Piezoelectric effect.

Arthur Beiser, Concepts of Modern Physics (Sixth Edition) Tata MC Graw – Hill Publication, New Delhi (1998).

Kenneth.S. Krane, Modern Physics (Second Edition) Wiley International Edition, 1998. (Ref. Book)

A. J. Dekkar, Electrical Engineering Materials, Prentice Hall of India Ltd., New Delhi, 1990.

B.G Streetman, Solid State Electronic Devices, Prentice Hall of India Ltd., New Delhi, 1981.

PH101 PHYSICS LABORATATORY (0-0-2) 1

Experiments on Zener Diode Characteristics, Series Resonance, Helmhotz Resonator, Photoelectric effect, Transistor Characteristics, Hall Effect. Air-Wedge/Newton's Ring Experiment.

Arthur Beiser, Concepts of Modern Physics (Sixth Edition) Tata McGraw Hill publication, New Delhi (1998)

Kenneth.S. Krane, Modern Physics (Second Edition) Wiley International Edition (1998).

Practical Work book for I/II sem B.Tech Students

Chauhan & Singh, A Text book of Advanced Practical Physics

PH201 QUANTUM MECHNICS FOR ENGINEERS (3-0-0) 3

Basic principles of quantum mechanics. Probabilities and probability amplitudes. Linear vector spaces. Bra and ket vectors. Completeness, orthonormality, basis sets. Change of basis. Eigenstates and eigenvalues. Position and momentum representations. Wavefunctions, probability densities, probability current. Schrodinger equation. Expectation values. Generalized uncertainty relation. One dimensional potential problems Particle in a box. Potential barriers. Tunnelling. Linear harmonic oscillator: wavefunction approach and operator approach. Motion in three dimensions. Central potential problem. Orbital angular momentum operators. Spherical harmonics. Eigenvalues of orbital angular momentum operators. The hydrogen atom and its energy eigenvalues. Charged particle in a uniform constant magnetic field, energy eigenvalues and eigenfunctions. Schrodinger and Heisenberg pictures Heisenberg equation of motion. Interaction picture.

V.K. Thankappan, Quantum Mechanics, Wiley Eastern (1985)

A.K Ghatak, S.Lokanathan Quantum Mechanics Theory and applications, Macmillan India Ltd (1984)

PH202 BASIC NUCLEAR PHYSICS (3-0-0) 3

Atomic structure-Bohr atom model, energy levels and atomic spectra, correspondence principle.

Nuclear structure- Composition and properties of nucleus, stability and binding energy, liquid drop model and shell model, meson theory of nuclear forces. Nuclear transformations-Radioactivity, α, β and γ decay, nuclear reactions, fission and fusion, nuclear reactors. Elementary particles-interaction of charged particles, Leptons, Hadrons, Quarks, fundamental interactions.

Concepts of Modern Physics – Arthur Beiser (Ch. 4, 11, 12 and 13), Tata McGraw Hill Pub.

PH203 CLASSICAL MECHANICS (3-0-0) 3

Review of Newton's Laws of motion; Conservation principles; Harmonic oscillator; Two particle systems; Time dependent forces; Variational Principle; Lagrange's equation of motion; Charged particles in EM fields; Planetry motion; Rutherford scattering; Small Oscillations; CO_2.. Molecule; Beads on a stretched string; Euler's equation for rotating bodies; Hamilton's equations of motion; Charged particle dynamics; Virial theorem; Hamilton – Jacobi equations; Action angle variables; Poisson Brackets; Integral invariants; Stretched elastic string; Energy momentum relations.

Herbert Goldstein, Charles Poole and John Safco, Classical Mechanics (Third Edition) Pearson Education
David Morin, Introduction to Classical Mechanics with Problems & Solutions, Cambridge Univ. Press, 1st Ed. 2009.
R.G. Takwale and P.S. Puranik, Introduction to Classical Mechanics, Tata McGraw Hill, 8th reprint 1987.

PH251 ELECTRICAL PROPERTIES OF MATERIALS (3-0-0) 3

Conductivity of metals-classical free electron theory and quantum free electron theory, Semiconductors - pure and impure semiconductors, band model, conductivity and its temperature dependence, Hall effect, Direct and indirect bandgap semiconductors, p-n junction and diode equation, Dielectric properties of insulators-dielectric behaviour in static and alternating fields, dipolar relaxation and dielectric loss, ferroelectric and piezoelectric materials.

A.J.Dekkar, Electrical Engineering Materials, Prentice Hall India Publ.
B.G. Streetman, Solid State Electronic Devices, Prentice Hall India Publ.

PH252 ELECTROMAGNETIC THEORY (3-0-0) 3

Electrostatics: electrostatic field, Divergence and Curl of electric field, Electric potential. Laplace's equation in three dimetians. Separation of variables. Electrosatic field in Matter Electric displacement. Magnetostatic , Lorentz force law, Biot-Savarts law, Divergence and Curl of Magnetic field, Ampere's law. Electromotive force Faraday's law, Maxwell's Equations plane wave solutions of Maxwell's equations, Poynting vector, wave propagation through a boundary, reflection, refraction, absorption and skin depth.

D. Griffiths, Introduction to Electrodynamics, 2nd ed., Prentice Hall, 1989.
William H. Hayt . Engineering Electromagnetics, 5th ed. Tata Mc Graw Hill Publishing Company Ltd.

PH301 SEMICONDUCTOR PHYSICS (3-0-0) 3

Review of atomic structure and statistical mechanics : Schrodinger wave equation- Particle in a periodic potential well. Crystalline and amorphous; inorganic and organic; elemental and compound semiconductors. Band models. Impurities and Defects. Bulk and thin film techniques. E-k diagrams, effective mass and mobility. Temperature dependence. Degenerate and non-degenerate semiconductors. Fermi level and impurity levels, Equilibrium and non-equilibrium characteristics. Carrier transport phenomena, Electrical conductivity, Temperature dependence, Conductivity in a magnetic field, Hall effect. Thermal Conductivity, Thermoelectric power. Optical and dielectric properties. Refractive index, Transmission and reflection, Debye length, photoconductivity and photovoltaic effect.. Oxidation methods, Diffusion, Ion implantation, Metallization and Etching processes. Measurement techniques: Resistivity, energy gap, thermal conductivity, film thickness and carrier mobility..

Donald A Neamen, Semiconductor Physics and Devices-Basic Principles.
M.S. Thyagi, Semiconductor Materials and Devices.
S.M. Sze, Physics of Semiconductor Devices.

PH302 X-RAYS AND CRYSTALLOGRAPHY (3-0-0) 3

Crystal structure- crystal systems, Bravais lattices, Miller indices, inter planar spacing, atomic packing factor, structure of NaCl, CsCl, ZnS and diamond. Symmetry considerations- rotational and translational symmetries, angle between planes and directions, reciprocal lattice and its relation to diffraction patterns. X-rays- production, continuous and characteristic x-rays, properties, diffraction of x-rays, Bragg's law, Bragg's spectrometer, Laue diffraction technique and Debye-Scherrer method of structure analysis.

L. V. Azaroff, Elements of x-ray crystallography, McGraw Hill publ.

PH351 PHYSICS OF SEMICONDUCTOR DEVICES (3-0-0) 3

The PN Junction Diode, basic device technology, current-voltage characteristics, Transient behaviour and noise. Heterojunction. Bipolar transistor- static characteristics. Microwave and power transistor and related devices. Metal-semiconductor contacts. Energy band relation, transport processes, barrier height JFET and MESFET basic device characteristics. Microwave performance. MOSFET-Device structure and characteristics, Nonvolatile memory devices Tunnel Diode, IMPATT and related transit-time diodes. Transferred-electron devices- Gunn effect. Principles of photonic devices: LEDs, semiconductor lasers; photodetectors – photodiodes and APDs. Solar Cells.

S.M. Sze, Physics of Semiconductor Devices.

Donald A Neamen, Semiconductor Physics and Devices-Basic Principles

M.S. Thyagi, Semiconductor Materials and Devices.

PH352 VACUUM TECHNOLOGY AND THIN FILMS (3-0-0) 3

Production of vacuum – mechanical pumps, sorption pumps and cryogenic pumps. Measurement of vacuum – thermal conductivity gauges and ionization gauges. Behaviour of gases at low pressure. Thin films – methods of preparation – vacuum evaporation, sputtering, electro-deposition, chemical deposition. Properties of thin films. Measurement of film thickness, Applications of thin films.

L. I. Maissel and R. Glang, Handbook of thin film technology, McGraw Hill publ.

PH401 OPTOELECTRONICS (3-0-0) 3

Light Propagation in material media. Maxwell's equations, Wave equations for dielectrics, Polarization., reflection and refraction of light from dielectric interfaces, total internal reflection, light propagation in uniaxial crystals. Nonlinear polarizability of material media, second harmonic generation of light, optical rectification, frequency conversion by 3-wave mixing, parametric oscillators. Optical wave guides- Types of optical wave guides, guided modes in planar wave guides, guided modes in step-index optical fibers. Attenuation and dispersion. Directional couplers, prism couplers. Mach-Zehnder interferometer, Optical sources and detectors - light absorption and emission in semiconductors, structure, working and operating characteristics of heterojunction LED's laser diodes, photodiodse and APDs. Noise in photodiodse, Electro-optic effect, longitudinal and transeverse electro-optic modulators. Acousto-optic effect, Bragg diffraction. Photonic switching and optical bistability.

B E Saleh & M.C. Teich, Fundamentals of Photonics.

J Wilson & J F B Hawkes, Optoelectronics - an Introduction

PH402 EXPERIMENTAL TECHNIQUES FOR CHARACTERISATION OF MATERIALS (3-0-0) 3

Metallographic Techniques – Optical Microscopy, Image Analysis. Diffraction Method. Crystallographic Texture, Measurement and Analysis, X-ray diffraction residual stress techniques, Neutron Diffraction. Resonance Methods. Electron Optical Methods, Spectroscopy and Other Methods, Atomic Absorption, X-ray, Infrared, Raman Spectroscopy, Atom Probe Micro-analysis.

Edington J.W., Practical Electron Microscopy, Vol-01.

A. Goldstein, Introduction to Scanning Electron Microscopy

B.D. Cullity, Metals Handbook, Vol. 10.Elements of X-ray diffraction.

HU302 PRINCIPLES OF MANAGEMENT (3-0-0) 3

Management: science, Theory and Practice. Management and Society: External Environment, Social Responsibility and Ethics. Global, Comparative and Quality Management. Planning: Principles, Process, MBO, Strategies, Policies, Planning Premises, Strategic Management, Decision Making. Organizing: Nature, Entrepreneuring, Reengineering, Organisation Structure, Departmentation, Line Staff Authority, Power, Empowerment, Decentralisation, Effective Organizing and Organization Culture, Staffing: Human Resource Management, Recruitment and Selection, Performance Appraisal. Career Strategy, Managing Change and Organization Development, Leading: Human Factors and Motivation, Leadership, Committees, Teams, Group Decision Making and Communication. Controlling: System and Process of Controlling, Controlled Techniques, Productivity, Operations Management and Total Quality Management.

Harold Koontz and Heinz Weihrich, Essentials of Management, Tata Mc Graw Hill, 2012.
Heinz Weihrich, Mark V, Cannice and Harold Koontz, Management, Tata Mc Graw Hill, 2012.
Evans, Pucik, Barsoux, The Global Challenge, Tata Mc Graw Hill, 2010.

M.Tech in Computer Science & Engineering (CS)

Suggested Plan of Study:

Sl. No.	Semester			
	I	II	III	IV
1	CS700	CS702	CS891	CS899
2	CS701	CS703	CS899	
3	*Elective*	*Elective*		
4	*Elective*	*Elective*		
5	MA707	*Elective*		
6	CS704	CS890		

Credit Requirements:

Category	Minimum Credits to be Earned
Programme Core (Pc)	21
Elective Courses (Ele)	15
Mandatory Learning Courses (MLC)	04
Major Project (MP)	20
Total	60

Programme Core (Pc)

CS700	Algorithms and Complexity	(3-0-2) 4
CS701	High Performance Computing	(3-0-2) 4
CS702	Database Engineering	(3-0-2) 4
CS703	Network Engineering	(3-0-2) 4
CS704	Mini Project	2
MA707	Mathematical Foundations of Computer Science	(3-0-0) 3

Elective Courses

Group I	**Software Engineering**	
CS800	Software Project Management	(3-0-0) 3
CS801	Software Quality Assurance	(3-0-0) 3
CS802	Software Architecture	(3-0-0) 3
CS803	Software Testing	(3-0-0) 3
Group II	**Data Management**	
CS810	Data warehousing & Data Mining	(3-0-0) 3
CS811	Information Retrieval	(3-0-0) 3
CS812	Distributed Database Systems	(3-0-0) 3
CS813	Topics in Data Management	(3-0-0) 3
Group III	**Networks**	
CS820	Mobile Computing	(3-0-0) 3
CS821	Wireless Networks	(3-0-0) 3
CS822	Topics in Computer Networks	(3-0-0) 3
CS823	Network Management	(3-0-0) 3
Group IV	**Algorithms**	
CS830	Applied Algorithms	(3-0-0) 3
CS831	Optimization Algorithms	(3-0-0) 3
CS832	Distributed Algorithms	(3-0-0) 3
CS833	Topics in Algorithm Design	(3-0-0) 3
Group V	**Systems**	
CS840	Compiler Optimization	(3-0-0) 3
CS841	Distributed Operating Systems	(3-0-0) 3
CS842	Knowledge Based Computer Systems	(3-0-0) 3
CS843	Power Aware Computing	(3-0-0) 3
Group VI	**Internet Technology**	
CS850	Web Engineering	(3-0-0) 3
CS851	Service oriented Computing	(3-0-0) 3
CS852	Cloud Computing	(3-0-0) 3
CS853	Social Network Analysis	(3-0-0) 3
Group VII	**Open Group**	
CS860	Information Security	(3-0-0) 3
CS861	Elementary Number Theory	(3-0-0) 3
CS862	Cyber Law and Ethics	(3-0-0) 3
CS863	Security Policies	(3-0-0) 3

Mandatory Learning Courses (MLC)

CS890	Seminar	2
CS891	Practical Training *(to be completed during vacation between 2nd & 3rd sem)*	2

Major Project (MP)

CS899	Major Project (3rd Sem)	8
CS899	Major Project (4th Sem)	12

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

CS700 ALGORITHMS AND COMPLEXITY (3-0-2) 4

Algorithmic paradigms: Dynamic Programming, Greedy, Branch-and-bound; Asymptotic complexity, Amortized analysis; Graph Algorithms: Shortest paths, Flow networks; NP-completeness; Approximation algorithms; Randomized algorithms and advanced data structures.

T.H. Cormen, C.E. Leiserson, R.L. Rivest, Introduction to Algorithms, McGraw Hill, 1994.
Dan Gusfield, Algorithms on Strings, trees and Sequences, Cambridge, 2005.
Sara Baase, Computer Algorithms: Introduction to Design and Analysis, Addison Wesley, 1998.
Michael T Goodrich & Roberto Tamassia, Algorithm Design: Foundations, Analysis & Internet Examples, John Wiley, 2002.

CS701 HIGH PERFORMANCE COMPUTING (3-0-2) 4

Overview and history of computing. Architectural Classification schemes. High performance computing, overview and performance quantification criteria, limits on performance Design of high performance architecture, parallel vs. pipeline architectures. Pipeline processing. Theory of pipeline scheduling and implementation. Hazards in Pipeline processors. Hazard detection and resolution techniques. Static and dynamic schedules. Evolution of RISC ISAs and pipeline hazards. Interconnection Networks. Topics of current research in High performance computing.

K. Hwang and F. A. Briggs, Computer Architecture and Parallel Processing, McGraw Hill, 1984.
John L. Hennessy and David A. Patterson, Computer Architecture: A Quantitative Approach, 3rd Edition, Morgan Kaufmann Publishers, 2002.

CS702 DATABASE ENGINEERING (3-0-2) 4

Distributed Databases: principles, Architecture, Design, Query Optimization, Transaction Processing, Concurrency control, Integrity and Security, Client/server architecture, Parallel Databases, Web databases, Current trends in database systems.

M.TamerÖzsu, Principles of Distributed Database Systems, Second Edition,
Raghu Ramakrishnan, Database Management Systems, McGraw-Hill, 2000
Ceri S and Pelagatti G, Distributed Databases Principles and Systems, Mc.Graw Hill, 1999.

CS703 NETWORK ENGINEERING (3-0-2) 4

Internetworking: Architectural principle, layering, names and addresses. Advanced topics in Transport Protocol, Congestion Control, Fair Queuing, Router design and router protocols. Network topologies, Peer-to-Peer networks. Application level protocols. Network management and access control.

Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Elsevier
Richard Stevens, TCP/IP Illustrated, Volume 1: The Protocols PHI, 2001.
Behrouz Forouzan, TCP/IP Protocol Suite, 3/e, McGraw Hill

CS704 MINI PROJECT 2

Experimental Design / Implementation tasks of relatively minor intensity and scope as compared to the Major-project and in line with the guidelines formulated by DPGC (CSE).

MA707 MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE (3-0-0) 3

Divisibility, gcd, prime numbers, fundamental theorem of arithmetic, Congruences, Fermat's theorem, Euler function, primality testing, solution of congruances, Chinese remainder theorem, Wilson's theorem. Groups and subgroups, homomorphism theorems, cosets and normal subgroups, Lagrange's theorem, rings, finite fields, polynomial arithmetic, quadratic residues, reciprocity, discrete logarithms, elliptic curve arithmetic. Fundamental principles of counting, pigeonhole principle, countable and uncountable sets, principle of inclusion and exclusion, derangements, equivalence relations and partitions, partial order, lattices and Boolean algebra, generating functions, recurrence relations, solution of recurrences. Graphs, Euler tours, planar graphs, Hamiltonian graphs, Euler's formula, applications of Kuratowski's theorem, graph colouring, chromatic polynomials, trees, weighted trees, shortest path algorithms, spanning trees, the max-flow min-cut theorem.

Niven, H.S. Zuckerman and Montgomery, An Introduction to the Theory of Numbers, 3/e, John Wiley and Sons.

R. P. Grimaldi, Discrete and Combinatorial Mathematics: An Applied Introduction, 3/e, Addison-Wesley

B. Kolman and R.C. Busby, Discrete Mathematical Structures for Computer Science, PHI, New Delhi.

CS800 SOFTWARE PROJECT MANAGEMENT (3-0-0) 3

Basic concepts of project management; Managing requirements; Software lifecycles; Software estimation; The project plan; Monitoring the project; Risk analysis; Managing quality and People problems, CMM & P-CMM Principles.

Joel Henry, Software Project Management, Pearson Education, 2003.

Kenneth R. Bainey, Integrated IT Project Management: A Model-Centric Approach, Allied Publishers.

Mario E. Moreira, Software Configuration Management Hand Book, Allied Publishers, 2004.

CS801 SOFTWARE QUALITY ASSURANCE (3-0-0) 3

Evaluation, Role, maturity in development, life cycle, models, maintenance issues, specification, object oriented design, management, testing, mechanisms, verification and validation, cost estimation, tools, debugging, simulators, ISO 9000 standards, Quality Assurance, Quality Standards: Quality Standards, Practices & Conventions- Software Configuration Management- Reviews and Audits- Enterprise Resource Planning software, Quality Metric System: Measurement Theory- Software Quality Metrics- Designing Software Measurement Programs- Complexity Metrics and Models- Organizational Learning- Improving Quality with Methodologies- Structured/Information Engineering.

Pankaj Jalote, An Integrated Approach to Software Engineering, Narosh Publication, 1995.

Capers Jones, Software Quality: Analysis & Guidelines for success International, Thompson press, 1997.

Achieving Software Quality through Teamwork, Isabel Evans, Allied Publishers, 2004.

CS802 SOFTWARE ARCHITECTURE (3-0-0) 3

Introduction to Software Architecture An Engineering Discipline for Software, Status of S/W Arch. Architecture Business Cycle, Where do Architectures Come from. Software Processes and the Architecture Business Cycle, Features of Good Architecture. Architecture Styles Pipes and Filters, Data Abstraction and Object Oriented organization, Even-based Implicit Invocation, Layered Systems, Registers, Interpreters, Process Control, Other Familiar Architectures, Heterogeneous Architectures. Shared Information Systems Database Integration, Interpretation in Software Development Environments.

Len Bass, Paul Clements, and Rick Kazman, Software Architecture in Practice, 2nd ed, Addison-Wesley,

Garmus, Herros, "Measuring the Software Process: A Practical Guide to Functional Measure", PHI.

Florac, Carleton, "Meas. Software Process: Stat. Proce. Cont. for Software process Improvemnts", PEA.

CS803 SOFTWARE TESTING (3-0-0) 3

Software testing concepts & principles, Testing Strategies, Testability and Related Issues, Methods for developing the strategy, Life Cycle Testing, Installation Phase Testing and Various Phases of Testing; Tools and Techniques for Software Testing, Testing Object Oriented Software.

Glenford J. Myers, The Art of Software Testing, John Wiley & Sons, 1979.

Boris Beizer, Black Testing: Techniques for Functional Testing of Software and Systems, John Wiley & Sons, 1995

William Perry, Software Testing: Effective Methods for Software Testing, John Wiley, 1995

Cem Kaner, Jack Falk, Hung Quoc Nguyen, Testing Computer Software, 2nd Ed, Intl. Thomson Computer Press.

CS810 DATA WAREHOUSING & DATA MINING (3-0-0) 3

Data Warehousing: Data warehousing components and building data warehouse. Data Mining – Objectives, examples, data mining process, Data mining techniques, Generalization, Data mining knowledge representation.

Raph Kimball, Data Warehouse Toolkit, John Wiley & Sons Publications

Michael. J. Berry, Gordon Linoff : Data Mining Techniques: Marketing, Sales, Customer support. John Wiley & Sons.

CS811 INFORMATION RETRIEVAL (3-0-0) 3

Introduction to Information Retrieval: unstructured and semi-structured text. Inverted index and Boolean queries. Text Indexing, Storage and Compression: Text encoding: Retrieval Models: Performance Evaluation: Text Categorization and Filtering: Text Clustering: Advanced Topics: Web Information retrieval.

Manning, Raghavan and Schutze, Introduction to Information Retrieval, Cambridge University Press.

Baeza-Yates and Ribeiro-Neto, Modern Information Retrieval, Addison-Wesley.

Soumen Charabarti, Mining the Web, Morgan-Kaufmann.

CS812 DISTRIBUTED DATABASE SYSTEMS (3-0-0) 3

Distributed database architecture, distributed database design, distributed query processing, query decomposition and optimization of distributed queries, distributed transaction management and concurrency control, distributed DBMS reliability, distributed database operating systems, Distributed multi database systems, Client/Server database systems,Peer-to-Peer Systems, Location-based Applications, Parallel DBMS.

Principles of Distributed Database Systems, M.T. Ozsu and P. Valduriez, Prentice-Hall, 2nd Ed. 1999.

Ceri and Pelagatti, Distributed Database Principles and Systems, McGraw Hill. 2000

D. Bell and J. Grimson, Distributed Database Systems, Addison-Wesley, 1992.

CS813 TOPICS IN DATA MANAGEMENT (3-0-0) 3

Unstructured data management: limitations of structured data models, data management and information retrieval, Web-based data management: semi-structured data and querying XML, semantic Web data management, cloud computing and data management, Advanced networked information systems: pervasive and mobile data management, stream data management, sensor data management.

Sandro Fiore, Giovanni Aloisio. Grid and Cloud Database Management.2011.1st Edition

Evaggelia Pitoura and George Samaras . Data Management for Mobile Computing. 1998. Kluwer Academic Publishers.

Hara, T., Zadorozhny,V., Bachman, E. (Eds). Wireless Sensor Network Technologies for the Information Explosion Era. 2010. Springer

CS820 MOBILE COMPUTING (3-0-0) 3

Static & Mobile networking, Mobile IP, Pervasive Computing & Sensor network, mobile operating system, Distributed & Mobile Systems architecture, Mobile and Internet Protocols, Standards, Mobile applications.

Reza B' Far, Mobile Computing Principles, Cambridge, 2005.

Geoffrey Elliott & Nigel Phillips, Mobile Computing & Electronic business Technology & Applications, Pearson Education, 2003.

Ariel Pashtan, Mobile Web services, Cambridge, 2005.

CS821 WIRELESS NETWORKS (3-0-0) 3

Overview of wireless communications and networking. Transmission fundamentals, Communication networks, TCP/IP protocol stack overview, Basic wireless communication technology, channel uncertainties and countermeasures , Coding and error control. Mobile IP and wireless access protocol4. Cellular wireless networks, Overview of cellular systems (TDMA, GSM, CDMA, 3G/UMTS), Wireless LAN systems, Bluetooth, Zigbee and UWB standards, Erlang formulas

Rappaport, Theodore S., Wireless Communications, Principles and Practice, Prentice Hall, Inc, 2002, Kaveh Pahlavan, Prashant Krishnamoorthy, Principles of Wireless Networks, - A united approach - Pearson Education, 2002.

CS822 TOPICS IN COMPUTER NETWORKS (3-0-0) 3

TCP/IP Protocol Suite and Protocols in different Layers, QOS, Load Balancing, Traffic Engineering. Case study: Data center networks, Virtual networks, Mesh networks. Emerging concepts in next generation networks.

Mahbub Hassan, Raj Jain, High Performance TCP/IP Networking, Prentice Hall, 2004

Dennis Abts, John Kim, High Performance Data Center Networks: Architectures, Algorithms and Opportunities, Morgan and Claypool Publishers 2010.

Recent papers on advancement in Computer Networks

CS823 NETWORK MANAGEMENT (3-0-0) 3

Network management standards and models, network management protocols, SNMP. Management information base (MIB), Network Configuring Proto (NETCONF), Policy Management & Sharing of Data, approaches for sharing information. Heterogeneous Network and network security management, Network Management tools and applications.

John Strassner, Policy based Networking management, Morgan Kaufman/Elsevier, 2004

M. Subramanian, Network Management: Principles and Practice, Addson- Wesley, 2000

J. Burke, Network Management Concepts and Practice, A Hands-On Approach, Pearson Education,2000.

CS830 APPLIED ALGORITHMS (3-0-0) 3

Selected algorithms from areas such as graph and combinatorial algorithms, computational geometry, string processing algorithms, algebraic and number theoretic algorithms, linear programming and combinatorial optimization.

Dan Gusfield Algorithms on Strings, Trees and Sequences, Cambridge Univ. Press, 2005.

C. Papadimitrou and K. Steiglitz, Combinatorial Optimization, Prentice-Hall, 2000

CS831 OPTIMIZATION ALGORITHMS (3-0-0) 3

Basic OR techniques, requirements, networks, design, role and methods, databases, compilers, optimization and performance in web computing, internet application, performance measurement tools, case studies

K Kanth, Introduction to computer system performance evaluation, McGraw Hill, 1992

David K smith, Network Optimization in Practice, Ellis Horwood publications, 1982

CS832 DISTRIBUTED ALGORITHMS (3-0-0) 3

Distributed algorithms are algorithms designed to run on multiple processors, without tight centralized control. In general, they are harder to design and harder to understand than single-processor sequential algorithms. Distributed algorithms are used in many practical systems, ranging from large computer networks to multiprocessor shared-memory systems. They also have a rich theory, which forms the subject matter for this course.

Nancy & Lynch, Distributed Algorithms, Harcour Asia, 2001.

Gerard Tel. Introduction to Distributed Algorithms. Cambridge University Press, Cambridge, UK, 2ndedition, 2000.

CS833 TOPICS IN ALGORITHM DESIGN (3-0-0) 3

Overview and comparative study of various algorithm design techniques. Randomized algorithms, Algorithms in Computational Biology, Parallel Algorithms, Algorithms for the web.

R. Motwani and P. Raghavan, Randomized Algorithms, Cambridge University Press, 1995

Haralambos Marmanis and Dmitry Babenko, Algorithms of the Intelligent, Manning Publications, 2009

Wing-Kin Sung, Algorithms in BioInformatics: A Practical Introduction, Chapman and Hall, Boca Raton, Florida, 2010.

CS840 COMPILER OPTIMIZATION (3-0-0) 3

Review of compiler fundamentals - lexical analysis, parsing, semantic analysis, error recovery and intermediate code generation; Runtime storage management; Code generation; Code improvement - peephole optimization, dependence analysis and redundancy elimination, loop optimization, procedural and inter-procedural optimization, instruction scheduling, optimization for memory hierarchy; Compilation for high performance architecture; Portability and retarget ability; Selected topics from compilers for imperative, object-oriented and mark-up languages, parallel and distributed programming and concurrency.

Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, Compilers: Principles, Techniques and Tools, Addison-Wesley.

Michael L. Scott, Programming Language Pragmatics, Elsevier.

Andrew W. Appel, Modern Compiler Implementation in C/Java, Cambridge University Press.

CS841 DISTRIBUTED OPERATING SYSTEMS (3-0-0) 3

Introduction to Distributed Systems: Distributed systems: Goals Hardware Concepts Software - design Communication distributed systems: Layered Protocol: ATM Networks client server model - remote procedure call – group communication. Synchronization: Clock synchronization - mutual exclusion - election atomic transactions - dead locks. Process and Processors: Threads - System models processor allocation - scheduling fault tolerance - real time distributed systems. Distributed file systems: File system design and implementation - trends in distributed file systems. Shared Memory: Introduction - bus based multi processors ring based multiprocessors switched multiprocessors - NUMA comparison of shared memory systems - consistency models - page based distributed shared memory - shared variable distributed shared memory - object based distributed shared memory. Case studies: MACH and CHORUS

Andrew S. Tanenbaum, Maarten " Distributed Operating System, *Prentice-Hall , 2005*

R. Chow and T. Johnson, Distributed Operating Systems & Algorithms, *Addison-Wesley (1997)*

CS842 KNOWLEDGE BASED COMPUTER SYSTEMS (3-0-0) 3

Architecture of AI & KBCS Systems, Design Issues of KBCS, Introduction to Expert System, Introduction to fuzzy logic systems, Natural Language processing, Heuristic Search techniques, knowledge based systems AI for security systems

Nilson, Artificial Intelligence: A new Synthesis, 2001.

Taghi M. Khosgoftaar, Software Engineering with Computational Intelligence, Allied Publishers, 2004.

Soldek, Jerzy, Drobiazgiewicz, Leszek, Artificial Intelligence and Security in Computing Systems, Allied Publishers, 2004.

CS843 POWER AWARE COMPUTING (3-0-0) 3

Energy- efficient, power efficient and thermal aware computing and communication Newton's cooling model and basic thermodynamics and sustainability. Middleware Support for green computing: Power states Power states Voltage and frequency scaling ACPI support for Linux and, Voltage and frequency scaling, ACPI support for Linux and Windows, compiler optimization, virtualization and server consolidation. Tools for monitoring: Sensor networks, cooling equipment and their behavior. HPC computing: Hadoop, Map-Reduce, Dynamic thermal-aware scheduling, Resource Management in Virtualized Environment. Green Mobile, embedded computing and networking: Optimizing for minimizing battery consumption, Safe and Sustainable Cyber-physical systems (Medical devices). Management Frameworks Standards and metrics for green computing

K. Kant, Data center evolution - a state of the art issues and challenges, Elsevier Computer Networks

L. Barraso and Holzl, Case for Energy Proportional Computing, IEEE Computer Dec 2007

CS850 WEB ENGINEERING (3-0-0) 3

Perspectives on Web Engineering, Requirements specifications & web based system dev. Methodologies, migration of legacy systems to web environments-technology and solutions, web-based real time application development, Web engineering- the new paradigm with multi disciplinary facts, user-centered web design & applications, web metrics, HCI, Testing, verification and validation

Journal of Web Engineering, Rinton Press & IEEE and ACM publications on these areas.

Cato & John, User centered Web design, Pearson Education, 2001.

Zimmermann, Olaf; Tomlinson, Mark R.; Peuser, Stefan, Perspectives on Web Services, Allied Publishers, 2004.

CS851 SERVICE ORIENTED COMPUTING (3-0-0) 3

SOA Reference Model and Service Models, SOA Business Case, Service Design Principles, BPEL, Modeling SOA with CPN and OPNET, SOA, SOAP and REST, SOA Infrastructure, SOA Governance, Web Services, Identity and Security, Technologies, Tooling and Vendors.

Thomas Erl, Service-Oriented Architecture: Concepts, Technology and Design, 2006

Mark Hansen. SOA Using Java Web Services,

CS852 CLOUD COMPUTING (3-0-0) 3

Introduction to Cloud Computing, Cloud Computing Delivery Models, Open Source and Industry case Studies of cloud (Apache VCL, Amazon, IBM and Eucalyptus) Introduction to Map/Reduce and Apache Hadoop Programming models for cloud computing and examples/applications, Virtualizations as an enabler for cloud computing infrastructure.

George Reese Cloud Application Architectures", O'Reilly Publications, 2009

Tim Mather, Subra Kumaraswamy, Cloud Security and Privacy, O'Reilly, 2009

Tom White, The Hadoop – Definitive Guide, O'Reilly, 2009

CS853 SOCIAL NETWORK ANALYSIS (3-0-0) 3

Different sources of network data, types of networks, tools for visualizing network data, review of graph theory basics. Structural properties of networks: Notions of centrality, cohesiveness of subgroups, roles and positions, structural equivalence, equitable partitions, stochastic block models. Cascading properties of networks: Information/influence diffusion on networks, maximizing influence spread, power law and heavy tail distributions, preferential attachment models, small world phenomenon. Mining Graphs: Community and cluster detection: random walks, spectral methods; link analysis for web mining

Wasserman, Stanley, & Faust, Katherine. Social Network Analysis: Methods and Applications. Cambridge: Cambridge University Press, 1994.

Scott, John. Social Network Analysis: A Handbook. 2nd Ed. 1994. Newberry Park, CA: Sage.

Robert Hanneman and Mark Riddle. Introduction to Social Network Methods, 2004.

CS860 INFORMATION SECURITY (3-0-0) 3

Information Security & cryptography - Basic concepts, Access control, Protection, Secure coding, Cryptography, Network security, Firewalls, Attack Techniques, IDS, Randomized algorithms, cryptography applications.

Goldrich, Foundations of Cryptography-Applications, vol-2, Cambridge Univ.Press, 2005

Blake, Seroussi & Smart, Advances in Elliptic curve cryptography, Cambridge, 2005.

CS861 ELEMENTARY NUMBER THEORY (3-0-0) 3

Elementary number theory, Finite fields, Arithmetic and algebraic algorithms, Secret key and public key cryptography, Pseudo random bit generators, Block and stream ciphers, Hash functions and message digests, Public key encryption, Probabilistic encryption, Authentication, Digital signatures, Zero knowledge interactive protocols.

Koblitz, N. Course on Number Theory and Cryptography, Springer Verlag, 1986

Menezes, A, et.al. Handbook of Applied Cryptography, CRC Press, 1996

Ivan Niven, Herbert S. Zukerman, Hugh L. Montgomery, An Introduction to the Theory of Numbers.

CS862 CYBER LAW AND ETHICS (3-0-0) 3

Cyber laws and rights in today's digital age; IT Act, Intellectual Property Issues connected with use and management of Digital Data The similar Acts of other countries Information Warfare: Nature of information warfare, including computer crime and information terrorism; Threats to information resources, including military and economic espionage, communications eavesdropping, computer break-ins, denial-of-service, destruction and modification of data, distortion and fabrication of information, forgery, control and disruption of information How, electronic bombs, and sops and perception management. Countermeasures, including authentication, encryption, auditing, monitoring, intrusion election, and firewalls, and the limitations of those countermeasures. Cyberspace law and law enforcement, information warfare and the military, and intelligence in the information age. Information warfare policy and ethical Issues.

Hon C Graff, Cryptography and E-Commerce - A Wiley Tech Brief, Wiley Computer Publisher, 2001.

Michael Cross, Norris L Johnson, Tony Piltzecker, Security, Shroff Publishers and Distributors Ltd.

CS863 SECURITY POLICIES (3-0-0) 3

General Overview of Policies, Policy Lifecycle, and Writing Security Policies, Information Classification and Privacy Policies, Network Security and Email Policies, Application, Operating System and Software Security Policy, Encryption and Key Management Policy, Security Policy: Audit and Compliance, Acceptable Use Policies and Training /Awareness, Security Policy: Enforcement and Effectiveness, Internet Censorship, Intellectual Property Protection, International Cooperation in Cyber Crime.

Scott Barman, Writing Information Security Policies, New Riders Publication.

Charles Cresson Wood, Information Security Policy made Easy.

Appendix XV

M.Tech in Computer Science & Engineering- Information Security (IS)

Suggested Plan of Study:

Sl. No.	Semester			
	I	II	III	IV
1	CS700	CS702	IS891	IS899
2	IS701	IS703	IS899	
3	*Elective*	*Elective*		
4	*Elective*	*Elective*		
5	MA707	*Elective*		
6	IS704	IS890		

Credit Requirements:

Category	Minimum Credits to be Earned
Programme Core (Pc)	21
Elective Courses (Ele)	15
Mandatory Learning Courses (MLC)	04
Major Project (MP)	20
Total	60

Programme Core (Pc)

CS700	Algorithms and Complexity	(3-0-2) 4
IS701	Number Theory & Cryptography	(3-0-2) 4
CS702	Database Engineering	(3-0-2) 4
IS703	Network Security	(3-0-2) 4
IS704	Mini Project	2
MA707	Mathematical Foundations of Computer Science	(3-0-0) 3

Elective Courses

Group I Secure Software Design

IS800	Formal Methods	(3-0-0) 3
IS801	Secure Coding	(3-0-0) 3
IS802	Security Architecture: Design & Analysis	(3-0-0) 3
IS803	Information Security Audit	(3-0-0) 3

Group II System Security

IS810	Security Administration	(3-0-0) 3
IS811	Security Threats & Vulnerability	(3-0-0) 3
IS812	Enterprise Security	(3-0-0) 3
IS813	Security in Computer System	(3-0-0) 3

Group III Cryptography

IS820	Applied Cryptography	(3-0-0) 3
IS821	Cryptographic Protocols	(3-0-0) 3
IS822	Advanced Cryptography	(3-0-0) 3
IS823	Cryptanalysis	(3-0-0) 3

Group IV Application Security

IS830	Database Security	(3-0-0) 3
IS831	Biometric Security	(3-0-0) 3
IS832	Web Application Security	(3-0-0) 3
IS833	Multimedia Security	(3-0-0) 3

Group V Network Security

IS840	Network Engineering	(3-0-0) 3
IS841	Distributed Systems Security	(3-0-0) 3
IS842	Internet Security	(3-0-0) 3
IS843	Mobile & Wireless Network Security	(3-0-0) 3

Group VI Advanced Security

IS850	Cyber Forensics	(3-0-0) 3
IS851	Cloud Security	(3-0-0) 3
IS852	Ethical Hacking	(3-0-0) 3
IS853	Advanced Topics in Security	(3-0-0) 3

Group VII

IS860	High Performance Computing for Security	(3-0-0) 3

And Any electives from Open group of M.Tech (CSE)

Mandatory Learning Courses (MLC)

IS890	Seminar	2
IS891	Practical Training *(to be completed during vacation between 2nd & 3rd sem)*	2

Major Project (MP)

IS899	Major Project (3rd Sem)	8
IS899	Major Project (4th Sem)	12

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

IS701 NUMBER THEORY & CRYPTOGRAPHY (3-0-2) 4

Elementary number theory, Finite fields, Arithmetic and algebraic algorithms, Secret key and public key cryptography, Pseudo random bit generators, Block and stream ciphers, Hash functions and message digests, Public key encryption, Probabilistic encryption, Authentication, Digital signatures, Zero knowledge interactive protocols, Elliptic curve cryptosystems, Formal verification, Hard problems, Randomness and Pseudo randomness & Testing.

Koblitz, N. Course on Number Theory and Cryptography, Springer Verlag, 1986
Menezes, A, et.al. Handbook of Applied Cryptography, CRC Press, 1996
Ivan Niven, Herbert S. Zukerman, Hugh L. Montgomery, An Introduction to the Theory of Numbers.

IS703 NETWORK SECURITY (3-0-2) 4

Introduction - Attacks, services and mechanisms - Classical encryption techniques - DES -Block cipher - Design principles and modes of operation. Encryption Algorithms - Hash functions - Triple DES - RC5 - Key management – Public key cryptography - RSA algorithm - Digital signatures and authentication protocols. System Security - Backups - Integrity management - Protecting against programmed threats, viruses and worms - Physical security - Personnel security. Network Security - Protection against eavesdropping - Security for modems - IP security - Web security - Electronic mail security - Authentication applications. Security Tools - Firewalls - Wrappers - Proxies - Discovering a break-in - Denial of service attacks and solutions - Cryptographic security tools: Kerberos, PGP, SSH, SRP, OPIE.

William Stallings, "cryptography and network security – principles and practice", ii Edition, Pearson education, 2000
Steve Burnett, Stephene Paine, "rsa security's official guide to cryptography", TMH, 2001
E. Nemeth, g. Snyder, s. Seebass, t.r. Hein, "unix system administration Handbook", 3rd Ed., PEL

IS704 MINI PROJECT 2

Experimental Design / Implementation tasks of relatively minor intensity and scope as compared to the Major-project and in line with the guidelines formulated by DPGC (CSE-IS).

IS800 FORMAL METHODS (3-0-0) 3

Formal Methods in Computing Specification; Formal Description Techniques in Communication Software Systems; Formal Methods in Object Orientation and Software Engineering, Proof Methods and Techniques, Temporal and Model Logic

Jan Ven Lecuwen—Formal Model and Semantics, Elsevier-MIT Press, 1992
Arindama Singh—Logic for Computer Science, PHI, IEEE, 2003
Programming Perl. Larry Wall, Tom Christensen and Randal Schwartz.1996. O'Reilly & Associates, Inc.

IS801 SECURE CODING (3-0-0) 3

Buffer Overrun, Format String Problems, Integer Overflow, and Software Security Fundamentals , SQL Injection, Command Injection, Failure to Handle Errors, and Security Touch points, Cross Site Scripting, Magic URLs, Weak Passwords, Failing to Protect Data, Weak random numbers, improper use of cryptography, Information Leakage, ace Conditions, Poor Usability, Not Updating Easily, Executing with too much privilege , Failing to protect network traffic, improper use of PKI, trusting network name resolution.

Howard, LeBlanc, and Viega, 24 Deadly Sins of Software Security, ISBN: 978-0-07-162675-0
John Viega and Gary McGraw, Building Secure Software, Addison Wesley
Gary McGraw, Software Security: Building Security, Addison-Wesley

IS802 SECURITY ARCHITECTURE –DESIGN & ANALYSIS (3-0-0) 3

Secure systems – hardware, software and communication systems – design issues and analysis, Secure software architecture – models and principles, hardware design related security – smart cards and other security solutions, communication protocols and application systems associated with security.

Asoke Talukder, Manish Chaitanya, Architecting Secure Software Systems, CRC Press

IS803 INFORMATION SECURITY AUDIT (3-0-0) 3

Security Policy frameworks: practices, and procedures, business practice disclosures. Policy authority and practices, information security practices, personal and physical security practices, operation management practices, PKIs and key management schemes, key generation, key storage, backup, recovery and distribution, XML frameworks for security policy specification, certificate management life cycle. Output measurement approaches, benchmarking, function points as measurement, estimation of software reliability, software metrics, software auditing, merits and auditing in outsourcing, SEI & ISO based measurement, merits, CMM and P-CMM, Auditing Standards & groups, Audit Methods & Tools.

International Function Points user group, IT measurement, Person education, 2002

Encyclopedia of Software Engineering, John Wiley & Sons 1994.

IS810 SECURITY ADMINISTRATION (3-0-0) 3

Communication Security & configurations, Win 2003, Linux / Unix security & administration, Use of digital Signatures, SHHTP,SSL, Firewalls in organizational network and system administration, Backup, Viruses, SPAM and other security measures.

Lars Klander, Hacker Proof, Galgotia publications, 2002

Internet Security Professional Security – Techmedia publications, 2002

IS811 SECURITY THREATS & VULNERABILITY (3-0-0) 3

Basic security principles, principle of least privilege trust, trusted computing basics, reference monitors, inline reference monitors and access control, secure multi party computation, secure two party models. Mobile code security Digital Defense: Issues in Security, and Critical Infrastructure Protection: Threats of viruses, worms, malicious codes, etc. models of propagation and their epidemic spread, dos attacks, defenses against hacking. DDoS, design of scalable test beds for simulation of attacks against critical infrastructures, architectures for robust

and flexible Internet, ubiquitous, dependable and indestructible storage.

Ross Anderson , Security Engineering: A guide to Building dependable Distributed systems, John Wiley,

Raymond Panko, Corporate Computer and Network Security

IS812 ENTERPRISE SECURITY (3-0-0) 3

Enterprise security basics, enterprise access control and crypto system techniques, enterprise security systems: design concepts, network, software and database security. Network Recovery concepts in Enterprises.

Robert C. Newmann, Enterprise Security, Pearson Education, 2005.

Michael Cross, Norris L Johnson, Tony Piltzecker, Security , Shroff Publishers and Distributors Pvt. Ltd.

Jean & Mario, Network Recovery, Elsevier India, 2005.

IS813 SECURITY IN COMPUTER SYSTEM (3-0-0) 3

Basic concepts, Access control, Protection, Secure coding, Cryptography, Network security, Firewalls, Security on the Internet and the World Wide Web, Attack Techniques, IDS, Security in Windows, Linux, Social & Ethical issues of Information Security, Information Security management, Case studies & current topics.

Matt Bishop, Computer Security: Arts & Science, Pearson Education, 2004.

Michael Cross, Norris L Johnson, Tony Piltzecker, Security, Shroff Publishers and Distributors Pvt. Ltd.

Pieprzyk, Josef, Hardjono, Thomas; Seberry, Jennifer, Fundamentals of Computer Security, Allied Publ.

IS820 APPLIED CRYPTOGRAPHY (3-0-0) 3

Privacy-Enhancing Technologies, Privacy-Preserving Data Collection and Data Publishing, Privacy-Preserving Data Mining, K-Anonymity, Anonymous communications, Anonymous credentials, Group signatures, Privacy and anonymity in peer-to-peer architectures, Privacy-enhanced access control or authentication/certification, Advanced Crypto Algorithms and Protocols, Zero-knowledge proof, Oblivious Transfer, Secure Multiparty Computation Digital Cash, Secret Sharing, Threshold Cryptography, Identity-Based Encryption, Attribute-Based Encryption

B.Schneier, Applied Cryptography, John Wiley & Sons.

Alfred J. Menezes, Paul C. Van Oorschot, Scott A. Vanstone Handbook of Applied Cryptography, CRC Press

Jonathan Katz and Yehuda Lindell, Introduction to Modern Cryptography, Chapman & Hall/CRC Press

IS821 CRYPTOGRAPHIC PROTOCOLS (3-0-0) 3

Competitive strategies for the information economy, network economics; Technologies and applications of telecommunications systems with emphasis on LANs and Internet technologies. Selection of technologies and configurations necessary to support business applications. Competitive, economic, and political factors that influence technology innovation in public and private organizations, domestically and internationally. Management of research and development: project selection, resource allocation, technology planning, management of development projects. Quality, manufacturing, and intellectual properly issues. Concepts in communication security, security issues in layered architecture, components of security models, IPSec, Transport layer security, SHTTP, IP encapsulation, VPNs, open PGP, Secret key & Public key cryptography , MD5, DES, Internet key Exchange, firewall & Internet Security protocols.

Huth, Secure communication systems: Design, analysis and implementation, Cambridge, 2005

Ross Anderson, Security Engineering: A Guide to Building Dependable Distributed Systems, John Wiley & Sons, 2001.

IS822 ADVANCED CRYPTOGRAPHY (3-0-0) 3

Objectives of cryptography, Symmetric Key Encryption- Stream ciphers & Block ciphers, Public-Key cryptography: RSA, Hash-functions, Discrete logarithm, Modular Squaring, Cryptographic Protocols: Key exchange & entity authentication, identification schemes, commitment schemes, electronic elections. Probabilistic algorithms, probably secure encryption & Digital signatures. Mathematical Models for Internet: Design and control communication networks that respond to: randomly fluctuating demands and failures by adapting rates, by rerouting traffic and by reallocating resources, stability and fairness of rate control algorithms for the Internet; economic issues, scalable models of simulation of such networks, Quantum Cryptography

Wenbo Mao, Modern Cryptography- Theory and Practice, Prentice Hall, 2004.

Susan Loepp & William K. Wooters, Protecting Information (Quantum Cryptography) Cambridge, 2005.

Hans DelFs & Helmutt Knebl, Introduction to cryptography: Principles & Application, Springer Verlag.

IS823 CRYPTANALYSIS (3-0-0) 3

Modern cryptography, Steganography, One-way functions; pseudo-randomness and random number generators; encryption; authentication, symmetric cryptography, asymmetric cryptography: public-key cryptosystem; digital signatures, message authentication codes, remote user authentication, notions of security; zero knowledge/ interactive proofs, multi-party cryptographic protocols, key exchange and applications; cryptanalysis of cryptographic primitives and protocols, such as by side-channel attacks, differential cryptanalysis, or replay attacks; and cryptanalytic techniques on deployed systems etc. Lattices in cryptography and cryptanalysis: Algorithmic aspects of the theory of point lattices and their applications to cryptography and cryptanalysis. Differential and Linear Cryptanalysis, side channel cryptanalysis.

Spillman & Richard J, Classical and Contemporary Cryptology, PHI International, 2004.

Han & Helmutt, Introduction to Cryptography: Principles and Applications, Springer Verlag 2002.

IS830 DATABASE SECURITY (3-0-0) 3

Design of Survivable and Dependable Distributed Systems: Issues in the design of distributed systems distributed OS, high-level protocols, distributed shared memory. OO distributed systems, distributed directory services, fault tolerance issues, issues of survivability, dependability, robustness. Distributed Systems and Fault Tolerance, Security Architecture for FT Systems, Security Architecture for Services, Algorithms, Techniques for Fault Tolerance and high integrity Services, Tools and Environments for building higher integrity service.

Ross Anderson, Security Engineering: A Guide to Building Dependable Distributed Systems, John Wiley & Sons, 2001.

Michael & David, Writing secure code, Microsoft Press, 2002.

IS831 BIOMETRIC SECURITY (3-0-0) 3

Security via biometrics. Spaced Domain based biometric and recognition techniques; Correlation based biometric, filters. Basic theory or Correlation filters; Design of advanced correlation fillers that offer tolerance to expected impairments; Methods to implement digital correlations; Applications of correlation filters.

Reid, Biometrics for Network Security, Pearson Education, 2004.

James L. Wayman , Anil K. Jain, Davide Maltoni, Dario Maio, Biometric Systems: Technology, Design and Performance Evaluation , Springer

Anil K. Jain, Ruud Bolle, Sharath Pankanti , Biometrics: Personal Identification in Networked Society, Kluwer Academic Publishers

IS832 WEB APPLICATION SECURITY (3-0-0) 3

Web safety and browser vulnerabilities, privacy concerns, issues with Java, JavaScript, ActiveX, and all things Web and security related. Various protocols and approaches to provide web services in as secure a manner as possible will be investigated, to include: digital certificates SSL (Secure Socket Layer), TLS (Transport Layer Security), host security, server access methods, and secure CGI/API.

D. Stuttard and M. Pinto. The Web Application Hacker's Handbook. Wiley. 2008.

Ivan Ristik. ModSecurity Handbook. Feisty Duck, Ltd. 2010.

Open Web Application Security Project. A Guide to Building Secure Web Applications and Web Services. http://www.owasp.org/index.php/Category:OWASP_Guide_Project

IS833 MULTIMEDIA SECURITY (3-0-0) 3

Introduction to digital rights management, Digital Watermarking-Basics, Theoretical Aspects, Schemes, Protocols, Media-specific watermarking. Steganography and Steganalysis, Finger Printing and Digital Forensics, Data Sanitization.

Ingemar Cox, Matthew Miller, Jeffrey Bloom, Digital Watermarking: Principles & Practice, The Morgan Kaufmann Series in Multimedia and Information Systems

Borko Furht, Darko Kirovski, Borivoje Furht, Multimedia Security Handbook (Internet and Communications), CRC Press, 2004

Bill Rosenblatt, Bill Trippe, Stephen Mooney, Digital Rights Management: Business and Technology, Wiley; 1st edition, 2001

IS840 NETWORK ENGINEERING (3-0-0) 3

Internetworking: Architectural principle, layering, names and addresses. Advanced topics in Transport Protocol, Congestion Control, Fair Queuing, Router design and router protocols. Network topologies, Peer-to-Peer networks. Application level protocols. Network management and access control.

Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Elsevier

Richard Stevens, TCP/IP Illustrated, Volume 1: The Protocols PHI, 2001.

Behrouz Forouzan, TCP/IP Protocol Suite, 3/e, McGraw Hill

IS841 DISTRIBUTED SYSTEMS SECURITY (3-0-0) 3

Distribute systems concepts and design, Weak connectivity and update conflicts, GFS, Cryptographic Primitives, SSL, Reasoning formally about authentication, Software vulnerabilities and exploits, Software based fault isolation.

Charlie Kaufman, Radia Perlman, and Mike Speciner, Network Security: Private Communication in a Public World, 2nd Edition, Prentice Hall, 2002

Abhijit Belapurkar, Anirban Chakrabarti et. al, Distributed Systems Security: Issues, Processes and Solutions, Willey Publs.

IS842 INTERNET SECURITY (3-0-0) 3

Business & legal principles, Information Security-Technological Solutions, Internet Security, Certificates Policies & Principles for E-business, non-repudiations-types & activities, PKI and its roles, examples & case studies.

Warwick Ford & Micheal Secure E-commerce, PH-PTR, 2001

Enrico Nardelli, Certification and Security in E-Services, Allied Publishers, 2004.

Gritzalis, Dimitris, Secure Electronic Voting, Allied Publishers, 2004.

IS843 MOBILE & WIRELESS NETWORK SECURITY (3-0-0) 3

Wired /wireless networks; Effect of mobility on networks, & systems; impact on IP stack from MAC layer and up; ad-hoc and sensor networks; wireless broadcast. II* broadcast. Satellite broadcast; issues of information capacity; distinction between wired and wireless networks from information theory; Issues of security in wireless; issues of 802.11 protocols; routing in wireless networks, design of secure protocols: key distribution for access control, source authentication of transmissions, and non-repudiation; Power management and selfishness issues, attacks in wireless networks; DOS and DDOS attacks, reaction to attacks, information processing for sensor networks

Perrig, Adrian; Tygar J. D., Secure Broadcast Communication in Wired and Wireless Networks, Allied Publishers, 2004.

Makki, S.K.; Reiher, P.; Makki, K.; Pissinou, N.; Makki, S. (Eds.), Mobile and Wireless Network Security and Privacy, Springer .

IS850 CYBER FORENSICS (3-0-0) 3

Industrial espionage and cyber-terrorism, principles of criminal law, computer forensic investigation, elements of personnel security and investigations, principles of risk and security management, conspiracy in computer crime, and computer fraud investigation. Introduction to Cyber Forensics: Computer Forensics and the law, Private & Public sector workplace practices, Cyber Crime examples: Defacements, DoS, Credit Card theft, Silent intrusion, internal attacks, investigative actions, Forensics analysis investigative action, Computer Forensic tools.

Jennifer Bayuk, Cyber Forensics: Understanding Information Security Investigations, Springer

Bill Nelson, Amelia Phillips, Christopher Steuart , Guide to Computer Forensics and Investigations

IS851 CLOUD SECURITY (3-0-0) 3

Introduction to cloud computing, Modular arithmetic background, concepts of security, how to assess security of a system, information theoretic security v/s computational security, Data security and storage in cloud, data dispersal techniques, High-availability and integrity layer for cloud storage, Encryption and key management in the cloud, Cloud forensics, Data location and availability, Data security tools and techniques for the cloud, Data distribution and information dispersal techniques Data encryption/decryption methodologies, Trustworthy cloud infrastructures, Cloud related regulatory and compliance issues

Mather, T., Kumaraswamy S., and Latif, S. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance. O'Reilly Media.

Stallings, W. Cryptography and Network Security: Principles and Practice, 5th Edition. Prentice Hall.

Menezes, A.; Oorschot, P., Vanstone, S. Handbook of Applied Cryptography. CRC Press, Edition 1st

IS852 ETHICAL HACKING (3-0-0) 3

Hacking Fundamentals, Rconnaissance, Network, Server, Client, Web Application Penetration Testing, Structure of Penetration Testing, Programming and reverse engineering, Digital Foresnsics.

Ankit Fadia, An Unofficial Guide to Ethical Hacking, Macmillan India, 2006

IS853 ADVANCED TOPICS IN SECURITY (3-0-0) 3

Foundations of Crypto complexity and NP Completeness, Complexity classes, Elliptic Curve Cryptography, Emerging security concerns.

Brauer G R, Complexity Theory and Cryptology An Introduction to Cryptocomplexity, Springer 2005
Darrel Hankerson, Alfred Menezes, Scott Vanstone , Guide to Elliptic Curve Cryptography, Springer

IS860 HIGH PERFORMANCE COMPUTING FOR SECURITY (3-0-0) 3

Overview and history of computing. Architectural Classification schemes. High performance computing, overview and performance quantification criteria, limits on performance Design of high performance architecture, parallel vs. pipeline architectures. Pipeline processing. Theory of pipeline scheduling and implementation. Hazards in Pipeline processors. Hazard detection and resolution techniques. Static and dynamic schedules. Evolution of RISC ISAs and pipeline hazards. Interconnection Networks. Topics of current research in High performance computing.

K. Hwang and F. A. Briggs, Computer Architecture and Parallel Processing, McGraw Hill, 1984.
John L. Hennessy and David A. Patterson, Computer Architecture: A Quantitative Approach, 3rd Edition, Morgan Kaufmann Publishers, 2002.

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL

DEAPARTMENT OF INFORMATION TECHNOLOGY (IT)

M.Tech in Information Technology

Suggested Plan of Study

Sl. No.	Semester			
	I	II	III	IV
1	IT700	IT703	IT891/ IT897	IT899
2	IT701	IT704	IT898	
3	IT702	MA712		
4	Elective 1	Elective 3		
5	Elective 2	Elective 4		
6	---	IT890		

Credit Requirements:

Category	Minimum Credits to be Earned	
	NITK Norms	Proposed
Program Core (PC)	≥ 20	24
Elective Courses (EL)	≥ 09	12
Mandatory Learning Courses (MLC)	04	04
Major Project (MP)	20	20
Total	60	60

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL

Department of Information Technology (IT)

M.Tech in Information Technology

Program Core (PC)

IT700	Advanced Algorithms	(3-0-2) 4
IT701	Advanced Database Systems	(3-0-2) 4
IT702	Advanced Web Technologies	(3-0-2) 4
IT703	Advanced Network Security	(3-0-2) 4
IT704	Multimedia Systems Development	(3-0-2) 4
MA712	Optimization Techniques and Random Processes	(4-0-0) 4

Elective Courses (EL)

IT800	Mobile Computing	(3-0-0) 3
IT801	Genetic Algorithms	(3-0-0) 3
IT802	Artificial Intelligence	(3-0-0) 3
IT803	Software Architecture	(3-0-0) 3
IT804	Artificial Neural Networks	(3-0-0) 3
IT805	Semantic Web Technologies	(3-0-0) 3
IT806	Distributed Computing Systems	(3-0-0) 3
IT807	Perceptual Audio and Speech Processing	(3-0-0) 3
IT808	Enterprise Resource Planning & Systems	(3-0-0) 3
IT809	Cyber Law & Intellectual Property Issues	(3-0-0) 3
IT810	Data Mining	(3-0-0) 3
IT811	E-Commerce	(3-0-0) 3
IT812	Web Services	(3-0-0) 3
IT813	Virtual Reality	(3-0-0) 3
IT814	Computer Vision	(3-0-0) 3
IT815	Cloud Computing	(3-0-0) 3
IT816	System Integration	(3-0-0) 3
IT817	Information Retrieval	(3-0-0) 3
IT818	Parallel Programming	(3-0-0) 3
IT819	Mobile Adhoc Networks	(3-0-0) 3
IT820	Wireless Sensor Networks	(3-0-0) 3
IT821	Intelligent Information Systems	(3-0-0) 3
IT822	Blind Signal and Image Processing	(3-0-0) 3
IT823	Information Technology for Healthcare	(3-0-0) 3
IT824	Perceptual Image and Video Processing	(3-0-0) 3

Mandatory Learning Courses (MLC)

IT890	Professional Practice / Seminar	2
IT891 / IT897	Practical Training / Minor Project	2

(To be completed during Vacation between 2nd & 3rd Sem.)

Major Project (MP)

IT898	Major Project I	6
IT899	Major Project II	14

IT700: Advanced Algorithms (3-0-2) 4

Algorithmic paradigms: Dynamic Programming, Greedy, Branch-and-bound; Asymptotic complexity, Amortized analysis; Advanced Data structures for efficient manipulation of sets and partition, Efficient Graph algorithms: Depth first search; Strassen's matrix multiplication, Efficient algorithms: matrix inversion and LUP decomposition, Modular arithmetic, NP completeness/approximation algorithms, Randomized algorithms: min cut, primality testing; Online, Linear/Integer programming, Machine Learning Algorithms; Applications and Recent Trends.

Aho, Hopcroft and Ullman, The Design and Analysis of Computer Algorithms, Addison Wesley, 1974.
Horowitz and Sahni, Fundamentals of Computer Algorithms, Galgotia Publications, 1985.
Baase S., Computer Algorithms: Introduction to Design and Analysis, Addison Wesley, 1998.
Michael T Goodrich & Roberto Tamassia, Algorithm Design: Foundations, Analysis & Internet Examples, John Wiley, 2001.
Dan Gusfield, Algorithms on Strings, Trees and Sequences, Cambridge, 2005.
Jon Kleinberg and Eva Tardos, Algorithm Design, Pearson/Addison Wesley, 2006.
T H Cormen, C E Leiserson, R L Rivest, C Stein, Introduction to Algorithms, 3rd Edition, MIT Press, 2009.
Steven S Skiena, The Algorithm Design Manual, 2nd Edition, Springer-Verlag, 2010.

IT701: Advanced Database Systems (3-0-2) 4

Design of database kernels, Schema integration, Data warehousing, Distributed databases and Client Server architecture, Object-Relational databases, Emerging database technologies and applications, Application of conceptual and physical design to the real world database problems.

M. Tamer Özsu, Principles of Distributed Database Systems, Prentice Hall, 1999.
Ceri S and Pelagatti G, Distributed Databases: Principles and Systems, McGraw Hill, 2000.
T Connolly and C Begg, Database Systems: A practical Approach to Design, Implementation/Management, Pearson, 2002.
R. Elmasri and S. B. Navathe, Fundamentals of Database Systems, Addison-Wesley, 3rd ed., 1999.
R. Ramakrishnan and J. Gehrke, Database Management Systems, McGraw-Hill, 2nd ed., 1999.
M. Stonebraker and J. Hellerstein, Readings in Database Systems, Morgan Kaufmann, 3rd ed., 1998
M. Stonebraker, Object-Relational DBMSs, Morgan Kaufmann, 1996.
R. Mattison, Data Warehousing (Strategies, Technologies and Techniques), IEEE Press, 1998.

IT702: Advanced Web Technologies (3-0-2) 4

Introduction: Structure of the Web, Architecture - Webserver, App Server and Database Server, SQL; Server Side Architecture: Microsoft – IIS, .NET, MSQL, Java – Apache, Tomcat, Oracle; Open source – Apache, LAMP, WAMP, MySQL, php, Adobe –Flash, FLIP, RIA, Content Management Systems (Wordpress, Drupal); Client Side Architecture: Browsers (IE, Mozilla, Firefox), Plugins, add-ons, HTML, Javascript, Actionscript, Silverlight, VBScript, XML, HTML5, Ajax, JQuery; Mobile Phones and Devices: App development issues, challenges, solutions, simulators, Phones, Tablets, Apple (Iphone, Ipad, Apps), Android (Google, Samsung, Devices, Apps), Windows 8 (Microsoft, Visual Studio, Apps), Legacy (RIM, Nokia, Handspring, Motorola); Web Services: SOAP, JSON, XML, B2B, Advantages, Security, Costs; Hosting Issues: Providers, Service Level Agreements, Metrics, Costs, Cloud Computing; Recent trends.

Rajkamal, "Web Technology", Tata McGraw-Hill, 2001.
Eric Ladd, Jim O' Donnel, "Using HTML 4, XML and JAVA", Prentice Hall of India – QUE, 1999.
Aferganatel, "Web Programming: Desktop Management", PHI, 2004.
Deitel & Deitel, Goldberg, "Internet and World Wide Web – How to Program", Pearson Education Asia, 2001.
Anders Møller and Michael I. Schwartzbach, An Introduction to XML and Web Technologies, Addison-Wesley, 2006.
Justin Gehtland et al: "A Web 2.0 primer Pragmatic Ajax", SPD Publications, 2006
Internet, Articles and papers from http://securityresearch.in

IT703: Advanced Network Security (3-0-2) 4

Basics of Network Security: Cryptography, Terminology, Mathematics (One way functions, Discrete Log problem, Integer Factorization), Background (App developers, Hosters, Listers, payloads, Attack life cycle), Authentication and Authorization, Defensive and Secure Programming, Threat Modeling and changes to SDL; Intranet Security: SPAM, Virus and Worms, Social Engineering, Network Management, Vulnerable Applications, Uneducated Users vs Spies, Firewall and DMZ, Piracy; Penetration Testing: Ethics, Moral, Legal values and repercussion, Procedures, Tools, Metasploit and Exploit db; Internet Security: Server side security (Webserver, Database server, Appserver, Compromised user accounts), Client side security (Browser security, Malicious Webserver and Victim Webserver, Malware and terms), Ecommerce (Internet Banking, E-shopping, Mobile Banking –Transactions & Reporting, Trading), Identity Theft (Password Stealing - Phishing/Keyloggers/Malware/Tab nabbing/Social Engg, Tools, Best Practices), Privacy (Introduction, Rights, Legal issues, Online services, Facebook, Google, Social web and Virtual Worlds), Cloud security, Mobile security (Challenges and Malware); Recent trends.

Yi Qian et al, Information Assurance – Dependability and Security in Networked Systems, Morgan Kaufmann, 2008.
William Stallings, Network Security Essentials, 4/e, Pearson Education, 2008.
Rolf Oppliger, Internet and Intranet Security, 2nd Edition, Artech House, 2007.
Nadia Nedjah et al, Computational Intelligence in Information Assurance and Security, Springer 2007.
Yang Xiao and Yi Pan, Security in Distributed and Networking Systems, World Scientific Publishing, 2007.
R Perlman, C Kaufman, M Speciner, Network Security: Private Commn in a Public World, 2nd Edition, Prentice Hall.
Applied Cryptography, Code Complete, Secure Programming, Articles and papers from http://securityresearch.in

IT704: Multimedia Systems Development (3-0-2) 4

Fundamental Concepts of Multimedia and Hypermedia; Media and Data Streams; Sound/Audio, Images/Graphics, Video and Animation, File Formats; Multimedia Compression Algorithms; Multimedia Networking: Multicasting, Quality of Service, Multimedia over IP; Interactive Multimedia Systems: Touch, Gesture, Marking, Speech and Audition, Virtual Humans: Overview of Virtual Humans, Face Cloning & Face Motion Capture and Analysis and Recent Research Trends.

Ze-Nian Li and Mark S. Drew, Fundamentals of Multimedia, Pearson Education, 2004.
N Magnenat-Thalmann and D Thalmann, Handbook of Virtual Humans, Wiley, 2004.
Steinmetz R and Nahrstedt K, Multimedia Systems, Springer-Verlag, 2004.
Yue-Ling Wong, Digital Media Primer, Pearson/Prentice Hall, 2009.
Fred Halsall and James F. Kurose, Multimedia Communications: Applications, Networks, Protocols & Standards, Pearson, 2004.

IT800: Mobile Computing (3-0-0) 3

Evolution of Wireless and Cellular Systems; Wireless Propagation: Encoding, Modulation, Multiplexing, and Error Handling Techniques; MAC Layer: Channel Allocation Techniques; Study of Mobile Communication Systems: Infrastructure, Registration and basic Call Establishment & Termination, Handoff, Roaming Support; Threat, Security & Privacy Issues; Ad-Hoc & Sensor Networks: Basic architecture/structure, terminology and Nomenclatures, Routing Protocols; IEEE 802.11 & 802.15; Recent Trends: Ultra-Wideband Technology, Sensor Networks, and Bluetooth;

Joschen Schiller, Mobile Communications, Pearson Education, 2003
Dharma Prakash Agarwal & Qing-An Zeng, Wireless & Mobile Systems, CENGAGE, 2nd Edition, 2006.
William Stallings, Wireless Communication & Networks, Prentice Hall of India, 2nd Edition, 2004.

IT801: Genetic Algorithms (3-0-0) 3

Robustness of traditional optimization and search techniques, Simple Genetic Algorithms, Similarity templates, goals of optimization, Schema Theorem of John Holland, Computer Implementation of genetic algorithms; Applications of genetic algorithms, advanced operators and techniques in genetic algorithms; Recent research Trends.

David Goldberg, Genetic Algorithms in search, optimizations and machine learning, Addition Wesley, 1999
Charles L Karr and L Michael Freeman, Industrial applications of Genetic Algorithms, CRC Press 1998.

IT802: Artificial Intelligence (3-0-0) 3

Problem Solving: Solving Problems by Searching, heuristic search techniques, constraint satisfaction problems, stochastic search methods. Game Playing: minimax, alpha-beta pruning. Knowledge and Reasoning: Building a Knowledge Base: Propositional logic, first order logic, situation calculus. Theorem Proving in First Order Logic. Planning, partial order planning. Uncertain Knowledge and Reasoning, Probabilities, Bayesian Networks. Learning: Overview of different forms of learning, Learning Decision Trees, Neural Networks. Introduction to Natural Language Processing, Applications and Recent Research Trends.

Nilsson, Nils, Artificial Intelligence: A New Synthesis. Morgan Kaufmann Publishers, 1998.
Russell, Stuart J and Norvig Peter, Artificial Intelligence: A Modern Approach, Prentice Hall, 2003.
NPTEL Videos: Artificial Intelligence

IT803: Software Architecture (3-0-0) 3

Definition and overview of software architecture, The architecture business cycle: what influences software architects, Different Architectural styles, Architecture description language, Understanding and achieving quality attributes, Attribute-driven design, Documenting software architecture, Evaluating software architecture, Architecture reuse, Case studies and Recent Research Trends.

Mary Shaw, David Garlan, "Software Architecture", Prentice Hall India, 2000
Bass, Len; Paul Clements, Rick Kazman,. Software Architecture In Practice, Second Edition, Addison-Wesley, 2003.
Clements Paul et al, Documenting Software Architectures: Views and beyond, Addison-Wesley, 2003.

IT804: Artificial Neural Networks (3-0-0) 3

Introduction to Artificial Neural Networks , Artificial Neuron Model and Linear Regression, Gradient Descent Algorithm, Nonlinear Activation Units and Learning Mechanisms, Associative Memory Model, Statistical Aspects of Learning, Single-Layer Perceptions, Least Mean Squares Algorithm, Perceptron Convergence Theorem, Bayes Classifier, Back Propagation Algorithm, Multi-Class Classification Using Multi-layered Perceptrons, Radial Basis Function Network, Principal Component Analysis and Independent Component Analysis, Self Organizing Maps, Applications and Recent Research Trends.

Simon Haykin, "Neural networks - A comprehensive foundations", Pearson, 2004.
Laurene Fausett: "Fundamentals of neural networks: architectures, algorithms, and applications", Prentice Hall.
J A. Freeman, D M. Skapure: Neural Networks Algorithms, Applications & Programming Techniques, Addison-Wesley.
James A. Anderson, "An Introduction to Neural Networks", Prentice Hall of India.
Yegnanarayana: "Artificial Neural Networks", Prentice Hall of India, 2004.

IT805: Semantic Web Technologies (3-0-0) 3

Introduction to the Semantic Web – What is Semantics; Syntax, Structure and Semantics, Formal Languages, Semantic Web vision and Layered Cake Architecture, Vocabularies (Dublin Core, RSS, FOAF); Taxonomies - Descriptive Taxonomies, Navigational Taxonomies, Data Management Vocabulary, Roles of taxonomy in Content Management, Building and Maintaining taxonomies; Structured Web Documents and Resource Description Framework – Understanding content, Metadata, metadata standards, XML + metadata specification, RDF and metadata processing, Knowledge Organization Systems; Classification of organization systems; Relationship Models; Programming with RDF/XML; Web Ontology Language (OWL) - Ontology, Domain Modeling - Logic, Inferencing, Context; Programming with Ontology; Logic Reasoning for the Semantic Web - Classification and semantic metadata extraction techniques: statistical, statistical learning/AI, lexical and natural language, knowledge based; Linked Data, Role of Agents, Semantic Web and Intelligent Agents; Semantic Applications - demonstrating power of semantic technology for services, search, personalization, contextual directory and custom/enterprise applications; next generation semantic content management, Review of some of the active projects (e.g., SHOE, OntoBroker, InfoQuilt) and initiatives (OntoWeb, DAML); Contributions of IR, AI, Logic, and NLP to Semantic Web and Research Trends.

P Hitzler, M Krötzsch, S Rudolph, Foundations of Semantic Web Technologies, Chapman & Hall, 2009.
K Breitman, M A Casanova, W Truszkowski, Semantic Web: Concepts, Technologies and Applications, Springer, 2010.
John Hebeler, Matthew Fisher, Ryan Blace, Andrew Perez-Lopez, Semantic Web Programming Wiley, 2009.
Grigoris Antoniou and Frank van Harmelen, A Semantic Web Primer, 2nd Edition, The MIT Press, 2008.
Rajendra Akerkar, Foundations of the Semantic Web Narosa Publishing House, New Delhi, Oxford, 2009.

IT806: Distributed Computing Systems (3-0-0) 3

Basic concepts - Computer networks, Distributed systems and Computing, Design goals, Fundamental issues and transparencies in DCS, Ordering of events, Ordering of messages and concerned protocols, Global state detection Process synchronization, Process communications, Load balancing techniques.

Mukesh Singhal and Niranjan G. Shivaratri, Advanced Concepts in Operating System, Tata McGraw Hill, 1994.
A.S Tanenbaum and M.V. Steen, Distributed Systems – Principles and Paradigms, PHI.
Randy Chow, Distributed Operating Systems and Algorithms, Addison Wesley.
G.F. Coulouies, J.D. Dollimore and T. Kindberg, Distributed Systems: Concepts & Design, Addison Wesley, 1994.

IT807: Perceptual Audio and Speech Processing (3-0-0) 3

Fundamentals of Audio and Speech Processing; Speech and Audio Analysis: Transforms – STFT, DCT, Wavelets and Gamma tone Filter banks; Audio and Speech Compression.Standards: MPEG, AC-3, EAC-3 and AAC; Human Auditory Perception; Perceptual Audio Quality Metrics, Perceptual Audio Coding and Processing of Digital Speech; Speech and Audio Storage, Retrieval and Communication; Applications and Research Trends.

Jacob Benesty, M. Mohan Sondhi and Yiteng Huang, Handbook of Speech Processing, Springer-Verlag, 2008.
Andreas Spanias, Ted Painter and Venkatraman Atti, "Audio Signal Processing and Coding", Wiley-Interscience, 2007.
Soren Bech and Nick Zacharov, "Perceptual Audio Evaluation - Theory, Method and Application", Wiley, 2006.
Hugo Fastl and Eberhard Zwicker, "Psychoacoustics: Facts and Models", Springer, 3rd edition, 2006.
Marina Bosi and Richard E. Goldberg, "Introduction to Digital Audio Coding Standards", Springer, 2002.
Ben G. and Nelson M., "Speech and Audio Signal Processing: Processing and Perception of Speech and Music", Wiley, 1999.

IT808: Enterprise Resource Planning and Systems (3-0-0) 3

Enterprise Resource Planning and Systems (ERP) – Introduction, ERP & Related Technologies, Customer Relationship Management (CRM), Human Resource Management (HRM), ERP Implementation Life Cycles, ERP Case Studies.

Alexis Leon- Enterprise Resource Planning.
V.K. Garg & N.K. Venkitakrishnan, ERP Ware: ERP Implementation Framework.
Garg & Venkitakrishnan, ERP: By Leon, ERP- Concepts and Planning.
Vinod Kumar G & N. K .Venkitakrishna, ERP - Concepts and Practice, PHI, 1998
Sunil C & Peter-SCM-Strategy and Planning and operation, Pearson Education, LPE, 2002

IT809: Cyber Law and Intellectual Property Issues (3-0-0) 3

The Right to Access, Anonymity, Data Protection, Malicious Code, Spam, Cyber-Hooliganism, Cyber-Stalking, Identity Theft, Cyber-Terrorism, Cyber-War, Distance Contracting, Obscene Publications, Digital Signatures, Civil Liberties, Civil Liability, Civil Remedies, Criminal Liability, Criminal Penalties, Sovereignty and Jurisdiction; Controlling Digital Goods: Copyright, Protection of Online Commercial Identity (Trade Mark, Domain Name), Controlling Online Business Methods: Patent, ICANN Dispute Resolution Policy and WIPO, Legal Position on Database protection in U.S, E.U and India, Protection of Multimedia works in cyber space, Copyright Infringement & Liability of Network Service provider.

Ahmed Kamal , The Law of Cyber Space , United Nations Institute of Training and Research , October 2005
Intellectual property issues in software published by National Academy Press, Washington D C 1991
Hahn, Robert W., Intellectual Property Rights in Frontier Industries: Software and Biotechnology, AEI Press, 2005.

IT810: Data Mining (3-0-0) 3

Basic concepts, KDD process, OLAP, Mining frequent patterns, Classification, Clustering, Database based mining, Graph mining, Web mining and Research Trends..

J. Han and M. Kambar, Data Mining: Concepts and Techniques, Morgan Kaufmann Publishers (Elsevier), 2008.
Oded Maimon, Lior Rokach, The Data Mining and Knowledge Discovery Handbook, Springer, 2005.
G. Piatetsky –Shapiro and W.J. Frawley (Editors), Knowledge Discovery in Databases, AAAI/MIT Press, 1991.
Sushmita Mitra and Tinku Acharya, Data Mining, Wiley- Interscience, 2004.

IT811: E-Commerce (3-0-0) 3

Infrastructure and Tools for E-Commerce, Current Trends in E-Commerce applications development, The Business of Internet Commerce, Enterprise level E-Commerce, Security and encryption, Electronic payment systems, Search engines, Intelligent agents in E-Commerce, On-line auctions, Data mining for e-commerce, Web metrics, Recommender systems, Knowledge management, Mobile e-commerce, Legal, ethical & social issues and recent trends.

Henry Chan et al., E-Commerce- Fundamental and applications, John Wiley & Sons, 2002
G.Winfield Treese and Lawrence C.S, Designing Systems for Internet Commerce, Pearson Education, LPE, 2002
Fensel, Dieter, Brodie M. L., Ontologies: A Silver Bullet for Knowledge Management & E-Commerce, Allied Publishers, 2004.
Zimmermann, Olaf; Tomlinson, Mark R.; Peuser, Stefan, Perspectives on Web Services, Allied Publishers, 2004.

IT812: Web Services (3-0-0) 3

Basic concepts, Enabling Infrastructure, Core functionality and standards, Service semantics, Web service composition, Service development, applications and research trends.

Alonso, G et al, Web Services - Concepts, Architectures and Applications Series: Data-Centric Systems and Applications 2004.
Sanjiva Weerawarana et al, Web Services Platform Architecture: SOAP, WSDL, WS-Policy, WS-Addressing, WS-BPEL, WS-Reliable Messaging, and More, Prentice Hall, 2005.
Thomas Erl, Service-Oriented Architecture: Concepts, Technology, and Design, Prentice Hall, 2005.
J2EE Web Services, Richard Monson-Haefel, Pearson (LPE), 2005.

IT813: Virtual Reality (3-0-0) 3

Introduction to Virtual Reality Technology and its effectiveness in Real-Time Applications, Scientific Visualization, Input Devices: Trackers, Navigation and Gesture Interfaces; Output Devices: Graphics, 3D Sound and Haptic Displays; Computing Architectures for Virtual Reality, Modeling, Virtual Reality Programming, Human Factors in Virtual Reality; Virtual Humans: Overview of Virtual Humans, Face Cloning & Face Motion Capture/Analysis, Body Cloning & Body Motion Capture, Body Gesture Recognition and Action Response, Cloth Simulation and Research Trends.

Gerard Jounghyun Kim, Designing Virtual Reality Systems – The Structured Approach, Springer-Verlag, 2005.
N Magnenat-Thalmann and D Thalmann, Handbook of Virtual Humans, Wiley, 2004.
L J. Hettinger and M W. Haas, Virtual & Adaptive Environment: Applications and Human Performance, Lawrence Erlbaum, 2003.
Grigore C Burdea and Phillippe Coiffet, Virtual Reality Technology, John Wiley, 2003.

IT814: Computer Vision (3-0-0) 3

Concept of application of computer vision, functional architecture of a vision system visual sensony model and camera calibrative, processing tools, 3D vision, 3D representative schemes, High level vision and navigation.

Sonka M., Hlavac V., Boyle R., "Image Processing Analysis and Machine Design". PWS Publishers
Ballard D., brown C., "Computer Vision", Prentice Hall
Bratt W., "Digital Image Processing", John Wiley & Sons

IT815: Cloud Computing (3-0-0) 3

Introduction to Cloud Computing, Cloud Computing Delivery Models, Open Source and Industry case Studies of cloud (Apache VCL, Amazon, IBM and Eucalyptus) Introduction to Map/Reduce and Apache Hadoop Programming models for cloud computing and examples/applications, Virtualizations as an enabler for cloud computing infrastructure

Cloud Application Architectures" by George Reese, O'Reilly Publications, 2009
"Cloud Security and Privacy", Tim Mather, Subra Kumaraswamy, O'Reilly, 2009
The Hadoop – Definitive Guide, Tom White, O'Reilly, 2009.

IT816: System Integration (3-0-0) 3

Enterprise Integration Drivers, Requirements and Strategies: The Business Imperative for Enterprise Integration, Business Drivers and Requirements, Enterprise Integration Strategy; Enterprise Integration Architecture: Overview, Current Integration Architecture Assessment, Technical Integration Architecture, Service Integration Architecture, Information Integration Architecture, Process Integration Architecture; Enterprise Integration Solutions: Application Integration, Information Integration, Composite Application Integration, Process-Driven Integration, Best Practices for Enterprise Integration; Current trends.

B. G-Bernstein and W. Ruh. Enterprise Integration: The Essential Guide to Integration Solutions. Addison-Wesley, 2005.
C. Britton and P. Bye, IT Arch & Middleware: Strategies for Building Large Integrated Systems, Addison-Wesley, 2004.

IT817: Information Retrieval (3-0-0) 3

Introduction: Basic IR Models, Basic Tokenizing, Indexing, and Implementation of Vector-Space Retrieval, Experimental Evaluation of IR,Query Operations and Languages, Text Representation, Web Search, Text Categorization and Clustering, Recommender Systems, Information Extraction and Integration.

C. D. Manning, P. Raghavan and H. Schütze, Introduction to Information Retrieval, Cambridge University Press, 2008.
Richardo & Bertheir, Modern Information Retrieval, Pearson Education, 2000
Korfhage Robert R, Information Storage and Retrieval, John Wiley & Sons, Inc, 1997.

IT818: Parallel Programming (3-0-0) 3

Introduction to Parallel Computer Architectures, Parallel Programming with OpenMP, Parallel Programming with MPI, Advanced concepts in MPI, Recent Advances in Parallel Programming techniques like Task, Parallelism using TBB, TL2, Cilk++ etc. and software transactional memory techniques. Advances programming on massively parallel processors like GPGPUs and APUs and introduction to compilers and tools on such machines.

J. Dongara, I. Foster, G. Fox, W. Cropp et al, "Sourcebook of Parallel Programming", Morgan Kaufmann.
Barbara Chapman, Gabriele Jost et.al, "Using OpenMP: Portable Shared Memory Parallel Programming", Scientific and Engineering Computation, MIT 2008.
B. Willanson and M. Allen, "Parallel Programming: Techniques and Applications", Prentice Hall.
S. Akhter and J. Roberts, "Multi-Core Programming–Performance through Multi-threading", Intel Press, 2006
David B. Kirk and Wen-mei W. Hwu, "Programming Massively Parallel Processors: A Hands-on Approach (Applications of GPU Computing Series)", Elsevier Press, 2010.

IT819 Mobile Adhoc Networks (3-0-0) 3

Mobile ad hoc networking; imperatives, challenges and characteristics, Bluetooth networks, Routing approaches, Proactive and reactive protocols. Clustering and hierarchical routing, Multipath routing, Security aware routing, Energy efficient communication in ad hoc networks, Measuring energy consumption, Power save protocols, Maximum life time routing, Secure routing protocols, Intrusion detection, Security considerations in ad hoc sensor networks, Key management, Characterization of IP traffic, QOS classification, Self similar processes, Statistical analysis of non – real time traffic and real – time services and Recent trends.

C.S. Murthy & B.S. Manoj, AdHoc Wireless Networks, Pearson
T.Janevski, Traffic Analysis and Design of Wireless IP Networks, Artech House
Ozan K. Tonguz & Gianluigi, Adhoc Wireless Networks, Wiley.

IT820: Wireless Sensor Networks (3-0-0) 3

Introduction to wireless communication networks and wireless sensor networks, Network architecture and design principles, MAC and Link-layer protocols, Topology control in WSN, Routing protocols, information aggregation, information storage and query, localization, Security issues, Recent trends: multimedia sensor networks etc.

Wireless Sensor Networks: An Information Processing Approach by F. Zhao and L. Guibas, Elsevier/Morgan-Kaufmann, 2004
William Stallings, Wireless Communications and Networks, Prentice Hall, 2004.
P.Nicopolitidis, M.S.Obaidat, G.I. Papadimitria, A.S. Pomportsis, Wireless Networks, John Wiley & Sons, 2003.
K. Pahlavan, P. Krishnamoorthy, Principles of Wireless Networks, - A united approach - Pearson Education, 2002.

IT821: Intelligent Information Systems (3-0-0) 3

Emerging Technologies and applications with latest knowledge applied to customized logic systems, agent based approaches to modeling, and human-based models, multi-mobile agent systems, the product development process, fuzzy logic systems and ambient intelligent environment such as development of information and communication technologies, multimedia data hiding and watermarking algorithms for real world audio and video applications.

Xuan F. Zha, "Artificial Intelligence and Integrated Intelligent Info Systems: Emerging Tech and Applications", IGI Global, 2006
Jialie Shen, "Intelligent Music Information Systems: Tools and Methodologies", Idea Group Reference Publishers, 2007
Pan, J.-S; Huang, H.-C; Jain, L.C.; Fang, W.-C; "Intelligent Multimedia Data Hiding", Springer, 2007.

IT822: Blind Signal and Image Processing (3-0-0) 3

Introduction to Blind Signal and Image Processing: Principal Component analysis (PCA), Blind Source Separation (BSS) and Independent Component Analysis (ICA), BSS of Instantaneous and Convolutive Mixtures, Sequential Blind Signal Extraction, Robust BSS/ICA with noisy data; Learning Algorithms for Estimation of Sources; Applications: Audio, Speech, Image and Biomedical Signal Processing; Research Trends.

A.Cichocki and S. Amari, "Adaptive Blind Signal and Image Processing: Learning Algorithms & Applications", John Wiley, 2002
Hyvarinen, J. Karhunen, and E. Oja, "Independent Component Analysis", John Wiley, 2001
C.S. Roberts and R. Everson, "Independent Components Analysis: Principles and Practice", Cambridge University Press, 2001
A. S. Bregman, "Auditory Scene Analysis", MIT Press, 2nd Edition, 1999
Handbook on Speech Processing and Speech Communication, Springer, 2007.

IT823 Information Technology for Healthcare (3-0-0) 3

Evolution of IT Enhanced Healthcare, Internet Technologies in Telemedical Systems, Wireless Systems in E-Health, Decision Support Systems in Medicine, Health Telematics Networks, Computer Aided Diagnosis and Recent Trends.

Krzysztof Zielinski, Mariusz Duplaga and David Ingram, IT Solutions For Healthcare, Springer, 2006
Robert E Hoyt, Nora Bailey, Ann Yoshihashi, Health Informatics, 5th Edition, Lulu Publishers, 2012
Kevin Beaver, Healthcare Information Systems, Auerbach Publications, 2nd Edition, 2002.

IT824: Perceptual Image and Video Processing (3-0-0) 3

Fundamentals of Image and Video Processing; Image and Video Analysis: Image Transforms - DCT, Hadamard, Haar, KL and Wavelets; Image and Video Compression Standards: JPEG, JPEG2000, MPEG1, MPEG2, MPEG4 & MPEG7, H.264 and AVC; Image and Video Rendering and Assessment; Human Visual Perception; Perceptual Video Quality Metrics, Perceptual Coding and Processing of Digital Pictures; Image and Video Storage, Retrieval and Communication; Applications Image and Video Processing and Research Trends.

Perceptual Based Image Processing, Morgan & Claypool, 2009
Al Bovik, "Handbook of Image and Video Processing", Elsevier Academic Press, 2005
H. R. Wu and K. R. Rao, "Digital Video Image Quality and Perceptual Coding", CRC Press, 2005
R. C. Gonzalez and R E Woods, "Digital Image Processing", Pearson Education, 2002.

Suggested Plan of Study

Sl No.	Semester			
	I	II	III	IV
1	IB710	IB713	IB891/IB898	IB899
2	IB711	IB714	IB899	-
3	IB712	IB715	-	-
4	Elective 1	IB890	-	-
5	Elective 2	Elective3	-	-
6.	-	Elective 4	-	-

Credit Requirements :

Category	Minimum Credits to be Earned for award of M.Tech. Degree
Core Courses	24
Elective Courses	12
Mandatory Learning Courses	04
Major Project	20
Total	60

Programme Core (Pc) (IB)

IB 710 Transport Phenomena (3-1-0)4
IB 711 Enzyme Engineering and Technology (3-1-0)4
IB712 Fermentation Technology (4-0-0)4
IB 713 Downstream Process Technology (3-1-0)4
IB 714 Bioreactor Theory and Design (3-1-0)4
IB 715 Environmental Biotechnology (4-0-0)4

Elective (Ele) Courses

IB800 Instrumental Methods of Analysis (3-0-0)3
IB801 Modeling, Simulation and Introduction to Bioinformatics (3-1-0)4
IB802 Biosensors (3-0-0)3
IB803 Immobilization Technology (3-0-0)3
IB804 Bioremediation Techniques (3-0-0)3
IB805 Animal Cell Biosystems and Immunotechnology (3-0-0)3
IB806 Bioinformatics (3-0-0)3
IB807 Quality Control in Biotechnology (3-0-0)3
IB808 Industrial Wastes Treatment and Management (3-0-0)3
IB809 Computer Aided Process Control (3-0-0)3
IB810 Total Quality Management and ISO 9000 (3-0-0)3
IB811 Protein Engineering (3-0-0)3
IB812 Genetic Engg. and Recombinant DNA Technology (3-0-0)3
IB813 IPR in Biotechnology (3-0-0)3
IB814 Cell Signaling and Systems (3-0-0)3
CH807 Industrial and Environmental Epidemiology (3-0-0)3

Mandatory Learning Courses (MLC)

IB890 Seminar 2
IB891/IB898 Practical Training / Minor Project 2
(tobe completed during vacation between 2nd & 3rd Sem.)

Major Project (MP)

IB899 Major Project (3rd Sem.) 6
IB899 Major Project (4th Sem.) 14

Course content (Proposed)

IB710 Transport Phenomena (3-1-0) 4

Introduction to general transport equations, cylindrical and spherical coordinates, simplification of general equations, energy and mass transport, boundary layer concepts, introduction to turbulent transport, formation of dimensionless groups, interface transport, microscopic balances for isothermal, non isothermal multi component systems, estimation of mass transfer, energetics of cell growth and product formation.

Transport phenomena- A unified approach, R.S.Brodkey and H.C.Hershey, 1988 Mc.Graw Hill
Transport phenomena by Bird, Stuart & Lightfoot, 1960, John Wiley

IB711 Enzyme Engineering and Technology (3-1-0) 4

Introduction: Nomenclature, specificity of enzyme action, monomeric and oligomeric enzymes; Kinetic and chemical mechanisms of enzyme catalysed reactions:bioenergetics, factors affecting rate of reaction, kinetics of uncatalysed reactions, initial velocity studies, nature of enzyme catalysis; Kinetics of single-substrate enzyme-catalysed reactions:Michaelis-Menten equations, Lineweaver-Burk plot, Eadie-Hofstee and Hanes plot etc.; Enzyme inhibition: reversible and irreversible inhibition.; Kinetics of multisubstrate enzyme-catalysed reactions; Chemical nature of enzyme catalysis: acid-base, electrostatic, covalent, enzyme catalysis.; Extraction and purification of enzymes; Immobilized biocatalysis: Reasons of immobilization, different types of carrier materials, immobilization methods, Kinetics.; Uses of enzymes in Industry: Starch industry, Milk processing, Cheese making, Brewing, Fruit juice productiondetrgent etc.

Enzymes-Biochemistry, Biotechnology, Clinical Chemistry by Trevor Palmer, Affiliated East-west press ltd. New Delhi 2004.
Biocatalysis-Biochemical fundamentals and applications by Peter Grunwald, Imperial College press, London 2009.
Enzyme Technology, Preparation, Purification, Stabilization, Immobilization: Recent Advances (Biotechnology review) S.Torrey, Noyes Pubns ,1983
Enzyme Technology by HF Chaplin and C Bucke, Cambridge Univ. Press, 1990

IB712 Fermentation Technology (4-0-0) 4

Introduction: history, time line. Microbial growth kinetics: Batch, continuous and Fed-batch cultures. Micro organism: Isolation, preservation and strain improvement; Media for industrial fermentations: carbon sources, nitrogen sources, other ingredients, design, optimization. Sterilization: Design of batch and continuous sterilization, sterilization of fermentor. Inoculum development. Aeration ,and agitation: mass transfer considerations, K_La value determination, factors affecting K_La values. Process technology for the production of : Baker's yeast, ethanol, organic acids, microbial polysaccharides, industrial enzymes and antibiotics.

Principles of Fermentation Technology by Stanbury & Whataker, ,2nd edition,Elsvier,2005.
Comprehensive biotechnology by Murray Moo-Young, ,1st Edition, Pergamon , 1985
Bioprocess technology, Kinetics & Reactors by A.Moser, Springer Verlag 1981

IB713 Downstream Process Technology (3-1-0) 4

Characteristics of bio-product; stages in Bioseparation; Cell disruption: Homogenizer, bead mill, sonicator. Cell wall permeabilization; Filtration: Filter press, rotary drum filter. Centrifugation: Tubular & disc-stack centrifuges. Extraction: Solvent, Aqueous two-phase, super-critical fluid extraction. Precipitation: solvents, salts. Crystallization. Chromatographic separation and purification processes; membrane technology-Ultra filtration, Dialysis, electro dialysis.

Bioseparations: Downstream Processing by P.A. Belter, E.L. Cussler, and W-S. Hu, Wiley, New York 1988.
Separation process in Biotechnology by Juan A. Asenjo, , 1st Edition, CRC 1990
Separation process principles by Seader JD & Henley E.J, 2nd edition,Wiley 2005
Engineering Processes for Bioseparations by Laurence R. Weatherley, Butterworth-Heinemann 1994

IB714 Bioreactor Theory and Design (3-1-0) 4

Definition and basic principles of bioreactors. Bioreactor design: stirred tank, immobilized biocatalytic reactors, pneumatically agitated bioreactors, membrane reactors, animal cell bioreactors, plant cell bioreactors, photobioreactors, solid state fermentor, bioreactor operation modes and scale-up stretagies. Analysis of batch, continuous and fed batch bioreactors, non-ideal effects. Bioreactor support system: sterilization and containmenrt, system supplies. Instrumentation and control: measurement of process variables, control systems, computer applications.

Bioreactor system design by Juan-Asenjo, CRC press 1994. Biochemical Engineering Fundamentals by J.E.Bailey & D.F.Ollis2nd Ed., McGraw Hill 1986

Bioproce ss Engineering Basic concepts by Michael L Shuler, Fikret Kagrgi, Prentice Hall 1992

Biochemical Engineering by H W Blanck and DS Clark, Marcel Dekker, 1996.

IB715 Environmental Biotechnology (4-0-0) 4

Scope of environmental biotechnology, Qualitative and Quantitative characterization of wastes, waste disposal norms and regulations, waste water treatment-aerobic processes; anaerobic processes; design of integrated purification processes, biological means of stabilization and disposal of solid wastes, treatment of hazardous and toxic wastes, degradation of xenobiotic substances; bioremediation; bioleaching; micro-organisms for hostile environment, ecosystem health and biomonitoring .

Environmental Biotechnology by C.F.Froster & D.A.J.Wase, PHI 1987

Environmental Biology for engineers and Scientists by DA Vaccari et al. Wiley Interscience 2006.

Waste water Engineering, Treatment, Disposal & Reuse by Metcalf & Eddy,.

IB800 Instrumental Methods of Analysis (3-0-0) 3

Basics of analytical chemistry. Concept of Atomic absorption spectrophotometry, inductively coupled plasma(ICP), applications. Concept of Chromatography, Principles of working of gas chromatography, types of gas chromatography, different detectors used in Gas chromatography, principles and working of liquid chromatography, types of liquid chromatography, different types of detectors, concept of ion chromatography, applications of chromatography. Spectroscopic methods-UV, Vis, IR, Fluorescence, ORD, CD, & PAS), Automatic analyser, protein sequenator, peptide synthesizer and N.A. synthesizer. centrifugation and Rotors angle / vertical, zonal/continuous flow buoyant density centrifugation. Ultra centrifuge - principle and application,

Instrumental methods of Analysis Willard and Merit, CSS Publishers 1986

Standard methods of Biochemical Analysis by S R Thimmaiah, Kalyani Publications 1999

Principles of Instrumental Analysis, 5th edition by DA Skoog, FJ Holler and TA Nieman, 1998

Quantitative chemical analysis, 6th edition, by DC Harris, 2002

A practical guide to instrumental analysis, by E Pungor and G Horvai, 1994

Chemical analysis: Modern instrumentation methods and techniques, by F Rouessac and A Rouessac, 2000

IB801 Modeling, Simulation and Introduction to Bioinformatics (3-1-0) 4

Mathematical modeling of a process and its significance; different approaches to modeling; structured and unstructured models of cell growth; substrate utilization and product formation (e.g. Monod – Perret Model), Heterogeneous model like Shu's segregated model; two-and-three compartment models of Harder and Roeis; Genetically structured models; Case studies; modeling; controlling and monitoring of activated sludge process; lactic acid fermentation; Concept of simulation: simulation languages like mimic (CDC & UNIVAC), CSMP (IBM); etc. FORTRAN VI computer programs (INT and DYFLD); Dynamic Process simulation (PACER; FLOWTRAN; CHESS etc); Structure for simulation programme; General arrangement of main programme; Mathematical techniques like Newton – Raphson convergence, linear interpolation; first order and second order integration by Euler method, Mathematical modeling of bioreactors

Dynamics of Environmental Bioprocesses by J.B.Snape, I.J.Dunn & J.E.Prenosy, V & H Publishers 1995

Process computations in Biotechnology by Jasun K Ghosh, McGrawHill 1994

H.R. Bungay, Computer Games and Simulation for Biochemical Engineering, Wiley, 1985

IB802 Biosensors (3-0-0) 3

Introduction to biosensors, biological sensing elements and transducer systems, classification of biosensors, enzyme and whole cell based biosensors, affinity biosensors, amperometric biosensors, immuno sensors, ELISA, plant cell based biosensors, pesticide biosensors, flow injection analysis based biosensors, stability of biosensors, signal amplification, stabilisation and measurement, luminescence based biosensors

Yang, V.C. and T.T. Ngo. 2000. Biosensors and Their Applications. Kluwer Academic/Plenum Publishers, New York, NY.

Ligler, F.S. and Rowe Taitt, C.A. 2002. Optical Biosensors: Present & Future. Elsevier, The Netherlands

"Biosensors: Fundamentals and Applications" A.P.F. Turner, I. Karube, and G.S.Wilson, s.; Oxford Science Publications: Oxford, 1987.

"Enzyme and Microbial Biosensors: Techniques and Protocols" Ashok Mulchandani and Kim R. Rogers, Eds.; Humana Press, Totowa, NJ, 1998.

"Affinity Biosensors: Techniques and Protocols" Ashok Mulchandani and Kim R. Rogers, Eds.; Humana Press, Totowa, NJ, 1998

IB803 Immobilization Technology (3-0-0) 3

Classification of immobilization techniques, characteristics of solid matrices, effect of physico-chemical parameters on immobilized enzymes/whole cells, Immobilized enzymatic reaction kinetics, Modelling and simulation of immobilized whole cell systems, Design of advanced immobilized enzymes/whole cell systems, immobilization of plant cells; application of immobilized enzymes/whole cells systems.

In Situ Immobilization of Heavy-Metal-Contaminated Soils (Pollution Technology Review)G. Czupyrna, .D. Levy, A.I. Maclean, H. Gold,Noyes Publications 1989

Bio-immobilization: Technology, products, and markets ([Business opportunity report]) Philip Rotheim, Business Communications Co

Enzyme Technology, Preparation, Purification, Stabilization, Immobilization: Recent Advances (Biotechnology review) S. Torrey,Noyes Pubns ,1983

IB804 Bioremediation Techniques (3-0-0) 3

What is Bioremediation? Case Histories, Constraints and Priorities of Bioremediation, Bioaugmentation for Bioremediation, Bioreactors for Remediation Processes, Types of Bioremediation, Applications - Examples, Biotechnology and Oil Spills. Biotechnology for Hazardous Waste Management, Xenobiotic Compounds, Recalcitrance, Hazardous Wastes, Biodegradation of Xenobiotics, Biological Detoxification, Biotechnology to Hazardous Waste Management, Pesticide Industry: Tannery Industry and Biotechnology. Paper Industry and Biotechnology. Waste Treatment of Food and Allied Industries: Biological Treatment Methods, Air Pollution Abatement and Odor Control. Solid Waste Management. Novel Methods for Pollution Control: Vermitechnology, Waste Water Treatment Using Aquatic Plants, Root Zone Treatment. Aiming for Biodegradable and Ecofriendly Products.

Biodegradation and Bioremediation Martin Alexander, Academic Press ,1999

Handbook of Bioremediation Robert, Hinchee, Brown, McCarty, Semprini, Wilson,Lewis Pubs, Inc. ,1993

Bioremediation : Principles and Applications (Biotechnology Research) Ronald L. Crawford, Don L. Crawford, James Lynch,Cambridge University Press ,1996

Bioremediation Katherine H.Baker, Diane S. Herson, McGraw-Hill Professional ,1993

IB805 Animal Cell Biosystems and Immunotechnology (3-0-0) 3

Characteristics of animal cells and their implication on process design Nutritional requirements and serum free culture of mammalian cells Kinetics of growth and product formation. Reactor systems for large-scale production using animal cells. Production of Polyclonal antibodies with different types of antigens: antigen preparation and modification, adjuvants does and rute of antigen administration, collection of sera, purification of antibodies. Hybridoma technology – production and applications of monoclonal antibodies for diagnosis and therapy. Production of virus vaccines, specific vaccines. Production of cellular chemicals like Interferons, Interleukin, etc.Immunoassay procedures.

Essential Immunology by Ivan M Roitt, Blackwell Scientific Publication, 4th Edition, 1980

Basic Concepts in Immunology : A Student's Survival Guide. par John Jr. Clancy (Editor), James Morgan McGrawHill Text

Textbook of Immunology. 2nd ed. Constantin A. Bona, Francisco A. Bonilla. Harwood Academic Pub. 1996.
Fundamental Immunology. 4th ed. Livre & CD edition. William E. Paul (Editor). Lippincott-Raven Pub.

IB806 Bioinformatics (3-0-0) 3

Introduction to Bioinformatics, biological data banks, gene banks, sequence analysis, structure prediction, protein folding, Proteomics, emerging areas in Bioinformatics.

Bioinformatics and Functional Genomics Jonathan Pevsner, Wiley-Liss, 2003
An Introduction to Bioinformatics Algorithms (Computational Molecular Biology) Neil C. Jones Pavel A. Pevzner, BradfordBooks, 2004

IB807 Quality Control In Biotechnology (3-0-0) 3

General considerations in quality of bioproducts (enzymes/vaccines/insecticides/r-DNA product etc.) such as molecular identity, potency, purity and stability, toxicity, immunogenecity and consistency. Physical and biological containment, facilities for experiments dealing with recombinant cells and viruses. General scientific considerations for assessing possible risks of viral/bacterial insecticides and recombinant organisms in large scale particles.

Total Quality Environmental Management : An ISO 14000 Approach Vasanthakumar N. Bhat, Quorum Books, 1998
ISO9000 for Better Business: Using ISO 9000 As a Foundation for Total Quality management Jack E. Small, Lanchester Press Inc, 1996
Bioprocess Monitoring and Control (Hanser Series in Biotechnology) Marie-Noelle Pons, John Wiley &SonsInc1993

IB808 Industrial Wastes Treatment And Management (3-0-0) 3

Sources and characteristics of industrial wastes; effects on environment. Waste volume reduction, Waste strength reduction, Neutralization, Equalization and Proportioning. Removal of suspended and colloidal solids. Removal of inorganic and organic dissolved solids. Disposal of sludge solids. Mathematical models of water quality systems. Streams & Estuarine models for pollution control. Waste treatment methodologies for specific industries.

Waste water Engineering Treatment & Disposal & Reuse, Metcalf & Eddy
Waste water Management by Arceivala

IB809 Computer Aided Process Control (3-0-0) 3

Evolution of computer control; data logging; supervisory control and direct digital control; types of computer control; program control; optimizing and adaptive control; steady state and dynamic control; process identification, control ability and observability; state space representation of process; canonical forms; time optimal control; pontyagrains maximum principle; multivariable control system; process control computer; main frame and microprocessor systems; dedicated vs. Time sharing applications; computer hardware; analog subsystems; buffers; A/D; D/A; E/P and P/E interfaces; man/Machine interfaces case studies of computer process control.

Chemical Process Control: An Introduction to Theory and Practice, G. Stephanopoulos, PrenticeHall Inc., 1984.
Bioprocess Monitoring and Control, ed. Marie-Noelle Pons, Hanser (1992)

IB810 Total Quality Management & ISO 9000 (3-0-0) 3

Historical background, challenge of the 21st century, Quality (quality characteristics, variables and attributes defect, standard or specification quality of design conformance and performance); Quality control Benefits of quality control; Quality assurance, Total quality control (TQC), Tools and Techniques used in TQM. Responsibility for quality. Quality cost Measuring quality costs; Management for quality (planning, organising, staffing directing and controlling for quality); Quality and Productivity (effect on cost and market) ; 5S campaign; 4M checklist; Quality and Function Deployment (QFD) & just-in-time (JIT); Philosophy and

their impact on quality (W. Edwards Deming and his contribution – comparison of the three philosophies) ; Malcolm Baldrige National Quality Award – Case studies on TQM.

Total Quality Environmental Management : An ISO 14000 Approach, Vasanthakumar N. Bhat, Quorum Books,1998
ISO 9000 for Better Business: Using Iso 9000 As a Foundation for Total Quality management Jack E. Small, Lanchester Press Inc, 1996
Measurement and Control in Bioprocessing (Elsevier Applied Biotechnology Series) K. G. Carr-Brion,Elsevier Applied Science,1991

IB811 Protein Engineering (3-0-0) 3

Introduction: Design and construction of novel proteins and enzymes, Conformation of proteins in general and enzymes in particular, Effect of amino acids on structure of proteins, Energy status of a protein molecule, Structure function relations of enzymes, Physical methods such as x-ray crystallography for determination of protein structure, Site directed mutagenesis for specific protein function, Basic concepts for design of a new protein/enzyme molecule, Specific examples of enzyme engineering, -Tryesyl t RNAsynthetase, Dihydrofolate reductase, Subtilisin.

Protein Engineering : Principles and Practice Jeffrey L. Cleland, Charles S. Craik, Wiley-Liss Hardcover,1996
Introduction to Proteins and Protein Engineering Barry Robson, Jean Garnier, Elsevier Science Ltd,1988

IB812 Genetic Engineering and Recombinant DNA Technology (3-0-0) 3

Introduction to r-DNA technology, vectors: definition and types; construction and properties fo plasmid, phage,cosmid and phagemid vectors; restriction enzymes – properties and uses in cloning; gene cloning – genomic and cDNA cling; impression of genes in recombinant cells, stability of recombinant cells, restriction mapping; DNA sequencing; gene mapping; polymerase chain reaction.

Genetic Engineering – A primer, WE Hill, Hard-Bead publishers, 2000
Principles of gene manipulation – RB Old and SB Primarose, Blackwell Scientific, 1992
Advanced topics in Molecular Biology – A Kumar and AK Srivastava, Horizon Press, 2001
Gene Probes – Principles –Protocols, MA deMuro and R Raples in Methods in Molecular Biology vol.179, Humana Press, 2002.
in Molecular Biology vol.179, Humana Press, 2002.

IB813 IPR in Biotechnology (3-0-0) 3

IPR in global economy, biodiversity related global IPR regime – TRIPS agreement, objectives and general principles, patents, trade secrets, UPOV convention, Plant variety rights, rights of traditional knowledge holders, etc. CBD, WTO, UNCTAD biotrade initiatives, nongovernmental initiated community IPR

Intellectual property rights, trade and biodiversity, G Dutfield, Earthscan publishers, 2000
Patents: A basic guide to patenting in biotechnology, RS Crespi, Cambridge Univ. Press, 1989
IPR in Biotechnology, K Singh, BCIL, New Delhi.

IB814 Cell Signaling and Systems (3-0-0)3

Introduction to cell signalling pathways and networks. Components of signalling pathways-receptors-protein phosphorylation-cyclic nucleotides-G-proteins- Inositol phosphate- reactive oxygen species-nitrogen species-toll like receptors-cytokine-receptors-apoptosis-innate immunity receptors. Systems biology-modelling of signalling networks-network motifs-feedback and feed forward systems.

Hancock J T. Cell signaling. Oxford University press. 2nd edition-2005.
Gomperts BD. Signal transduction. Academic press. 1st edition-2003.
Alone U. An Introduction to Systems Biology: Design Principles of Biological Circuits. Chapman and Hall/CRC.1st edition-2006.

CH807 Industrial and Environmental Epidemiology (3-0-0)3

Basic principles and concepts of epidemiology relating to the design, analysis and interpretation of epidemiological studies. Epidemiologic methods for studying industrial and environmental determinants of disease. Estimating industrial workplace and environmental exposure, design experiments to understand the effects of exposure, analyse data from health reports and epidemiological studies. Specific health outcomes, including: cancer, non-malignant respiratory diseases. Introduction to statistical software ("R") for epidemiological studies.

Checkoway H, Pearce N, and Kriebel D. Research methods in occupational epidemiology. Oxford University press, 2nd eidition-2004.

Rothman J J. Epidemiology: An introduction. Oxford University press. 1st edition-2002.

Rothman J J, and Greenland S. Modern epidemiology. Lippincott Williams & Wilkins, 3rd edition-1998.

M. Tech. in Materials Engineering (ML)

Suggested Plan of Study

Sl. No.	Semester I	II	III	IV
1	ML700	ML705	ML891/ ML897	ML899
2	ML701	ML890	ML 898	
3	ML702	*Elective 1*		
4	ML703	*Elective 2*		
5	ML704	*Elective 3*		
6	MA702	*Elective 4*		

Category	Minimum Credits to be Earned for award of M.Tech. Degree
Core Courses	24
Elective Courses	12
Mandatory Learning Courses	04
Major Project	20
Total	60

Programme Core (Pc)

ML700	Advanced Physical Metallurgy	(3-1-0) 4
ML701	Materials Characterisation	(3-1-0) 4
ML702	Plastics Engineering	(3-0-0) 3
ML703	Mechanical Behaviour & Design of Materials	(3-1-0) 4
ML704	Materials Engineering Lab	(0-0-3) 2
ML705	Ceramics Engineering	(3-1-0) 4
MA 702	Design & Analysis of Experiments	(3-0-0) 3

Elective (Ele) Courses

ML800	Steels & Their Heat Treatment	(3-0-0) 3
ML801	Composite Materials	(3-0-0) 3
ML802	Electronic Properties of Materials	(3-0-0) 3
ML803	Non-destructive Testing	(3-0-0) 3
ML804	High Temperature Materials	(3-0-0) 3
ML805	Fracture Mechanics	(3-0-0) 3
ML806	Surface Engineering	(3-0-0) 3
ML807	Science and Technology of Nanomaterials	(3-0-0) 3
PM803	Advanced Welding Technology	(3-0-0) 3
PM804	Corrosion Engineering	(3-0-0) 3

Mandatory Learning Courses

ML890	Seminar	2
ML891/ML897	Practical Training/Minor Project *(to be completed during vacation between 2nd & 3rd Sem.)*	2

Major Project

ML898	Major Project (3rd Sem.)	6
ML899	Major Project (4th Sem.)	14

COURSE CONTENTS - PG&R

DEPARTMENT OF METALLURGICAL & MATERIALS ENGINEERING

M.TECH - MATERIALS ENGINEERING PROGRAMME

ML700 **Advanced Physical Metallurgy** (3-1-0) 4

Thermodynamics, phase diagrams, classification of transformation, diffusion, high diffusivity path, applications; nucleation and growth kinetics, TTT diagram, precipitation hardening, spinodal decomposition, strengthening mechanisms, dispersion strengthening, eutectoidal transformation, order - disorder transformation, recovery and recrystallisation.

D. A. Porter and K. E. Esterling, Phase transformation in metal and alloys, Chapman Hall, 1992.
V. Raghavan, Solid state phase transformation, PHI of India Pvt. Ltd., New Delhi, 1987.

ML701 **Materials Characterisation** (3-1-0) 4

Quantitative metallograhy. X-RD techniques: Single crystal orientation, Texture studies, Lattice parameter, Chemical analysis, Stress analysis. TEM: Theories of contrast in crystal, electron diffraction, SAD patterns, lattice defects, precipitates, second phases, specimen preparations. SEM: Electron - specimen interactions; modes of working, X-ray, auger induced conductivity, high resolution scanning transmission microscopy. Field ion and field emission microscope

P. G. Grundy and G. A. Jones, Electron Microscopy in Study of Materials, Edward Ernold, 1976.
B. D. Cullity, Elements of X-ray Diffraction, Addison - Wesley Publications, 1978.
P. E. J. Flewitt & R. K. Wild, Physical Methods of Materials Characterization, IOP, 1994 Publishing Ltd, 1994 Metals Hand Book, Vo.10, ASM, Metals Park, Ohio, 1986

ML702 **Plastics Engineering** (3-0-0) 3

General properties of plastics - introduction, polymeric materials, plastics available to the designer, selection of plastics. Mechanical behaviour of plastics - introduction, viscoelastic behaviour of plastics, short term testing of plastics, long term testing of plastics, design method for plastics using deformation data, mathematical models of viscoelastic behaviour, fracture behaviour of unreinforced plastics, creep failure of plastics, fatigue of plastics, Impact behaviour of plastics. Processing of plastics - introduction, extrusion, injection moulding, transfer moulding.

R. J. Crawford, Plastic Engineering, 2nd edn. Pergamon Press, 1987, Reprinted in 1989.
William J. Patton, Plastic Technology, D. B. Taraporevala Sons and Co. Pvt. LTd., 1981.
Peter C. Powell, Engineering with Polymers, Chapman & Hall, 1983.

ML703 **Mechancial Behaviour & Design of Materials** (3-1-0) 4

Atomic and molecular bonds, classification of materials, their properties with respect to the types of bonds present in them as a class. Dislocations and plastic deformation, slip, torsion, CRSS, slip systems, strain hardening, recrystallization. Tensile behaviour and testing, temperature and strain rate effects, compression behaviour and testing, hardness testing, torsion testing, impact testing & transition temperature. Failure under combined stresses (triaxial), design against failure. Failure behaviour and fracture toughness testing. Fatigue behaviour of materials, design against fatigue failures. Creep behaviour and testing: design against creep failures. Failure analysis: a few case studies.

G. I. Dieter, Mechanical Metallurgy, Sl metric edition, McGraw Hill, 1988.
J. A. Collins, Failure of Materials in Mechanical Design, Wiley Interscience Publication, 1981.
Metals Handbook, Vol.11, 9th edition, ASM, 1986.

ML704 **Materials Engineering Lab** (0-0-4) 2

Experiments in quantitative metallography, X-ray diffraction, diffusion, phase transformations and properties of materials.

ML705 Ceramics Engineering (3-1-0) 4

Structure of ceramics: bonding, Pauling's rules, oxide structures, carbide and nitride structures, structure of glasses, Zachariasen rules, silicate structures. Ceramic phase diagrams, microstructure of ceramics. Defects in ceramics: thermodynamics approach; structure, formation and properties of glasses. Processing of ceramics: general route - traditional ceramics, advanced ceramics. Powder production: leaching, thermal decomposition, spray drying, sol-gel synthesis, Forming - die compaction, slip casting, tape forming process, Consolidation - sintering, grain growth, HIP. Properties and testing of ceramics: mechanical, thermal, magnetic, ferroelectric, dielectric, optical, ceramic, fibres, Toughening mechanisms.

Michel W. Barsoum, Fundamental of Ceramics, International Edition, 1997

W. D. Kingery, Introduction to Ceramics, 2nd Edition, John Wiley & Sons, 1991

Alan G. King, Ceramic Technology and Processing, Noyes Publications, New York, 2002

Jhon B. Watchman, Mechnical Properties of Ceramics, Jhon Wiley & Sons, 1996.

ML800 Steels & Their Heat Treatment (3-0-0) 3

Iron and its solid solutions, iron - carbon equilibrium diagram, plain carbon steel, influence of alloying elements in

Fe-C alloys, low alloy steels, heat treatment of steel, formation of martensite, bainite reaction, concept of hardenability, tempering of martensite, thermomechanical treatment, surface hardening, stainless steels, tool steels, embrittlement and fracture of steels, Cast irons: characteristics, applications.

R.W. K. Honeycombe, Steels - Microstructure and Properties, Edwards Arnold, 1995

W. C. Leslie, The Physical Metallurgy of Steels, McGraw Hill Book Company, New York, 1982

F. B. Pickering, Physical Metallurgy and the Design of Steels, Applied Science Publishers , 1978

ML801 Composite Materials (3-0-0) 3

Introduction, their characteristic features, interfaces, wettability, bonding. Important reinforcements fibers, whiskers, short fibers and particles, production. Properties, and applications of polymer matrix composites: metal matrix composites, ceramic matrix composites, carbon /carbon composites, intermetallic matrix composites, mechanics, laminate composites, short fiber composites, toughness of composites - thermal, fatigue and environmental effects, joining of composites, designing with composite materials.

K. K. Chawla, Composite materials, Springer - Verlag Press, 2001.

Mathews F. L. and Fawlings R. D., Composite Materials: Chapman Press.

Bryan Harris, Composite Materials, Institute of Materials, London 1996.

ML802 Electronic Properties of Materials (3-0-0) 3

Introduction: Brilluion Zone Theory; Fermi level, Band theory. Thermal Properties: specific heat, thermal expansion & thermal conductivity. Electrical properties: conductors, insulators, intrinsic semiconductors, extrinsic semiconductors. Single crystal growth, zone refining, producion of PNP, NPN transistors, intergrated circuits. Dielectrical - materials and applications, electrostriction, magnetostriction. Ultrasonic transducers: piezoelectric materials and applications, ferroelectric materials and applications. Magnetic Properties: soft magnetic materials, hard magnetic materials, ferrites, garnets, ESD magnets, magnetic tapes, films, ferromagnetic materials, antiferromagnetic materials, materials for computer memories. Neutron diffraction. Superconductivity: Type I, Type II superconductors, hard and soft superconductors, Meissener effect, high temperature superconductors, Applications of superconductors, photoconducting applications. Optical Properties: lasers, gas laser, He-Ne laser, N_2CO_2, Ar, H_2-Cd lasers, liquid lasers, dye lasers, solids laser, ruby, Nd - YA glass lasers, semiconductor diode laser, applications of laser. Optical storage, optical computing, optical fibres.

R. E. Hummmel, Electronic Properties of Materials, Navona, 1995

J. Wulff, Electronic Properties, Edition of1964.

C. M. Srivastava & C. Srinivasan, Science of Engineering Materials, NewAge International Pvt. Ltd., India. 1999,

ML803 Non-Destructive Testing (3-0-0) 3

Ultrasonic Inspection: ultrasonic waves, variables, attenuation, inspection methods, pulse echo, transmission methods, inspection standards, standard reference blocks, practical applications. Radiography Inspection: radiographic inspection principles, radiation sources, image quality, radiographic sensitivity, geometric unsharpness, image intensifiers, X-ray films, exposure, penetrameters, inspection standards, neutron radiography, gamma radiography. Other techniques: visual inspection, insitu metallography, dye penetrant inspection, magnetic particle inspection, eddy current method, acoustic emission method, holography, computed tomography.

Barry Hull & Vernon John, Non-destructive Testing, ELBS edn., Macmillan, London, 1989.
R. Halmshaw, Non-destructive Testing, 2nd edn., Edward Arnold, London, 1991.
McGonnagle W. J., Non-destructive testing, Gordon & Beach Science, New York, 1983.

ML804 High Temperature Materials (3-0-0) 3

Materials composites and structure, Fe based super alloys, Ni base super alloys, Co base super alloys, titanium and its alloys, refractory metals and alloys, high temperature ceramic materials, cermets, cemented carbides, creep
resistance, fatigue resistance, corrosion resistance, oxidation resistance, formability, weldability, fluidity; application of superalloys, titanium alloys, refractory metals and alloys, cermets, cemented carbides, ceramics.

Donachie, A technical guide on Super alloys, A.S.M. Ohio, 2002
C. T.Sims & N. C. Hagel, super alloys, JohnWiley Publishers, 1972
Betteridge, The Nimonic Alloys - Edward Arnold Publishers Ltd., London, 1959

ML805 Fracture Mechanics (3-0-0) 3

Failure analysis, conventional design concepts & its limitations, mechanics of fracture - fracture toughness, determination of fracture toughness - ASTM standards, Brittle and ductile fractures, cleavage fracture, cleavage cracks, crystallographic mechanism, designing and testing for fracture resistance, design, improved toughness in ceramics, composites, case studies in failure anaysis.

D. Boreck, Elementary Engineering Fracture Mechanics, Marines Nijhoff, Dordredet (1986).
E. J. F. Knott Fundamentals of Fracture Mechanics, Butterworths (1973)
S. Teteleman and A. J. MCEvily, Facture of Structural Materials, John Wiley and Sons, (1961)

ML806 Surface Engineering (3-0-0) 3

Surface Cleaning: Classification and Selection of Cleaning Processes Finishing Methods: Classification and Selection of Finishing Processes; Topography of Surfaces; Microstructural Analysis of Finished Surfaces Plating and Electroplating: Electrodeposition Processes: Copper Plating; Nickel Plating; Zinc Plating; Zinc Alloy Plating; Selective (Brush) Plating; Electroforming. Nonelectrolytic Deposition Processes: Eletroless Nickel Plating; Electroless Alloy Deposition Dip, Barrier and Chemical Conversion Coatings: Batch Hot Dip Galvanized Coatings; Phosphate Coatings; Chromate Conversion Coatings; Rust Preventive Compounds; Painting; Ceramic Coatings and Linings; Anodizing. Vacuum and Controlled - Atmosphere Coating and Surface Modification Processes: Thermal Spray Coatings; Chemical Vapor Deposition of Nonsemiconductor Materials; Chemical Vapor Deposition of Semiconductor Materials; Plasma - Enhanced Chemical Vapor Deposition; Growth and Growth - related Properties of Films Formed by Physical Vapor Deposition; Vacuum Deposition, Reactive Evaporation, and Gas Evaporation; Sputter Deposition; Ion Plating; Ion-Beam-Assisted Deposition; Arc Deposition; Ion Implantation; Diffusion Coatings; Pulsed - Laser Deposition. Testing and Characterization of Coatings and Thin Films: Film Thickness Measurements Using Optical Techniques; Corrosion Testing; Evaluation of Mechanical Properties of Thin Films.

P. K. Dutta & I. S. Gray, Surface Engineering, Vol. I - III, Royal Society of Chemistry, 1993.
ASM Hand Book, Vol.5, ASM International, Metals Park, Ohio, 1999.
Kenneth G. Budinsk, Surface Engineering for wear resistance, Prentice Hall, NJ1988.

ML807 Science and Technology of Nanomaterials (3-0-0) 3

Introduction: Definitions, classification, fundamental principles, fullerences, nanoparticles, nanoclusters, nanowires, nanotubes, nanolayers, nanopores, supramolecules. Properties: Size dependence of properties such as electrical, physical, optical and chemical. Synthesis: Top-down and bottom-up approaches, plasma arcing, chemical vapor deposition, electrodeposition, sol-gel synthesis, high energy milling/ball milling, nanolithography; self assembly, Langmuir-Blodgett films. Characterization: Scanning tunneling microscopy, transmission electron microscopy and atomic force microscopy. Application: Nanomachines and nanodevices, impact of nanomaterials in the areas of materials manufacturing, health care, data storage, clean energy etc. Society and nanotechnology: Challenges and fears, impact on health and environment.

M. Tech. in Process Metallurgy (PM)

Suggested Plan of Study

Sl. No.	Semester			
	I	II	III	IV
1	PM700	PM705	PM891/ PM897	PM899
2	PM701	PM890	PM 898	
3	PM702	*Elective 1*		
4	PM703	*Elective 2*		
5	PM704	*Elective 3*		
6	MA702	*Elective 4*		

Category	Minimum Credits to be Earned for award of M.Tech. Degree
Programme Core (Pc)	24
Elective Courses (Ele)	12
Mandatory Learning Courses (MLC)	04
Major Project (MP)	20
Total	60

Programme Core (Pc)

PM700	Advances in Iron Making	(3-1-0) 4
PM701	Advanced Metallurgical Thermodynamics	(3-1-0) 4
PM702	Momentum and Thermal Transport Phenomena	(3-1-0) 4
PM703	Experimental Techniques	(3-0-0) 3
PM704	Process Metallurgy Lab	(0-0-3) 2
PM705	Theory of Metallurgical Processes	(3-1-0) 4
MA 702	Design & Analysis of Experiments	(3-0-0) 3

Elective (Ele) Courses

PM800	Advances in Steel Making	(3-0-0) 3
PM801	Mechanical Processing of Steel	(3-0-0) 3
PM802	Advanced Foundry Technology	(3-0-0) 3
PM803	Advanced Welding Technology	(3-0-0) 3
PM804	Corrosion Engineering	(3-0-0) 3
ML800	Steels & Their Heat Treatment	(3-0-0) 3
ML805	Fracture Mechanics	(3-0-0) 3

Mandatory Learning Courses (MLC)

PM890	Seminar	2
PM891/PM897	Practical Training/Minor Project	2

(to be completed during vacation between 2nd & 3rd Sem.)

Major Project (MP)

PM898	Major Project (3rd Sem.)	6
PM899	Major Project (4th Sem.)	14

M.TECH - PROCESS METALLURGY PROGRAMME

PM700 Advances in Iron Making (3-1-0) 4

Different and emerging methods of Ironmaking, Modern developments in Ironmaking in the blast furnace, Preparation of inputs, Physico-chemical study of the reduction of iron ores and oxides. Study of processes inside an iron blast furnace, Study of blast furnace slags, Heat exchange zones in blast furnace, Stoichiometry, Material and Heat Balance and Mathematical Modelling. Recent trends in the operation of blast furnaces. Gas based DRI making by HyL, Midrex and fluidized bed processes, Coal based DRI making by rotary kiln; Electric pig iron furnace; Corex and other SR processes. Production of ferroalloys.

Making, Shaping and Treating of Steel, 10th Edition, Edited by United States Steel, 1985; or 11th Edition, Edited by the Association of Iron and Steel Engineers, 1999.

A. Ghosh and A. Chatterjee, Ironmaking and Steelmaking: Theory and Practice, PHI Learning (P) Ltd., New Delhi.

A. K. Biswas, Principle of Blast Furnace iron making, SBA Publications, Calcutta, 1981

Strasburger, Brown, Stephenson & Dancy, B. F. Theory and Practice, Vol.I & II, 1969, Gordon & Reach, New York.

Robert L. Stephenson, Direct reduced Iron – Technology & Economics of production and use, 1980, Iron & Steel Society of AMIE.

C. K. Gupta and A. K. Suri, Ferroalloys Technology in India, 1982, Milind Pub., New Delhi.

PM701 Advanced Metallurgical Thermodynamics (3-1-0) 4

Review of heat capacity, enthalpy, entropy and free energy concept, fugacity, activity, activity coefficient and the equilibrium constant, solutions - Raoult's law and Henry law, properties of Raoultian ideal solution, non-ideal solution, binary Gibbs-Duhem equation and its application to activity and activity coefficient determination, study of thermodynamic properties of metallurgical systems with special emphasis on liquid metals and slags, quasichemical theory, excess thermodynamics functions, regular and sub regular models of metallic solutions, interaction parameter and interaction coefficient, ternary Gibbs-Duhem integration, theory of ideal mixing of silicates, tubular representation of thermodynamic data and the free energy function.

R. T. Dehoff, Thermodynamics in Materials Science, McGraw Hill, 1993

D. R.. Gaskell, Introduction to Thermodynamics of Materials, McGraw Hill, 1981

R. A. Swalin, Thermodynamics of solids, John Wiley, 1972

PM702 Momentum and Thermal Transport Phenomena (3-1-0) 4

Momentum Transfer in Metallurgical Processes - Viscous properties of fluids, Laminar flow and the momentum equation, Turbulent & complex flows, Energy balance applications, Problems in compressible flow, Sonic velocity and supersonic jets, production of vacuum, Differential models of turbulence for bulk convecting flows, Electromagnetically driven flows, Physical & computational models, Recent advances in metallurgical fluid dynamics: Advances resulting from physical and mathematical modeling. Heat Transfer in Metallurgical Processes - Unsteady state conduction of heat, Differential thermal energy balance in fluids, Forced and Natural convention of heat, The heat transfer coefficient, Heat Transfer Correlations, Radiant heat transfer between black - body surfaces, gray - body surfaces, radiation through emitting and absorbing media, Heat transfer in continuous casting, welding and quenching, Inverse heat conduction problem - solution and applications. Process Modelling - Introduction, types of models, similarity criteria, development of process models, model implementation.

D. R. Poirier & G. H. Geiger, Transport Phenomena in Materials Processing, TMS, Warrendale, 1994.

R. I. L. Guthrie, Engineering in Process Metallurgy, Oxford Science Publications, 1989

M. A. Glinkov & G. M. Glinkov, A General Theory of Furnaces, Mir, Moscow, 1980

Nobuo Sano, W. K. Lu & P. V. Ribound: Advanced Physical Chemistry for Process Metallurgy, Academic Press, London 1997

N. J. Themelis, Transport and Chemical Rate Phenomena, Gordon Breach, New York, 1995.

PM703 Experimental Techniques (3-0-0) 3

Introduction to metallurgy – crystal structure, defects & phase diagram. experimental determination of phase diagrams including TTT and CCT diagrams, Elements of Optical, Scanning & transmission electron microscopy, Mechanical properties tensile, creep & fatigue, fracture toughness testing, x-ray methods - qualitative and quantitative chemical analysis by diffraction, absorption and fluorescence, stress analysis, texture.

V. Raghavan, Physical Metallurgy, Principles and Practice, Prentice Hall of India Private Ltd., New Delhi, 1985.

G. E. Dieter, Mechanical Metallurgy, 1986, McGraw Hill, New York.

B. D. Gullity, Elements of X-ray Diffraction, Addison - Wesley, New York., 1956

PM704 Process Metallurgy Lab (0-0-3) 2

Experiments in extractive metallurgy, Metallography optical & scanning microscopy techniques, quantitative metallography, x-ray diffraction.

PM705 Theory of Metallurgical Processes (3-1-0) 4

Review of various rate theories, Gibbs and Langmiuir isotherms, diffusion in solids, liquids and gases, mass transfer: concept of mass transfer coefficients, mass transfer correlations, mass transfer models, interfacial phenomenon interfacial turbulence, electrocapillary effects, enhanced vaporization; process analysis, staged operations, impinging jets and submerged jets, continuous flow systems, analysis of single particle reactions, correlation with packed beds and fluidized beds.

F. D. Richardson, Physical Chemistry of Melts in Metallurgy, Vols.1 & 2, 1974, Academic Press, London.

J. Szekely & N. Themelis, Rate Phenomenon in Process Metallurgy, Wiley International, 1971

L. Coudrier et al, Fundamentals of Metallurgical Processes, 1978, Pergamon

PM800 Advances in Steel Makeing (3-0-0) 3

Review of the development in steelmaking processes, physico - chemical and thermodynamic principles of important reactions in steelmaking, deoxidation of steel. Basic oxygen steelmaking processes, developments in L.D. converter. Bottom oxygen process and combined blowing, energy optimizing furnace (EOF) process. Steelmaking in electric arc furnaces, principles and practice adopted for stainless steel production, recent developments in stainless steel making, recent developments in electric arc furnace practice. Steelmaking in electric arc furnace, recent developments. Conarc process, steel makinf in induction furnace. Secondary steel making processes, ladle furnace method, injection metallurgy, vacuum treatment of molten steel. Non - metallic inclusions in steel – Mechanism of formation and removal; Principles and practice adopted for stainless steel production, recent developments in stainless steel making. Electroslag refining and vacuum arc remelting, vaccum induction melting, plasma melting, electron beam melting and microwave melting. Continuous casting of steel, fluid flow in the tundish, moulds used for continuous casting, use of casting powder, electromagnetic stirring and magnetic brake, defects in continuous casting products, Introduction to mathematical modeling of continuous casting process.

Making, Shaping and Treating of Steel, 10th Edition, Edited by United States Steel, 1985; or 11th Edition, Edited by the Association of Iron and Steel Engineers, 1999

A. Ghosh and A Chatterjee, Ironmaking and Steelmaking: Theory and Practice, PHI Learning (P) Ltd., New Delhi, 2008

A. K. Chakravarty, Sttelmaking, PHI (P) Ltd., New Delhi, 1007

R. H. Tupkary, Modern Steel Making, 1982, Khanna Pub. New Delhi, 1008

C. Bodsworth, Physical Chemistry of Iron and Steel Making

T. Rosenqvist, Principles of Extractive Metallurgy, 1983

PM801 Mechanical Processing of Steel (3-0-0) 3

Review of stress and relationship for elastic behaviour, elements of the theory of plasticity, effects of various factors on the plastic deformation of polycrystalline aggregates, fundamentals of metal working, effects of various factors on forming processes, mechanics of metal forming, work of plastic deformation, formability tests and evaluation, friction in forming operations, experimental techniques of forming analysis, detailed analysis of the various hot and cold working processes with special reference to steels based on the following points: Classification of processes, equipment, deformation forces and geometrical relationship variables, defects, residual stresses, theories of the forming process, power requirements, lubrication problems, recent developments, heating for mechanical working, soaking pit practice, control methods and computer simulation. CAD, CAM, FEM. Numerical Problems Design Aspects.

G.E. Dieter, Mechanical Metallurgy, S. I. Metric McGraw Hill, 1988.
T. Altan, S. Oh. H. Gegel, Metal Forming - Fundamentals and Applications, ASM, Ohio, 1983.
Making, Shaping & Treating of Steel, 10th Edition, USS, 1985.

PM802 Advanced Foundry Technology (3-0-0) 3

Liquid, solid and solidification; shrinkage nucleation and growth, segregation, mechanism of solidification of ferrous alloys, flow of metals in gates, heat transfer during solidification, melting furnaces and processes for the production of cast irons and steel castings, special problems in heat treatment to ferrous castings, sand practice for iron and steel casting production, modern trends, engineering design of castings, sources of fluctuation in properties, influence of form and environment. Numerical problems and computers in foundry.

J. Campbell, Castings, Butterworth, 1991, London
Heine and Rosenthal, Principles of Metal Casting, 1955, McGraw Hill, NY.
Solidification of Metals, W. C. Winegard, Institute of Metals 1964.

PM803 Advanced Welding Technology (3-0-0) 3

Introduction to conventional welding process, energy source for fusion welding, heat flow and fluid flow for fusion welding, fluxes for fusion welding, slag/metal interaction, solid state transformation, cracking phenomena, gases in welds. Special welding processes: TIG, ESW, plasma, ultrasonic, laser, electron beam welding, surface hardening, weldability of metals and alloys, stresses in welds, welding of carbon steels, low alloy steels, stainless steels. Cast iron, welding of non-ferrous and composite materials, numerical aspects of modeling the welds, weld design, weld tests. Computers in Welding.

ASM Handbook, vol.6: Welding Brazing and Soldering, 1994
Welding Handbook: American Welding Society, 1991
J.F. Lancaster, Metallurgy of Welding, 2007

PM804 Corrosion Engineering (3-0-0) 3

Definition of corrosion, corrosion damage, standard expressions for corrosion rate, classification of corrosion, electrochemical aspects, electrochemical reactions, Pourbaix diagrams, mixed potential theory, polarization, Evan's diagrams, passivity, effects of environment - oxygen and oxidizers, temperature, corrosive concentration, cathode/anode area ratio, galvanic coupling using mixed potential theory. Forms of corrosion - uniform, galvanic, crevice, intergranular, pitting, selective leaching, erosion, stress corrosion, corrosion fatigue, fretting. Corrosion rate measurements - Tafel and linear polarization, AC impedance, small - amplitude cyclic voltammetry. Corrosion testing. Interpretation of results, Corrosion protection: materials selection, alternative environment, design, cathodic and anodic protection, coatings, High - temperature corrosion: mechanisms and kinetics, high - temperature materials.

Mars G. Fontana, Corrosion, McGraw - Hill Book Company 1986.
David Talbot and James Talbot, Corrosion Science and Technology, CRC Press, NewYork, 1998
Denny A. Jones, Principles and Prevention of Corrosion, Maxwell Macmillan 1992
Metals Handbook, Vol.13, Corrosion, ASM Metals Book, Ohio1987.

Annexure XX

M.Tech in Nanotechnology (NT)

Suggested Plan of Study

Sl. No.	I	II	III	IV
1	NT700	Elective – 1	NT898	NT899
2	NT701	Elective – 2	NT897	
3	NT702	Elective – 3		
4	NT703	Elective – 4		
5	NT704	NT749		
6	NT748	NT890		

Credit Requirements:

Category	Minimum Credits to be earned
Programme Core (Pc)	24
Elective Course (Ele)	12
Mandatory Learning Courses (MLC)	04
Major Project (MP)	20
Total	60

Programme (Pc)

NT700	Introduction to Nanoscience & Nanotechnology	(3-1-0) 4
NT701	Quantum Theory of Nanoscale Materials	(3-1-0) 4
NT702	Synthesis Techniques for Nanomaterials	(3-1-0) 4
NT703	Thermodynamics of Solids	(3-1-0) 4
NT704	X-Ray and Electron Microscopy Techniques	(3-1- 0) 4
NT748	Nanomaterials Synthesis Laboratory	(0-0-3) 2
NT749	Materials Characterization Laboratory	(0-0-3) 2

Elective Course (Ele)

NT750	Nanophotonics	(3-0-0) 3
NT751	Nanoelectronics	(3-0-0) 3
NT752	Surface Phenomena	(3-0-0) 3
NT753	Carbon Nano Structures &Applications	(3-0-0) 3
NT754	Nano Biotechnology	(3-0-0) 3
NT755	Polymer Nanotechnology	(3-0-0) 3
NT756	Nano Composites	(3-0-0) 3
NT757	Chemistry of Nanomaterials	(3-0-0) 3
NT758	Advanced Characterization Techniques	(3-0-0) 3
NT759	Microstructure & Mechanical Properties of of Nano-structures	(3-0-0) 3
NT760	Nanomaterials for Energy Conversion	(3-0-0) 3
NT761	Integrated Microelectronic Devices	(3-0-0) 3
NT762	MEMS/NEMS Devices and Systems	(3-0-0) 3
NT763	Nanotribology	(3-0-0) 3
NT764	Computational Material Science	(3-0-0) 3

Mandatory Learning Course (MLC)

NT890	: Seminar	2
NT897	: Minor Project	2

Major Project (MP)

NT898	: Major Project (3rd Sem.)	6
NT899	: Major Project (4th Sem.)	14

M.TECH - NANOTECHNOLOGY PROGRAMME

NT700 Introduction to Nanoscience & Nanotechnology (3 – 1 – 0) 4

Miniaturization of devices, need for nanoparticles; Fundamentals of structure and energetic of nanomaterials; Size effects, surface energy; Thermodynamic laws governing equilibrium properties; Relating macroscopic behavior to molecular models of materials; Heat capacities, Phase transformation, Electronic properties, Magnetic properties, diffusion; Structure of nanocrystalline, crystalline and liquid crystalline states; Tensor properties of materials; Point, line and surface imperfections; Environmental impact; Real world examples such as materials for fuel cells/batteries, engineered materials, nano-electronic and nano-photonic devices, MEMS and NEMS devices, ionic and network solids, polymers and biomaterials.

C.P. Poole and F.J. Owens, Introduction to Nanotechnology, Wiley Interscience 2003.
C.N.R. Rao, Achim Muller and A.K. Cheetham, The Chemistry of Nanomaterials, Vol I & II, Wiley VCH, 2004.
B.Rogers, S.Pennathur and J.Adams, Nanotechnology: Understanding small systems, CRC Press, 2008.
A. Nouailhat, An instriduction to nanoscience and nanotechnology, John Wiley & Sons, 2008.
Dieter Vollath, Nanomaterials: An introduction to synthesis, properties & applications, Wiley-VCH, 2008.
T. Pradeep, Nano: The Essentials – Uncerstanding Nanoscience and Nanotechnology, Tata McGraw Hill
H.S. Nalwa, Encyclopedia of Nanotechnology, ASP, 2011

NT701 Quantum Theory of Nanoscale Materials (3 – 1 – 0) 4

Introduction to quantum mechanics, Schrodinger equation, uncertainty principle, bound states of 3–D potential wells and periodic potentials, angular momentum, quantum statistics; perturbation theory, electronic band structures in semiconductors, metals, organic materials and nanostructures; vibrational properties of solids; light-matter interaction; electronic bonding; electronic, optical and magnetic properties of nanomaterials.

B.Rogers, S.Pennathur and J.Adams, Nanotechnology: Understanding small systems, CRC Press, 2008.
Dieter Vollath, Nanomaterials: An introduction to synthesis, properties & applications, Wiley-VCH, 2008.
M.F.Ashby, P.J.Ferreira, D.L.Schodek, Nanomaterials, Nanotechnologies and design, Elsevier, 2009.

NT702 Synthesis Techniques for Nanomaterials (3 – 1 – 0) 4

Physical Methods: Inert gas condensation, Arc discharge, RF-plasma, Plasma arc technique, Ion sputtering, Laser ablation, Laser pyrolysis, Ball Milling, Molecular beam epitaxy, Chemical vapour deposition method and other variants, Electrodeposition. Chemical Methods: Metal nanocrystals by reduction, Solvothermal synthesis, Photochemical synthesis, Electrochemical synthesis, Nanocrystals of semiconductors and other materials by arrested precipitation, Thermolysis routes, Sonochemical routes, Liquid-liquid interface, Hybrid methods, Solvated metal atom dispersion, Post-synthetic size-selective processing. Sol- gel, Micelles and microemulsions, Cluster compounds. Biological Methods: Use of bacteria, fungi, Actinomycetes for nanoparticle synthesis, Magnetotactic bacteria for natural synthesis of magnetic nanoparticles; Mechanism of formation; Viruses as components for the formation of nanostructured materials; Synthesis process and application, Role of plants in nanoparticle synthesis. Lithographic Techniques: AFM based nanolithography and nanomanipulation, E-beam lithography and SEM based nanolithography and nanomanipulation, Ion beam lithography, oxidation and metallization. Deep UV lithography, X-ray based lithography.

H.S. Nalwa - Encyclopedia of Nanotechnology, 2011
Leon L.Shaw(Ed), Processing & properties of structural nanomaterials, 2010
C.N.R. Rao, Achim Muller and A.K. Cheetham, The Chemistry of Nanomaterials, Vol I & II, Wiley VCH, 2004.
G. Cao, Nanostructures & Nanomaterials Synthesis, Properties & Applications, Imperial College Press, 2004

NT703 Thermodynamics of Solids (3 – 1 – 0) 4

Laws of thermodynamics, relations between thermodynamic quantities; Thermodynamics of chemical reactions, magnetism, polarizability and elasticity; Phase transformation, partial molar and excess quantities; Multi-phase equilibria and their phase diagrams, free energy of binary systems; Electrochemical equilibria; Thermodynamics of surfaces and interfaces; Macroscopic equilibrium phenomena.

Dieter Vollath, Nanomaterials: An introduction to synthesis, properties & applications, Wiley-VCH, 2008.

R.A.Swalin, Thermodynamics of solids, John Wiley, 1972

M.F.Ashby, P.J.Ferreira, D.L.Schodek, Nanomaterials, Nanotechnologies and design, Elsevier, 2009.

NT704 Materials Characterization (3 – 1 – 0) 4

XRD techniques: Single crystal diffraction, texture studies, lattice parameter, chemical analysis, stress analysis. TEM: Theories of contrast in crystal, electron diffraction, SAD patterns, lattice defects, precipitates, second phases, specimen preparation, SEM: electron – specimen interactions, modes of operation, X-ray, Auger induced conductivitiy, high resolution electron microscopy, field ion and field emission microscopy, UV-VIS spectroscopy, IR and FTIR spectroscopy.

B.D. Cullity and S.R. Stock, Elements of X-ray diffraction, Prentice Hall, 2001.

P. Goodhew, F.J. Humphreys and R. Beanland, Electron Microscopy and Analysis, 3rd Ed., Taylor & Francis, 2001.

P.E.J. Flewitt and R.K. Wild, Physical methods of materials characterization, IoP Publ. Ltd. 1994.

NT748 Nanomaterials Synthesis Laboratory (0 – 0 – 4) 2

Synthesis of nanostructured metals and metal oxides (ex. Ag, Cu, Sn, As, ZnO, SnO_2, oxides of iron, etc) by hydrothermal, microwave, and ultrasonic methods under varying conditions; surface functionalization .

NT749 Materials Characterization Laboratory (0 – 0 – 4) 2

Characterization of nanomaterials by powder XRD, study of size distribution and variation; Study of morphology of nanomaterials by Optical microscopy, SEM and TEM; metallographic specimen preparation.

NT750 Nanophotonics (3 – 0 – 0) 3

Nanophotonics: Background, Maxwell's equations, optical modes, 1D, 2D and 3D photonic crystals and light propagation in them, Photonic Properties of Nanomaterials; Photon Absorption, Emission & Scattering; Permittivity & free Electron Plasma of metals, Extinction Coefficient of Metal particles; Gold & silver particles for nanophotonic devices, bandgap engineering of nanoscale devices, Thin films, Quantum wires and dots, photonic crystal fibers, Quantum Confinement based light sources and detectors, optical tweezers, photonic crystal devices, nonlinear optics in nano and microstructures.

B.Rogers, S.Pennathur and J.Adams, Nanotechnology: Understanding small systems, CRC Press, 2008.

H. Rigneault, J.M. Lourtioz, C. Delalandeand A. Levenson, ISTE Ltd., 2007.

A. Nouailhat, An instriduction to nanoscience and nanotechnology, John Wiley & Sons, 2008.

Dieter Vollath, Nanomaterials: An introduction to synthesis, properties & applications, Wiley-VCH, 2008.

G.L. Hornyak, J.J. Moores, H.F. Tibbals and J. Dutta, Fundamentals of Nanotechnology, CRC Press, 2009.

NT751 Nanoelectronics (3 – 0 – 0) 3

Semiconductors: Tuning the Band gap of Nanoscale Semiconductors, Excitons, Semiconductor nanowires-Fabrication strategies, quantum conductance effects in semiconductor nanowires, porous Silicon, nanobelts, nanoribbons, nanosprings; Quantum dot, Single electron devices, molecular electronic devices; Metal-insulator transition, Nanostructured ferromagnetism, effect of bulk nanostructuring of magnetic properties, dynamics of nanomagnets, Nanocarbon ferromagnets, Giant & colossal magnetoresistance, Nanopore containment of magnetic particles,

B.Rogers, S.Pennathur and J.Adams, Nanotechnology: Understanding small systems, CRC Press, 2008.
A. Nouailhat, An introduction to nanoscience and nanotechnology, John Wiley & Sons, 2008.
Dieter Vollath, Nanomaterials: An introduction to synthesis, properties & applications, Wiley-VCH, 2008.
G.L. Hornyak, J.J. Moores, H.F. Tibbals and J. Dutta, Fundamentals of Nanotechnology, CRC Press, 2009.

NT752 Surface Phenomena (3 – 0 – 0) 3

Thermodynamics of surfaces; Reactivity of surfaces; Atomic models of crystal surfaces; Electron diffraction from surface layers; Surface diffusion; Physical and chemisorptions of gases on surfaces; Chemical reactions at surfaces; Nucleation on surfaces and bulk phases.

Dieter Vollath, Nanomaterials: An introduction to synthesis, properties & applications, Wiley-VCH, 2008.
G.L. Hornyak, J.J. Moores, H.F. Tibbals and J. Dutta, Fundamentals of Nanotechnology, CRC Press, 2009.

NT753 Carbon Nano Structures & applications (3 – 0 – 0) 3

Carbon nanostructures and types of CNTs, growth mechanisms, synthesis of CNTs by flame, CVD, laser ablation and electric arc processes, purification and characterization methods, mechanical reinforcements, solid disordered carbon nanostructures, nanostructured crystals, electrical, vibrational, mechanical properties of CNTs, optical properties, Raman spectroscopy of CNTs, carbon clusters and fullerenes, decoration of CNT by nano metals/oxides, lithium and hydrogen adsorption and storage, fuel cell applications and energy storage, sensor applications of CNTs. Applications to nanoelectronics, nanocomposites, nanowires and drug delivery.

C.N.R. Rao, Achim Muller and A.K. Cheetham, The Chemistry of Nanomaterials, Wiley Interscience, 2005.
A. Jorio, G. Dresselhaus and M.S. Dresselhaus, Carbon Nanotubes – Advanced Topics in the Synthesis, Structure, Properties and Applications, Springer 2008.
A. Loiseau, P. Launois, P. Petti, S. Roache, J.P. Salvetat, Understanding Carbon Nanotubes - From basics to applications, Springer 2006.

NT754 Nano Biotechnology (3 – 0 – 0) 3

Biosynthesis of nanosized materials using microbes, bioconjugation of biomaterials (enzyme) with nanoparticles, different types of inorganic materials used for synthesis of hybrid nano- bio-assemblies, nanoprobes for analytical applications – a new methodology in medical diagnostics and biotechnology, synthesis of nanomedicines and its behavior in biological systems. Synthesis of nanodrug carriers (soft, hard), applications of nanomaterials to cancer detection and treatment, Lab on Chip, DNA Micro-array, Protein Micro-array, Bioelectronics, Biobatteries, Biorobotics, Molecular motors.

A.K. Bandyopadhyay, Nanomaterials, New Age Publishers.
T. Pradeep, Nano: The Essentials – Uncerstanding Nanoscience and Nanotechnology, Tata McGraw Hill,2007

NT755 Polymer Nanotechnology (3 – 0 – 0) 3

Processing of Nanoparticles - Binding mechanisms in Nanoparticles, Dispersion of Nanoparticles, Stabilization of Nanoparticles. Processing and fabrication of polymer nanocomposites - Melt blending, Solvent casting, In-situ polymerization, Solution polymerization, Template synthesis, High shear mixing. Homogenoeous/heterogeneous nucleation, plasma promoted nucleation, Cold Plasma Methods, Atomic layer deposition fundamentals, Laser ablation, Vapour – liquid – solid growth, particle precipitation aided CVD. Polymer nanocomposites with structural, gas barrier and flame retardant properties, carbon fiber reinforced polymer composites, elastomer and thermoplastic elastomer nanocomposites for propulsion systems, water borne fire-retardant Nanocomposites, hybrid composites for cosmetics, protective and decorative coatings. Polymer based optical, electronic and magnetic materials. Nanoelectronics. Molecular Electronics Components. Characterization of polyphenylene based switches and complex molecular devices. Molecular rectifying diode switches,

Chung, Deborah D. L., Composite Materials: Science and Applications, Spinger International Edition, Springer-Verlag, London (2004)-Indian Edition 2006

B. T. Astrom, Manufacturing of Polymer Composites, Chapman and Hall, London 1995

T. G. Gutowski, Advanced Composites Manufacturing, John Wiley and Sons, New York 1997

K. Goser, Peter Glösekötter, Jan Dienstuhl, *Nanoelectronics & Nanosystems: From Transistor to Molecular & Quantum Devices. Springer Berlin, 2004*

NT756 Nano Composites (3 – 0 – 0) 3

Introduction to nanocomposites, composite materials, mechanical properties of nanocomposite materials, stress –strain relationship, toughness, strength, plasticity, cermic-metal nanocomposites, ceramic based nanoporous composites, metal matrix nanocomposites, polymer based nanocomposites, carbon nanotubes nanocomposites, natural nano-biocomposites, bio-mimetic nanocomposites and biologically inspired nanocomposites, nanocomposites for hard coatings, DLC coatings, thin film nanocomposites, modeling of nanocomposites, synthesis of various nanocomposite materials, Sputtering, mechanical alloying, sol-gel synthesis, thermal spray synthesis, nano-indentation, processing of polymer nanocomposites, properties of nanocomosites, salt infiltration, powder mixing, intrusion method, exfoliation and interaction, gel-casting impregnation techniques.

P.M. Ajayan, L.S. Schadler and P.V. Braun, Nanocomposite Science and Technology, Wiley-VCH, 2003

C.P. Poole and F.J. Owens, Introduction to Nanotechnology, Wiley Interscience 2003.

H.S. Nalwa, Encyclopedia of Nanotechnology, 2004

Chung; Deborah D. L., Composite Materials: Science and Applications, Spinger International Edition, Springer-Verlag, London (2004)-Indian Edition 2006

NT757 Chemistry of Nanomaterials (3 – 0 – 0) 3

Nanomaterials, size effects, general methods for preparation, sol-gel, solvothermal, sonochemistry and other novel methods of synthesis, properties and uses of nanomaterials, growth of nanocrystals in solutions, structure, energy bands, methods of measuring properties, particle size determination, metal and semiconductor nanocrystals, oxide nanoparticles, nanotubes and nanowires, nanostructured polymers and composites, nanoporous materials, nanocatalysis, industrial applications.

C.N.R. Rao, Achim Muller and A.K. Cheetham, The Chemistry of Nanomaterials, Vol I & II, Wiley VCH, 2004.

C.N.R. Rao, Achim Muller and A.K. Cheetham, Nanomaterials Chemistry, Wiley VCH, 2007

C.P. Poole and F.J. Owens, Introduction to Nanotechnology, Wiley Interscience 2003.

NT758 Advanced Characterization Techniques (3 – 0 – 0) 3

Compositional and structural characterization techniques: XPS, X-topography, Electron probe microanalysis, Electron diffraction, Electron probe microanalysis, SIMS and RBS, AFM, STM, Raman spectroscopy, Photoluminescence spectroscopy, Hall measurement, dynamic and static I-V characteristics, C-V measurement, EBIC, SQUID, VSM, MFM, neutron diffraction, DSC, TGA, DMA.

C. Suryanarayana, A practical approach to X-ray diffraction analysis, 1998
Z.L. Wang, Characterization of Nanostructured materials, 2003
J.I. Goldstein, Scanning Electron Microscopy and X-ray microanalysis, 2003
E.Smith and G. Dent, Modern Raman Spectroscopy: A practical approach, 2005

NT759 Microstructure & Mechanical properties of Nano-structures (3 – 0 – 0) 3

The phenomenological, mechanistic and micro-structural aspects of the mechanical properties of materials are developed, with particular emphasis on the similarities and differences among various material systems including metals, ceramics and polymers. Phenomenological aspects of the three-dimensional characteristics of stress and strain, various yield criteria, elastic behavior, viscoelastic behavior, plastic behavior, statistical aspects of brittle fracture and fracture mechanics are presented. Mechanistic and micro-structural topics include edge and screw dislocation behavior, slip systems, critical resolved shear stress, dislocation multiplication and interactions, barriers to motion, polymer chain conformation and entropy.

C.P. Poole and F.J. Owens, Introduction to Nanotechnology, Wiley Interscience 2003.
H.G.Rubahn, Basics of Nanotechnology, Wiley-VCH, 3rd ed., 2008.
Dieter Vollath, Nanomaterials: An introduction to synthesis, properties & applications, Wiley-VCH, 2008.
G.L. Hornyak, J.J. Moores, H.F. Tibbals and J. Dutta, Fundamentals of Nanotechnology, CRC Press, 2009.

NT760 Nanomaterials for Energy Conversion (3 – 0 – 0) 3

Fundamentals of thermodynamics, chemistry, and transport applied to energy systems. Analysis of energy conversion and storage in thermal, mechanical, chemical, and electrochemical processes in power and transportation systems, with emphasis on efficiency, performance, and environmental impact. Applications to fuel reforming and alternative fuels, hydrogen, fuel cells and batteries, solar cells, combustion, catalysis, combined and hybrid power cycles using fossil, nuclear and renewable resources. CO_2 separation and capture. Biomass energy.

C.P. Poole and F.J. Owens, Introduction to Nanotechnology, Wiley Interscience 2003.
H.G.Rubahn, Basics of Nanotechnology, Wiley-VCH, 3rd ed., 2008.
Dieter Vollath, Nanomaterials: An introduction to synthesis, properties & applications, Wiley-VCH, 2008.
G.L. Hornyak, J.J. Moores, H.F. Tibbals and J. Dutta, Fundamentals of Nanotechnology, CRC Press, 2009.

NT761 Integrated Microelectronic Devices (3 – 0 – 0) 3

Semiconductor fundamentals, p-n junction, metal-oxide semiconductor structure, metal-semiconductor junction, MOS field-effect transistor, and bipolar junction transistor. Emphasis on physical understanding of device operation through energy band diagrams and short-channel MOSFET device design. Issues in modern device scaling outlined. Includes device characterization projects and device design project.

R.S. Muller, T.I. Kamins and M. Chan, Device Electrnics for Integrated Circuits, 3rd Ed., John Wiley, 2002.
S.M. Sze, Physics of Semiconductor Devices, Wiley Interscience, 2nd Ed., 1981.

NT762 MEMS/NEMS Devices and Systems (3 – 0 – 0) 3

MEMS & NEMS – overview, sensors, transducers and actuators designing, Basics of MEMS engineering, scaling laws, materials for MEMS and NEMS; microsystem manufacturing: photolithography, bulk, surface and LIGA processes, comparison of wet and dry etching, striction, methods to reduce striction, microsystem design, CAD applications in MEMS design, Applications of MEMS and NEMS in automotive, aircraft, medical electronics, and sensor systems.

Tai Ram Hsu, MEMS and micrsystems – Design and Manufacturing, Tata McGraw Hill, 2002.
M.J. Madou, Fundamentals of microfabrication – the science of miniaturization, IEEE Press,
S.D. Senturia, Microsystems Design, Kluwer Academic Publishing, 2003.

NT763 Nanotribology (3 – 0 – 0) 3

Nanotribology, nanomechanics, surface forces, nano-rheology of molecular thin films, interfacial forces, spectroscopic study of confined fluids, friction and wear on atomic scale, nanomechanical properties of solid surfaces and thin films, computer simulation of nanometer scale indentation and friction, mechanical properties of nanostructures, scale effects in mechanical properties and tribology, nanoscale boundary lubrication studies, bio-mimetics, lotus effect, superhydrophobic surfaces, measurement techniques, scanning probe microscopy, noncontact AFM, and related topics.

Bharat Bhushan (Ed.), Nanotribology and Nanomechanics, 2nd Ed., Springer XXXIV, 2008.

NT764 Computational Materials Science (3 – 0 – 0) 3

Theory and application of atomistic computer simulations to model, understand, and predict the properties of real materials. Energy models: from classical potentials to first-principles approaches. Intermolecular forces and potentials, Density-functional theory and the total-energy pseudopotential method. Many body model potentials, Atom site stress field, Errors and accuracy of quantitative predictions. Thermodynamic ensembles: Monte Carlo simulation methods, Computation for few particles, Markov process, molecular dynamics simulations, Numerical integrations of equations of motion, Systems in contact with heat bath, Free energies and phase transitions. Fluctations and transport properties. Coarse-graining approaches and mesoscale models.

G. Ali Mansoori, Principles of Nanotechnology, World Scientific, 2006.
K.Ono, K.Esfarjani and Y. Kawazoe, Computational Materials Science, From Ab-initio to Monte-Carlo, Springer Series in Solid State, New York, 1999.
D.C. Rapaport, The Art of Molecular Dynamics Simulation, CUP, 2004.
W.H. Press, S.A. Teukolsky, W.T. Wetterling and B.R. Flannery, Numerical Recipies, The Art of Parallel Scientific Computing, CUP, 1996.

DEPARMENT OF MATHEMATICAL AND COMPUTATIONAL SCIENCES, NITK, SURATHKAL,

REVISED CURRICULUM FOR M.TECH (SACA)

Sl. No.	Semester			
	I	II	III	IV
1	SY711	SY721	SY891/SY897 (Mini Proj.)	SY899 (MP)
2,	SY712	SY722	SY890(Seminar)	
3,	SY713	SY723	SY898(MP)	
4,	SY714	SY724		
5.	SY715	SY725		
6.	Elective .1	Elective .2 Elective 3		
7.				

Category	Minimum Credits to be Earned
Program Core (Pc)	27
Elective (Ele.)	09
Mandatory Learning Course (MLC)	04
Major Project (MP)	20
Total	60

Programme Core (Pc)

SY711	General Systems Theory Concepts	(3-0-0)3
SY712	Computer Organization & Architecture	(3-0-0)3
SY713	Data Structures & Algorithms	(3-0-0)3
SY714	Data Structures & Algorithms Lab	(0-0-3)2
SY715	Discrete Mathematical Structures	(3-0-0)3
SY721	Data Base Systems	(3-0-0)3
SY722	Data Base Systems Lab	(0-0-3)2
SY723	Operating Systems	(0-0-3)3
SY724	Operating Systems Lab	(0-0-3)2
SY725	Software Engineering	(3-0-0)3

Elective (Ele) Courses

SY751	Systems Analysis & Design	(3-0-0)3
SY752	Stochastic Analysis & Applications	(3-0-0)3
SY801	Management Information Systems	(3-0-0)3
SY802	Computer Graphics	(3-0-0)3
SY803	Computer Networks	(3-0-0)3
SY804	Artificial Neural Networks	(3-0-0)3
SY805	Computational Combinatorics	(3-0-0)3
SY806	Algorithmic Graph Theory	(3-0-0)3
SY807	Cryptography & Network Security	(3-0-0)3
SY808	Distributed Computing Systems	(3-0-0)3
SY809	Fuzzy System Models	(3-0-0)3
SY811	Genetic Algorithms	(3-0-0)3
SY812	Information & Coding Theory	(3-0-0)3
SY813	Internet Technology & Applications	(3-0-0)3
SY814	Image Processing	(3-0-0)3
SY815	Natural Language Processing	(3-0-0)3
SY816	Pattern Recognition	(3-0-0)3
SY817	Stochastic System Models	(3-0-0)3
SY818	System Modeling & Simulations	(3-0-0)3
SY819	Theory of Computation	(3-0-0)3
SY820	Web Technology	(3-0-0)3
SY821	Advanced Data base Systems	(3-0-0)3
SY822	Advanced Operating Systems	(3-0-0)3
SY823	Client Server Computing	(3-0-0)3
SY824	Combinatorial Optimization	(3-0-0)3
SY825	Selected Topics in Network Modeling & Analysis	(3-0-0)3
SY826	Selected Topics in Network Flow Optimization	(3-0-0)3
SY827	Selected Topics General Systems Design	(3-0-0)3
SY828	Information Storage & Management	(3-0-0)3
SY829	Collective Decision Making Processes	(3-0-0)3

Mandatory Learing Courses (MLC)

SY890	Seminar	(2)
SY891/ SY897	Practical Training/Minor Project	(2)

(to be completed during vacation between 2nd & 3rd Semester)

Major Project (MP)

SY898	Major Project (3rd sem)	6
SY899	Major Project (4th sem)	14

Dr. S.M. HEGDE
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Program Core:

SY711 General Systems Theory Concepts (3-0-0) 3

Boundary, interface, structure, behaviour and description of a system; state transitions. General systems approach to problem solving; Primary dimensions in systems studies. Problem Classification: Analysis; Design; Optimization; Control; Simulation; etc. System Models; Modeling of system uncertainties; parametric uncertainties.

G.M. Weinberg, General Systems Thinking-An Introduction, Dorset House, 2000
H.A. Simon, The Sciences of the Artificial, MIT Press,2001
http://pespmc1.vub.ac.be/CYBSYSTH.html
http://systemtheory.net/
http://www.well.com/abs/
http://www.er.ele.tue.nl/sweiland/ssyst.htm

SY 712 Computer Organization & Architecture (3-0-0)3

Data Representation, Number system, Logic design, Addressing modes, Assembly Language programming, Memory organization, Arithmetic: Adders, Carry Look ahead Adder, CSA, Fast multipliers, Booth multiplier, Floating points representation and operations, CPU architecture and organization, Microprogramming, Hardwired control unit, Instruction formats, I/O architecture. Multiprocessing, RISC vs. CISC Architectures, Pipelining and superscalar machines, Parallel processing.

VC Hamachar, ZG Vranesic and SG Zaky, Computer Organization, McGraw Hill, 1996.
Moris Mano, Computer System Architecture, Prentice Hall, 1992.

SY 713 Data Structures & Algorithms (3-0-0) 3

Introduction to analysis of algorithms: asymptotic notations, big-oh, big-omega, theta, small-oh, small-omega notations, worst-case and average-case analysis, solving recurrences. Abstract data types, Linear Data Structures and their sequential storage representation: stacks, queues, priority queues, and their applications, Pointers and linked storage representation: singly linked list, circular linked list, doubly linked lists and their applications, skip lists. Nonlinear data structures: trees, storage representation of binary trees, operations on binary trees: tree traversals, insertion, deletion, searching, applications of trees, AVL trees. Graphs: representations of graphs, breadth first search and depth first search, shorted paths problem, minimum cost spanning trees, applications of graphs. Sorting: selection sort, bubble sort, insertion sort, merge sort, heap sort, quick sort, radix sort. Searching sequential search, binary search, search trees, hash tables.

T.H.Cormen, C.E. Leiserson, R.L. Rivest, C. Stein. Introduction to Algorithms, Prentice-Hall of India. 2003
A.V. Aho, J.E. Hopcroft and J.D. Ullman. Data Structures and Algorithms. Pearson Education. 2003
J.P.Trembly and P.G. Sorenson. An Introduction to Data Structures with Application. Tata Mc.Graw-Hill. 1991.

SY 715 Discrete Mathematical Structures (3-0-0) 3

Fundamentals of logic: Propositional and predicate calculus, Graph Theory: Trees, Representations of graphs, spanning Tree and shortest path algorithms, Planarity, Connectivity, Traversability, Colorability, Network flow algorithms, Search Procedures, Recurrence relations and generating functions, Group Theory: Groups, Subgroups, Lagrange's Theorem, Cyclic groups, Permutation groups, Normal subgroups, Lattice Theory: Order relations, Partial order, Linear order, Lattices, Boolean lattices, Boolean algebra.

J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with applications to Computer Science, McGraw Hill. 2005.
Judith L. Gerstring, Mathematical Structures for Computer Science, Freeman, 5th edn,2006.
Ralph. P. Grimaldi, Discrete and Combinatorial Mathematics, An applied introduction, Pearson Education, 4th edn,2004.

SY 721 Database Systems (3-0-0)3

Files versus database systems, Three-level architecture of databases, Data Models, ER-diagram, EER-model, Relational model, ER-Relational mapping, Relational algebra and calculus. Query languages, SQLm embedded SQL, Relational database design algorithms, Normalization, Physical database organization, Indexing and hashing, Transaction processing, Concurrency control techniques, Database recovery techniques, Database security and authorization.

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Surathkal, Srinivasnagar, Mangalore

Ramez Elmasri, Shamkant B Navathe, Fundamentals of database system, Addison Wesley, McGraw –Hill, 2000.
Silberschatz Korth and Sudarshan, Database System concepts, McGraw Hill,2001.
Ramakrishnan R., Gehrke Database Management Systems, Third edition, McGraw Hill, 2003.

SY723 Operating System (3-0-0)3

Evolution of operating systems. Types of operating systems. Process Management. Process States, CPU Scheduling algorithms. Process synchronization mechanisms. Semaphores, Classic problems of synchronization. Process communications, Deadlocks handling. Memory Management: Main memory and secondary memory management. Memory allocation algorithms. Paged and Segmented memory management. Virtual memory, page replacement algorithms. Disk Scheduling algorithms. File management Protection and security. Input output systems management. Basic UNIX commands, Shell programming.

Silberschatz and Galvin, Operating System Concepts, John Wiley 2001.
William Stallings, Operating Systems, Prentice Hall, Fifth Edition, 2005.
Pramod Chandra P. Bhatt. An Introduction to Operating System: Concepts and Practice, Prentice Hall of India Ltd., Second Edition. 2006.

SY 725 Software Systems Engineering (3-0-0) 3

Software Engineering paradigms, Planning, Cost estimation, Organization structure, Software project scheduling, Risk analysis and management, Requirements and specification, Rapid prototyping, software design, software metrics, Software testing and maintenance, Software configuration management and case tools, OO modeling, OO software development process, OOT concepts, Unified software development process, Development Phases, UML, structural and behavioral modeling, architectural modeling.

Roger S.Pressman, Software Engineering: A Practitioner Approach, McGraw Hill, 1999.
L. Sommerville, Software Engineering, Addison Wesley, 1996.
Grady Booch "OO Analysis and Design with Applications", Pearson Education Asia, 1997
Jacobson, Booch and Rambaugh. "The unified software Development process" Pearson Education Asia, 1998

SY714 Data Structures & Algorithms Lab (0-0-3) 2

Implementation of stacks and queues using arrays and linked lists, Implementation of operations on linked lists and its applications, implementation of operations on binary trees, implementation of graph algorithms, sorting, searching and hash methods.

AM Tenenbaum and MJ Augenstein, Data Structures using C AND C++, Prentice Hall of India, 1997.

SY722 Database Systems Lab (0-0-3) 2

A mini project to design and implement a database package incorporating all the relevant concepts learnt in the course.

SY724 Operating Systems Lab (0-0-3) 2

Basic UNIX Commands, Shell Programming, Implementation of scheduling, processes synchronization, deadlock and disk scheduling algorithms, simulation of paging and segmentation.

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National Institute of Technology Karnataka,
Srinivasnagar, Mangalore 575025

ELECTIVES:

SY751 System Analysis & Design (3-0-0) 3

Overview of system analysis and design, business systems concepts, system development life cycle, project selection, feasibility analysis, design, implementation, testing and evaluation, Project Selection: Sources of project requests, managing project review and selection, preliminary investigation, Feasibility study – Technical and economical feasibility, cost and benefit analysis, system requirement specification and analysis, Fact finidng techniques data flow diagrams, data dictionaries, process organization and interactions, decision analysis, decision trees and tables. Detailed design – Modularisation, module specification, file design, systems development involving data bases. System Controol and Quality Assurance – Design objectives reliability and maintenance, software design and documentation tools, top-down, bottom-up and variants, Units and integration testing, testing practices and plans, System Controls, Audit trails, System administration and training, conversion and operation plans. Hardware and software selection, Hardware acquisition, memory, processes, peripherals, bench working, vendor selection, software selection – operating system languages, language processes, performance and acceptance criteria.

Howrysz Kiewycz I.T, System Analysis and design, Prentice Hall, 1997.
James, A.S.I Analysis of Design of information Systems, McGraw Hill, 1986.

SY752 Stochastic Analysis and Applications (3-0-3) 3

Overview of probability, random variables, probability functions, functions of r v s, some important probability distributions, stochastic processes, basic concepts,classification, Markov chains, C-K equations, ergodic chains, steady state behaviour, Poisson processes, birth and death processes, queuing systems, basic concepts , M| M| 1 and M| M| s queues, Reliability, definitions, concept of hazard, bath-tub curve, system reliability for various configurations.

J. Medhi, Stochastic Processes, New Age Internationsl Publishers, 1996.
K. S. Trivedi, Probability and Statistics with Reliability, Queuing and Computer Science Applications, PHI, 1998.

SY801 Management Information Systems (3-0-0) 3

Definition of management information systems. Information Systems for decision making process, informationbased support system requirements, Planning Designing and implementing MIS, Case Study.

GB Davis and MH Olson, Management Information Systems, McGraw Hill, 1984.
Murdick RG and Ross J.E, Information Ssytems for modern Management, Prentice Hall, 1988.

SY802 Computer Graphics (3-0-0) 3

Display devices: Line And point plotting systems, (Raster, Vector), Pixel and Point Plotters, Continued refresh and storage displays Digital frame buffer, Display processors, Character generators, Color display techniques, (shadow mask and penetration CRT) color look – up tables, Display description, Screen – Coordinates, user co-ordinates. Transformation and animation: Graphical data Structure, 2D transoframation, Animation, interactive Graphics: Conceptual frame work for interactive graphics, Basic raster graphics algorithms Graphics Hardware Pointing and positioning devices, Interactive graphical techniques, their implementation issues, dynamic graphics, User interface software, Graphics standard: GKS, PHIGS 3D graphics: Projections viewing in 3D, 3D transformations, Hidden line and surface elimination.

Foley, Van dam, Fundamentals of Interactive Computer graphics, Addison Wesley, 1999.
Hearn D. Baker, Computer graphics, PHI, 1998.
Rogers D.F and Adams J., Mathematical Elements for Computer Graphics, McGraw Hill, 1998.

SY803 Computer Networks (3-0-0) 3

Introduction: Uses of Computer Network, Network hardware, Network software, Hierarchical Reference Models; Physical Layer: The theoretical Basis for Data Communication, Transmission media. Wireless transmission, The Telephone system, Data Link Layer: Data Link Layer Design Issues, Error correction and detection, Elementary data link layer protocols; Sliding Window Protocols, Protocol Specification and verification, Medium Access Sublayer: The channel allocation problem, Multiple Access Protocols, IEEE 802 standards for LANs and MANs, Bridges. Network Layer: Network Layer Design issues, Routing algorithms, congestion control algorithms, internet working. Transport Layer: Transport services, transport protocols. Application layer, Cryptography.

Tannenbaum, Computer Networks, Prentice Hall, 1997.
J. Martin, Computer Networks and Distributed Processing, PHI, 1998.
Sailings and William, Local Networks: Protocols, Standards and Interfaces, Prentice Hall,1998.
Black, Data Networks; Concepts, Theory and Practices, Prentice Hall,1997.

SY804 Artificial Neural Networks (3-0-0) 3

Introduction; Artifical Neural Network, Learning Process, Types of Learning, perceptron convergence theorem. Single layer and multi layer perceptrons; Back propagation algorithm; limitations, applications, convolution network; Radial Basis Function network: Approximation Properties of RBF networks, Comparison of RBF metworks and Multilayer perceptrons. Kernel Regression and its relation to RBF network, Learning Strategies, Support Vector Machines: Linearly Separable patterns, nonseparable patterns, SVM for Nonlinear Regression. Principle Component Analysis. Self-organising Maps, Properties, pattern classification, Hierarchical Vector Quantization, Contextural Maps.

Simon Haykin, Neural Networks: A comprehensive Foundation, Prentice-Hall 1999.
Fredic M. Ham and Ivika Kostanic, Principles of Neurocomputing for science and Engineering, Tata Mc-Graw-Hill, 2001.
B. Yegnanarayana, Artificial Neural Networks, Prentice Hall of India, NewDelhi,2001.

SY805 Computational Combinatorics (3-0-0) 3

Enumeration, General Counting Methods for Arrangements and Selections, Generating Functions; Recurrence Relations; Generalized Permutations and Combinations; Inclusion-Exclusion; Inversion Formulae; The Vander Waerden Conjecture; Partitions; Projective and Combinatorial Geometries; The Burnside-Frobenius Theorem; Group Theory in Combinatorics; Permutation Groups and their Cyclic Indices; Polya's Enumeration Theorem;(0-1) Matrices; Latin Squares; Hadamard Matrices; Reed-Muller Codes; Coding Theory and Cryptology; Combinatorial Designs, Orthogonality; Combinatorial Problems in Graphs , Trees, Flows in Networks, Algebraic Graph Theory, Eigen-value Techniques, Combinatorial Optimization, Representations and Solution Algorithms.

B. Bollobas; Combinatorics; Cambridge Univ Press, 2001.
I. Anderson; Combinatorics of Finite Sets; Dover, 2003.
S. Gill Williams, Combinatorics for Computer Science, Dover, 2001.
T. C. Hu and M. T. Shing, Combinatorial Algorithms, Dover, 2004.
R. T. Rockafellar, Network Flows and Monotropic Optimization, Athena Scientific, 2000.

SY806 Algorithmic Graph Theory (3-0-0) 3

Algorithms-structures and properties, Classification, Flow-chart description, structural flow charts, recursion and iteration. Functions –Base functions and strategy set, primitive recursive functions over integers, primitive recursive predicates, primitive recursive functions over an alphabet, partialand general recursive functions. Programs and recursive functions, Computation – algorithmic complexity – interactability, program correctness, graph theorybasic definitions, Euler paths, planar graphs and Euler formula, Four colour and five colour problems. Fast fourier transforms and its applications: Discret Fourier transforms and its inverse – FFT algorithm. The FFT using bit operations. Producs of polynomials, Schonhage-strassen integer multiplication algorithm. Difference equations – homogeneous and nonhomogeneous – their solutions, Fibonacci sequence.

Tremblay J. P & Manohar P, Discrete Mathematical Structures with applications to Compute Science, edn, McGraw Hill, 1963.
E. V. Krishnamurhty, Introductory theory of Computer Science, edn., East-west Press, 1963.
Braincrd and Landwebber, Theory of Computation, John Wiley,1978.
Aho. A V., Hopcroft J.E. and Ullman J. D., The Design and Analysis of Computer,1976.

SY807 Cryptography & Network Secuirty (3-0-0) 3

Conventional Encryption, Classical techniques, Modern Techniques, Introduction to Finite Fields; Conventional Encryption, AES; Contemporary Symmetric Ciphers; Confidentiality Using Conventional Encryption. Public-Key Encryption and Hash Functions, Introduction to Number Theory, Public Key Cryptography; Key Management; Message Authentication and Hash Functions; Hash and Mac Algorithms; Digital Signatures and Authentication Protocols. Network security Practice: Authentication application, Electronic Mail Security, IP security, Web security, System Security, Intruders and Viruses, firewalls.

William Stallings; Cryptography and Network Security; Pearson Education India,2001.
R.E. Smith; Internet Cryptography; Pearson Education India,2003.

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SY808 Distributed Computing Systems (3-0-0) 3

Principles of distributed computing, distributed databases, distributed query processing, distributed concurrency control, commit protocols, distributed deadlock detection and resolution, distributed algorithms, load balancing techniques, distributed operating systems and network operating systems, distributed programming, clock synchronization.

G.F. Coulouries, J.D. Dollimore and T.Kindberg, Distributed Systems: Concepts and Design Addison Wesley, 1994 (II Edn)
Parker Y and Verjus J.P., Distributed computing systems, Synchronization, control and communication, Academic press, 2000.
Ceri S and Pelagatti S., Distributed Systems, Springer-Verlag, 1989.
Sape Mullender (Ed.), Distributed Systems, ACM Press, 1989.

SY809 Fuzzy System Models (3-0-0) 3

Characteristics of Fuzzy System Models, Classification, Problems; Examples, Modeling of system uncertainties; parametric uncertainties; scope and validity of results. From Classical (Crisp) Sets to Fuzzy Sets: A grand Paradig shift, Fuzzy Numbers, Fuzzy Arithmetic, Fuzzy Measures, Operations on Fuzzy Sets, Fuzzy Relations, Multi-valued Logic, Fuzzy Logic; Uncertainty and information, Uniqueness of Uncertainity Measure; Possibility Theory; Approximate Reasoning; Fuzzy Decision Making.

Klir and Folger, Fuzzy Sets, Uncertainty and Information, Prentice Hall of India, 2001.
Klir and Yuan, Fuzzy Sets and Fuzzy Logic, Prentice Hall of India, 2002.
T. J. Ross, Fuzzy Logic with Engineering Applications, McGraw Hill, 2004.
Zimmermann, Fuzzy Set Theory and its applications, Kluwer Academic Publishers, 2001.
C. V. Negoita, Fuzzy Systems, Abacus Press, 2002.

SY811 Genetic Algorithms (3-0-0) 3

Introduction, Robustness of Traditional Optimization and Search techniques, goals of optimization, a simple genetic algorithm, similarity templates. Mathematical Foundations; Fundamental theorem, schema processing, 2 – armed and K-armed bandit problem, building block hypothesis, minimal deceptive, similarity templates as hyper planes; implementation of genetic algorithm: Data structure, reproduction, crossover and mutation, mapping objective functions, top fitness form, fitness scaling. Advanced operators and techniques in genetic algorithm search; Dominance, Diplody and abeyance, inversion and other re-ordering operators, macro operators, niche and special specification, multi objective optimization, knowledge based techniques, genetic algorithms and parallel processors, genetic based machine learning, classifier systems. Application of genetic Algorithms; Data mining using genetic algorithms, using genetic operators to distinguish chaotic behaviour form noise in a time series.

David Goldberg, Genetic Algorithm in search, optimization and machine learning, Addison Wesley International 1999
Charles L Karr and L. Michael Freeman, Industrial applications of Genetic Algorithms, CRC press Washington DC 1998

SY812 Information & Coding Theory (3-0-0) 3

Information Measure, Noiseless Coding; Construction of Optimal Codes; Discrete Memoryless Channel; Channel Capacity, Fundamentals theorem of Information Theory, Error-Correcting Codes; Minimum Distance Principles, Hamming bound, General Binary Code, Group Code, Linear Group code, Convolution Encoding, Algebraic Structures, Gilbert Bound; Threshold Decoding for Block Codes; Cyclic Binary Codes; BCH Codes, Generalised BCH Code and Decoding, Optimum Codes; Information Rate, High-rate Volume Bound, Elias Bound, Asymptotic Error Bound, Non-Cyclic Codes; Residue Codes; Reed-Muller Codes; Orthogonizable Codes; Condition for complete orthogonaliation, Non-binary BCH Codes, Non-binary coding modulation scheme, weight functions.

R. Ash, Information Theory, Dover, 1997.
A. Khinchin, Mathematical Foundations of Information Theory, Dover, 1999.
F. M. Reza, An Introduction to Information Theory, Dover. 1996.
S. Kullback, Information Theory and Statistics, Dover, 1997.

SY813 Internet Technology & Applications (3-0-0) 3

Introduction: Internets, Intranets and Extranets, Understanding and applying Internet Concepts, Web Programming;HTML, CGI, Client and Server side Scripting, DHTML, ASP, PHP Development platforms and Tools, Web Server Management and tuning. E- Commerce aspects, Advertisement on Internet, Advantages, Disadvantages, Cost issues access segmentation, Reach and Comparative studies of various media such as print, T.V., and internet, Electronic messages, Automatic file exchanges, Intelligent business catalog directory, EDI, EDI-software, Internet standards, Guidelines, Intrastore 2000, Internet business enablers, International Trade

Impact, Knowledge Management, Buying, locate Suppliers, Negotiate purchase, Place orders, receive invoices, selling, Receive orders Acknowledge orders, advice on delivery, raise invoices exchange ideas, Workflow, B2B B2C, C2C and other supply chain management, Logistics and Transportation, manufacturing, web-enabled MRP application, freight forwarder, consignment tracking trading post, query, update receipts, configuration of specific product requirements, quotations, Web-enabled forms, proforma invoice, business gaps, shoping cart and others, Mobile e-business and related issues connected with mobile services.

Deitel & Deitel, Internet & word Wide web, How to program, Prentice Hall, 2000
D. Norton and H. Schild, Java 2, the complete reference, TMH 2000.
Szeto, Designing Interactive Web Sites. Allied Publishing, 2003.
Vasquez Peters, Teach yourself Great Web design in a week, Allied Publishing,2002.
Hahn, The Internet Complete Reference, 2nd ed, Tata McGraw Hill, 2001.

SY814 Image Processing (3-0-0) 3

Digital image fundamentals, Image Acquisition (Sampling and Quantization) , Image Enhancement (frequency and spatial filtering), Image Transforms (FFT, DCT, DWT etc), Image compression methods, Image restoration methods, Morphological image processing, Image segmentation, Image Analysis.

Rafel C. Gonzalez and Richard E Woods, Digital Image Processing, Addison – Wesley, 1998.
Anil K Jain, Fundamentals of Digital Image Processing, Prentice Hall of India, 1997.
R.E. Duda and P.E. Hart, Pattern Classification and Scene Analysis, John Wiley, NY, 2000.
Pratt W.K., Digital Image Processing, McGraw Hill, 1998.

SY815 Natural Language Processing (3-0-0) 3

Introduction, Essentials of linguistics, the Language Pheomena, Syntax semantics and Pragmatics, Linguistic background, An outline of English, Review of finite state Automata, Chomsky hierarchy, Context Sensitivity of Natural Language Morphology, Role of Lexicon in NLP, Lexical Resources such as WordNet POS tagging, stemming, Word sense Disambiguation Grammars for Natural Language, Basic parsing techniques; Handling movement, Natural Language semantics, Semantics and logical form, semantic, interpretation, strategies, context and word knowledge, Handling Anaphora and Ellipsis, Thematic Roles, Knowledge Representation. Statistical NLP, Introduction to the statistics of language, Zipf's laws, Language modeling, Term Distribution models, poissson and k-mixture models, Inverse document frequency (IDF), use of term distribution models, Term weighting, Term Characterization: Frequency measures, Collocations, concordances, n-grams, Introduction to probabilistic models (HMM, Bayesian), Vector space document model. Major Applications.

Allen J., Natural Language Understanding, The Benjamins/Cummings Publishing Company Inc, 1994.
Manning C. D. and H. Schutze, Foundations of Statistical Natural Language Processing, The MIT Press, 1999.
Jurafsky D and J. H. Martin, Speech and language Processing, Prentice Hall, 2000.
Charniak E, Statistical Language Learning the MIT Press, 1996.
Van Rijsbergen C. J., Information Retrieval (II edn.) Butterworths, London, 1979.

SY816 Pattern Recognition (3-0-0) 3

Machine perception, Classification model, Continuous and Discrete, Baye's Decision Theory, Maximum likelihood parameter estimation, Problems of Dimensionality, Nearest Neighbor non parametric estimation, Fisher's linear discriminant analysis, Linear Discriminant Functions and Decision Surfaces, Clustering and Dimensionality Reduction, Linear and Nonlinear Methods of Features transformation. Application of pattern recognition to real world problems such as speech recognition.and character recognition.

Duda and Hart, Pattern Classification, Prentice-Hall of India, 2002.
K. Fukunaga, Introduction to Statistical Pattern Recognition, Academic Press, 2001.

SY817 Stochastic System Models (3-0-0) 3

Characteristics of Stochastic System Models. Classification. Problems. Examples. Modeling of System Uncertainties; Parametric Uncertainties. Scope and Validity of Results.

Mesarovic & Takahara; General Systems Theory; Academic Press, 2000.
Pugachev & Sinitsyn, Stochastic Systems, Theory and Applications, World Scientific, 2003.
Kulkarni V. G., Modeling, Analysis, Design and Control of Stochastic Systems, Springer Verlag. 2001.
Antoulas A. C, Mathematical Systems Theory, Springer Verla,2000.

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National Institute of Technology Karnataka
Surathkal, Srinivasnagar, Mangalore 575025

SY818 System Modelling & Simulation (3-0-0) 3

Basic simulation Modeling: The nature of simulation, definition of systems, models and simulation. Structure of simulation models; advantages and disadvantages of simulation, steps in a simulation study. Classification of simulation models, Examples of Discrete – Event Simulation: Continuos simulation and Monte Carlo Simulation. Discrete-Event simulation: Selecting Input Probability Distributions, Random-number Generators, Testing random number Generators, Generating Random variables for standard distributions, Output Analysis for a single system,Comparing Alternative system configurations, Experimental Design and Optimization. System Software: GPSS;general description, facilities, storages, Queues, transfer blocks, control statements, variable logic switches, Boolean variables, functions, concept of user chains, facility preemption, matching Introduction to other simulation languages such as MATLAB, TUTSIM Modeling and Simulation of Continuous Systems.

G. Gordon, System Simulation, P-H-I,2000.
A. M. Law and W. D. Kelton, simulation, modeling and anlysis, McGraw Hill, 2004.
J. A. Payne, Introduction to simulation, Programming Techniques and methods of analysis, 2003.
Thomas J. Schriber, Simulation Using GPSS, John Wiley and Sons, 2001.
Mariyansky, Digital Computer and Simulation, CBS Publishers, New Delhi, 2000.

SY819 Theory of Computation (3-0-0) 3

Introduction, Abstract Models for Computation and their relationship with formal languages and Theory of Recursive Functions; Computational and Representational System Models: Finite Automata; Push-down Automata;Linear Bounded Automata; Turing Machines; Formal Language Models; Regular Expressions, Context free Languages, Context Sensitive Languages, Recursively, Enumerable Languages, Generative Grammars, Recognition Procedures; Finite Representation for formal languages, Chomsky Hierarchy; Normal Forms; Derivation Graphs; Pumping Lemma; Undecidability; Recursive Functions and Computability; Computational Effectiveness,Complexity Measures, Reducibility; Complexity Classes.

Hopcroft and Ullman, Introduction to Automata Theory, Languages and Computation,Narosa, 1998.
Gyorgy E. Revesz, Introduction to Formal Languages, Dover, 2003.
Aho, Hopcrafi & Ullman, Automata, Languages and Computation, Narosa, 1986.
Mishra and Chandrashekar, Theory of Computer Science, Prentice Hall of India, 1999.

SY820 Web Technology (3-0-0) 3

The Web Design Environment; Designing for a variety of Browsers, Designing for a variety of displays, Web design principles for print designer, beginning guide for the server; HTML: HTML Overview, Structural HTML Tags,formatting text, creating links, adding image and other page elements,Tables, Frames, forms, Image mapping,cascading style sheets; Using Web design Tools like MS Front page, Flash Dreamweaver, coreldraw, Photoshop;Multimedia and Client side scripting: Audio on the web, Video on the web, DHTML, Introduction to java script,Java Applets. Server-side scripting: Active Server Pages, XML.

Web Design in a nutshell - Jennifer Niederst, Orielly publications, 2004.
XML and Java Developing Web Applications. Hiroshi Maruyama, Kent Tamura, Naohiko Uramoto, 2003.
Thomas Powell, Fritz Schneider, Javascript, the complete refernce, Tata McGraw Hill, 2002.
David Crowder, Rhonda crowder, Web design, IDG books of India Pvt. Ltd., 2001.
Jennifer Neiderst, Web design in a nutshell, Orielly Publications,2000.

SY821 Advanced Database Systems (3-0-0) 3

Introduction , basic concepts and terminology, software architecture for data sharing database management system, federated database management system, designing distributed databases, distributed transactions, Client server architecture, multimedia databases, object oriented DBMA. Data mining, Introduction to data mining and knowledge discovery, Foundations of pattern clustering abstraction and similarity, clustering paradigms, clusteing for data mining, data mining using neural networks and genetic algorithms, fast discovery of association rules. Discovery of frequent episodes in event sequences. Applications, Applications of data mining.

Tamer Ozsu Patrick valduring, Principles of Distributed Database Systems, PHI2003.
Ceri S. Pelagatti S., Distributed Databases, Principles and Systems, McGraw Hill,2002.
Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, Addison Wesley, 2000.
Stefano Ceri & Giuesppe Pelagatti, Distributed Databases – Principles and Systems, McGraw Hill, 2001.

SY822 Advanced Operating Systems (3-0-0) 3

Overview; An overview of operating system functions, information management, process management, memory management, and secondary storage space management, parallel processing, Distributed operating systems,

introduction, design issues, distributed shared memory, algorithms for implementing distributed scheduling, recovery and reference. Protection and Security; Resource security & protection, data security, cryptography, Multiprocessor Operating Systems; Introduction architecture, interconnection network for multiprocessing, caching, structure of multiprocessor Operating System; various types of threads, design issues, case study of any machine operating systems. Database operating systems: Introduction, requirement of a database operating system., concurrency control , Introduction, transaction, conflicts, transaction processing, the problem of concurrency – control, serializibility, logs serial logs, log equivalence, sample concurrency control algorithms. Object oriented operating systems and its characteristics.

Mukesh Singhal Niranjan, G.Shivorothri, Advanced Concepts in Operating Systems, PHI, 2000.
Andrew S Tannenbaum, Distributed Operating Systems, PHI, 2002.

SY823 Client Server Computing (3-0-0) 3

History of computing; Development of Client/Server computing, Advantages and challenges, Application areas, Architecture: RPC process: Remote, Message, Network & application Services, Dynamic data exchange, OLE and CORBA, Establishing an Architecture, data access Architecture, Execution Architecture, Vertical slice, two tired Client/server stored procedures, three tired architecture. Characteristics: Client characteristics and tools, use of GUI and Local processing with examples, server characteristics and functionality, various server services like file, database communication and security, available platforms: LAN, WAN and enterprise wide services, Network operating system, Connectivity: Interface technology (H/W, S/W) applications layer services like SWMP, NFS, SMPT, Vendor product examples – IPC Services like pipes, Semaphores, shared memory, DDE, RPC, OLE, Application development Management Issues, Platform and Productivity, Enviornment definition, Productivity measures, Performance Support Organization and Management, application partitioning, Task allocations, server and client side , Client /Server Risks and Responsibilities.

Robert Orfalietall, Essential Client/Server Survival Guide, PHI 2000.
Larry T. Vaughn, Client/Server System Design & Implementation. PHI, 2005.

SY824 Combinatorial Optimization (3-0-0) 3

Algorithms for optimization of combinatorial optimization problems. Integer Programming and Network Optimization algorithms, combinatorial problems on Graphs or Networks, Polyhedral Combinatorics, Complexity of Problems such as linear programming and the traveling salesman problem. NP-Completeness, approximation algorithms, worst case and probabilistic analysis of algorithms and local search.

C.H. Papadimitriou and K. Steiglitz, Combinatorial Optimization, Algorithms and Complexity, Prentice Hall, 1982.
E. L. Lawler, Combinatorial Optimization – Networks and Matroids, Holt, Rinehart and Winston, 1976
C. Berge, Principles of Combinatorics, Academic Press, 1971
A. Tucker, Applied Combinatorics, IIedn, John Wiley, 1984
L. R. Ford Jr. and D. R. Fulkerson, Flows in Networks, Princeton, Univ. Press, 1952.

SY825/MA825 Selected Topics in Network Flow Modeling and Analysis (3-0-3) 3

Representation and analysis network structures. Printed network algorithm and applications. Representation and analysis of flows in networks. Max flow Min cut theorem. Feasible distributor problem. Flow rectification problem. Tucker representation of circulation space and differential space extremal representation problem. Matching and assignment problems. Bottleneck optimization problems. Max tension min path theorem. Feasible differential problem. Tension rectification problem. Routing problem. Optimal differential problem. Duality results. Simplex pivoting algorithm. Thrifty adjustment algorithm. Out-of-Kilter algorithm.

SY826/MA826 Selected Topics in Network Flow Optimization PRE REQ: SY825/MA825 (3-0-3) 3

Piecewise linear and convex cost functions. Characteristic curvers. Optimal distribution problem. Conjugate cost functions. Optimal differential problem. Duality theorem and equilibrium conditions. Equilibrium models. Improvement of flows and ptotentials. Existence and boundedness of solutions. Optimal distribution algorithm. Optimal differential algorithm. Thrifty adjustment algorithm. Out-of-Kilter algorithm. Termination and refinements. Fortified and discretized descent algorithms. Optimizing sequences. Linear systems of variable. Elementary vectorsand supports. Concept of generalized circuits and cuts. Multi-commidity systems and factorization. Painted index theorem and algorithm. Preprocessing and termination. Constraints and feasibility. Shortcuts in implementing pivoting algorithms. Augmented and aggregated formats. Extreme solutions. Monotropic optimization problems.Descent by elementary vectors. Duality and existence of solutions. Boundedness property. Decomposition.Applicatons to network flow/traffic optimization problems. Basic descent algorithms. Fortified and discretized descent. Generalized simplex pivoting algorithms. Generalized Out-of-Kilter algorithms. Other formats and termination. General parametric programming.

SY827 Selected Topics in General Systems Design PREREQ: SY810 (3-0-0) 3

General systems thingking dealing with complexity. Observation. Interviewing. Design philosophy. Thing versus process dichotomy. Being, behaving and becoming. Quality versus cost tradeoff. Trading analysis for design. Optimization. Error correction. System optimization. Design as a human activity. Design as a creative art. Creativity and innovation. Problem of persistence. Aggregates. Birth-free aggregates. Reasoning about aggregates. Modeling differentiated aggregates. Programs for models of differentiated aggregates. Structure and behaviour. Structureregulation law. Search for regulation. Homeostatic heuristics. Alternative regulatory heuristics. Types of regulatory mechanisms. Regulation and environment. Noise, errors and model failures. Myth of superiority. Search for nonexistent set points. Quest for perfection. Overly simplified views on regulation. False alarms and flareback. Dealing with system complexity. Environment as reference point. Homunculus fallacies.

SY 828 Information Storage and Management (3–0–0) 3

Introduction to Storage Technology: Review of data creation and the amount of data being created the value of data to a business, challenges in data storage and data management, solutions available for data storage, core elements of a data center infrastructure, role of each element in supporting business activities.

Storage Systems Architecture: Hardware and software components of the host environment, key protocols and concepts used by each component, physical and logical components of a connectivity environment, major physical components of a disk drive and their function, logical constructs of a physical disk, access characteristics, and performance implications, concept of RAID and its components, different RAID levels and their suitability for different application environments: RAID 0, RAID 1, RAID 3, RAID 4, RAID 5, RAID 0+1, RAID 1+0, RAID 6,comparison of integrated and modular storage systems, high-level architecture and working of an intelligent storage system.

Introduction to Networked Storage: Evolution of networked storage, architecture, components and topologies of FCSAN, NAS and IP-SAN, benefits of the different networked storage options, CAS and its applications, appropriateness of the different networked storage option for different application environments.

Information availability, monitoring and managing datacenter: Reasons for planned/unplanned outages, impact of downtime, difference between business continuity (BC) and disaster recovery (DR), RTO and RPO, single points of failure in a storage infrastructure and solutions to mitigate these failures, architecture of backup/recovery, different backup/recovery topologies, replication technologies and their role in ensuring information availability and business continuity, remote replication technologies and their role in providing disaster recovery and business continuity.

Key areas, to monitor in a data center, industry standards for data center monitoring and management, key metrics to monitor for different components in a storage infrastructure, key management tasks in a data center.

Securing Storage and Storage Virtualization: Information security, critical security attributes for information systems, storage security domains, analysis of the common threats in each domain. Virtualization technologies, block-level and file-level virtualization technologies and processes. Case Studies

EMC Corporation, Information Storage and Management, Wiley, ISBN number: 04702942134, 2004.
Robert Spalding, "Storage Networks: The Complete Reference", Tata McGraw Hill, Osborne, 2003.
Marc Farley, "Building Storage Networks", Tata McGraw Hill, Osborne, 2001.
Meeta Gupta, Storage Area Network Fundamentals, Pearson Education Limited, 2002.
Gerald J Kowalski, Mark T Maybury, "Information Storage and Retrieval Systems Theory and Implementation", BS Publications, 2003.
Thejendra BS, "Disaster Recovery and Business Continuity", Shroff Publishers and Distributors, 2002.

SY 829 Collective Decision Making Processes (3-0-0) 3

Decision Making Processes, Individual Preferences, Collective Outcomes, Process Influence, Arrow's Theorem, Sen's Theorem, Voting Profiles, Voting Paradoxes and their resolution through refinements in axioms, Binary Independence, Transitivity, Monotonicity, General Aggregation Processes.

Donald G. Saari, "Chaotic Elections – A Mathematician Looks At Voting", AMS,2000.
Donald G. Saari, "Decisions and Elections – Explaining the Unexpected", Cambridge Univ. Press, 2001.
Donald G. Saari, "Geometry of Voting", Springer – Verlag, 2002.
Kenneth J.Arrow "social Choice and Individual Values", Yale Univ. Press, 2003.

M. Tech. in Communication Engineering (CE)

Suggested Plan of Study:

Sl. No.	Semester			
	I	II	III	IV
1	CE720	CE723	CE898	CE899
2	CE721	CE724		
3	CE722	CE725		
4	*Elective 1*	*Elective 3*		
5	*Elective 2*	*Elective 4*		
6	CE897	CE890		

Credit Requirements:

Category	Minimum Credits to be Earned
Program Core (Pc)	24
Elective Courses (Ele)	12
Mandatory Learning Courses (MLC)	04
Major Project (MP)	20
Total	60

Program Core (Pc)

CE720	Digital Modulation & Spread Spectrum Systems	(3-1-0) 4
CE721	Mathematical Foundations for Communication Engineering	(3-1-0) 4
CE722	RF Circuits & Systems	(3-1-0) 4
CE723	Light wave Communication	(3-1-0) 4
CE724	Detection & Estimation Theory	(3-1-0) 4
CE725	Advanced Digital Signal Processing	(3-1-0) 4

Elective (Ele) Courses
(At least 2 electives must be chosen from CE Electives)

CE820	Digital Signal Compression	(3-0-0) 3
CE821	Error Control Coding	(3-0-0) 3
CE822	Wireless Communications & Networks	(3-0-0) 3
CE823	Cryptography	(3-0-0)3
CE824	Radar Signal Processing	(3-0-0) 3
CE825	Optical Networks	(3-0-0) 3
CE826	Image & Video processing	(3-0-0) 3
CE827	Speech & Audio processing	(3-0-0) 3
CE828	Multimedia Communications	(3-0-0) 3
CE829	MIMO Communication Systems	(3-0-0) 3
CE830	Information Theory	(3-0-0) 3
CE831	Computer Communication Networks	(3-0-0) 3
CE832	Advanced Antenna Theory	(3-0-0) 3
CE833	Photonic Devices	(3-0-0) 3
CE834	Active RF Devices and Circuits	(3-0-0) 3
CE835	Soft Computing	(3-0-0) 3
CE836	Adaptive Signal processing	(3-0-0) 3
VL832	Digital Signal Processing Architectures	(3-0-0) 3

Mandatory Learning Courses (MLC)

CE890	Seminar	2
CE897	Minor Project	2

Major Project (MP)

CE898	Major Project - I	06
CE899	Major Project - II	14

M. Tech. in VLSI Design (VL)

Suggested Plan of Study:

Sl. No.	Semester			
	I	II	III	IV
1	VL720	VL723	VL898	VL899
2	VL721	VL724		
3	VL722	VL725		
4	*Elective 1*	*Elective 3*		
5	*Elective 2*	*Elective 4*		
6	VL890	VL897		

Credit Requirements:

Category	Minimum Credits to be Earned
Program Core (PC)	24
Elective Courses (Ele)	12
Mandatory Learning Courses (MLC)	04
Major Project (MLC)	20
Total	60

Program Core (Pc)

VL720	Digital IC Design	(3-0-2) 4
VL721	Analog IC Design	(3-1-0) 4
VL722	Advanced Computer Architecture	(3-1-0) 4
VL723	Advanced Mixed Signal Design	(3-1-0) 4
VL724	VLSI Design Automation	(3-1-0) 4
VL725	Digital VLSI Testing & Testability	(3-1-0) 4

Elective (Ele) Courses
(At least 2 electives must be chosen from VLSI Design Electives)

VL820	Logic Synthesis Techniques	(3-0-0) 3
VL821	Low Power VLSI Design	(3-0-0) 3
VL822	Modeling and Simulation	(3-0-0) 3
VL823	Submicron Technology	(3-0-0) 3
VL824	Advanced VLSI Design	(3-0-0) 3
VL825	Hardware Software Co-design	(3-0-0) 3
VL826	Sensor Technology and MEMS	(3-0-0) 3
VL827	Embedded Systems	(3-0-0) 3
VL828	VLSI Technology	(3-0-0) 3
VL829	Digital Design using FPGAs	(2-0-2) 3
VL830	Active Filter Design	(3-0-0) 3
VL831	RF Integrated Circuits	(3-0-0) 3
VL832	Digital Signal Processing Architectures	(3-0-0) 3
VL833	Reconfigurable Computing	(2-0-2) 3
CE725	Advanced Digital Signal Processing	(3-1-0) 4
CE836	Adaptive Signal processing	(3-0-0) 3

Mandatory Learning Courses (MLC)

VL890	Seminar	2
VL897	Minor Project	2

Major Project (MP)

VL898	Major Project - I	06
VL899	Major Project - II	14

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

CE720 Digital Modulation and Spread Spectrum Systems (3–1–0) 4

Review of fundamental concepts and parameters in Digital Communications, Performance of Carrier modulation Schemes: Performance of BPSK and QPSK in AWGN channel, Performance of binary FSK and M-ary PSK in AWGN channel, Minimum Shift Keying (MSK) Modulation, GMSK, Continuous Phase Modulation(CPM) Schemes; Channel Characterization and Modeling: Optimum Receivers for AWGN channels, Equalization Techniques; Orthogonal Frequency Division Multiplexing (OFDM):Carrier Synchronization, Timing synchronization; Spread spectrum signals for digital communications: Introduction to Spread Spectrum Modulation, DSSS, FHSS, CDMA signals, Code Acquisition and Tracking, Spread Spectrum as a Multiple Access Technique; Multichannel and Multicarrier Systems; Digital Communications through Fading Multipath channels; Multi User Communications.

J. Proakis, Digital Communications, McGraw Hill, 2000

J. Viterbi and J. K. Omura, Principles of Digital Communications and Coding, McGraw Hill, 1979

Marvin K. Simon, Jim K Omura, Robert A. Scholtz, Barry K.Levit, Spread Spectrum Communications, 1995.

Andrew J Viterbi, CDMA Principles of Spread Spectrum Communications, Addison Wesley, 1995.

CE721 Mathematical Foundations for Communication Engineering (3–1–0)4

Introduction to Probability and Stochastic Processes: Notion of multiple Discrete and Continuous Random Variables, Stochastic Processes, Sum of Random Variables, Statistical Inference, Gaussian Q-function, Marcum Q-function; Linear Equations, Matrices, Vector Spaces, Basis and Dimensions, Linear Mappings, Matrices and Linear operators, Determinants, Eigen values and Eigen vectors; Groups, Rings and Fields, Vector Spaces and Modulus, Field Theory, Algebraic extensions; Introduction to Number Theory

R D Yates, D J Goodman, Probability and Stochastic Processes, John Wiley and Sons, 1999

H. Stark, J.W Woods, Probability and Random Processes, Pearson Education, 2002

K. Huffman, R. Kunze, Linear Algebra, Prentice Hall of India, 1998

CE722 RF Circuits and Systems (3–1–0) 4

Review of Basic Transmission Line Theory, Planar Transmission Lines - Stripline, microstrip line, suspended stripline and coplanar line; Parallel coupled lines in stripine and microstrip – Analysis, design and characteristics. Microwave Network Analysis - Microwave network representation, Impedance and admittance matrices, Scattering parameters, Typical two-port, three port, four port networks; Impedance Matching Techniques - Smith chart, Matching networks using lumped elements, Single- and double-stub matching, Quarter wave transformer, Multi-section transformers -Binomial and Chebyshev. Basic Passive Components -Lumped elements in MIC, Discontinuities and resonators in microstrip, Balun. Analysis and design of stripline/microstrip components- Directional couplers, Power divider, Hybrid ring. Switches and Phase Shifters - PIN diode– Equivalent circuit and Characteristics, Basic series and shunt switches in microstrip; SPST and SPDT switches, Switched line, branchline coupled and loaded line phase shifters in microstrip. Applications in phased arrays. MIC Filters - Lumped element filter design at RF. Impedance and Low pass scaling, Frequency transformation, High impedance/Low impedance low pass filter, Parallel coupled band pass filter, Spur line band stop filter, Realization in microstrip and suspended stripline Basics of MIC, MMIC and MEMS technologies - Substrates used. Fabrication process.

– BRD –

Relative advantages. Examples- Realization of lumped elements and filters in MMIC, Realization of planar transmission lines and filters in MEMS.

M.M. Radmanesh, Radio Frequency and Microwave Electronics, Pearson Education Asia, 2001.

B. Bhat & S.K. Koul, Stripline-like Transmission Line for Microwave Integrated Circuits, New Age Intl. (P) Ltd.,1989.

D. K. Misra, Radio Frequency and Microwave Communication Circuits – Analysis and Design, John Wiley & Sons, 2001;

D. M. Pozar, Microwave Engineering, 2nd Edition, John Wiley & Sons, 1998.

CE723 Light Wave Communication (3–1–0) 4

Importance of OFC; Light wave propagation in dielectric slab waveguides, Ray Theory, Numerical aperture, SI and GI waveguides, channel waveguides. Optical fibers: Types, fabrication techniques, attenuation, dispersion, Modes in SI and GI , DSF, DFF, PM fibers, plastic fibers, fiber bundles, connectors, couplers, power splitters etc. Optical Sources and detectors: Review of PN junction diodes, LEDs, Laser Diodes, Noise sources; Photo-detectors: PIN and APD design, Noise characteristics, Modulation of LEDs/LDs, drive circuits for LDs & PDs., high speed operation. OFC Systems: Simple networks and their analysis, BER calculations, WDM principle and techniques. Optical TDM etc, long haul DWDM. EDFAs and their applications to OFC. Optical Fiber Sensors. Coherent detection in OFC

G.P. Agarwal, Fiber Optic Communication Systems, John Wiley 1997

Senior J., Optical fiber communications, Principles & Practice, PHI,1992

Keiser G., Optical fiber communications, McGraw-Hill, 1999

A Selvarajan, S.Kar, T Srinivas, Optical Fiber Communications, TMH, 2002

William B. Jones, Introduction to optical fiber communication systems, OUP, 1998

CE724 Detection and Estimation Theory (3–1–0) 4

Hypothesis Testing, Neyman Pearson Lemma, UMP test, Decision Theoretic framework, Multiple-Decision Problem. Parameter Estimation - Unbiasedness, Consistency, asymptotic normality, sufficient statistics, minimax estimation, decision theoretic framework, Rao-Blackwell theorem, Cramer – Rao inequality. Estimation: Minimum mean square linear estimation, Wiener filter, Kalman filter, Levinson – Durbin and innovation algorithms.

H. L. Van Trees Detection, Estimation and Modulation Theory, Part I, John Wiley, 1968.

Srinath, Rajasekaran and Viswanathan, Introduction to Statistical Signal Processing with applications, PHI, 1995.

Steven M. Kay, Fundaments of Statistical Signal Processing, Vol. I:Estimation Theory, Vol. II: Detection Theory, Prentice Hall International, 1993

Papoulis A., Probability Random Variables and Stochastic Processes, McGraw Hill, 2002

H. Stark and J. W Woods, Probability and Random Processes with applications to signal processing, Pearson Education, 2002.

CE 725 Advanced Digital Signal Processing (3-1-0) 4

2-D signals and systems, Analysis of 2D systems in spatial, frequency and transform domains; Short time Fourier Transform; Multirate Signal Processing: Decimation Interpolation, DFT filter banks, QMF filter banks, Multiresolution Signal analysis wavelets theory of sub band decompositions, Sub band coding and wavelet transforms, Application of wavelet transforms. Power spectral estimation; Higher order spectral estimation; Adaptive filters and applications. Recursive estimation and Kalman filters.

P.P. Vaidyanathan, Multirate systems and Filter banks, Prentice Hall, 1993.
S.J. Orfanidis, Optimum Signal Processing, McGraw Hill, 1989.
S. Haykin, Adaptive Filter Theory, Pearson, 1996

CE820 Digital Signal Compression (3–0–0) 3

Data Compression. Speech & image waveform characterization. Predictive coding. Transform coding. Subband coding, VQ based compression, Fractal coding of images. High quality video & audio compression for digital broadcasting. Standards for digital signal compression-data, speech, audio, image & video.

D. Salomon, Data Compression – the complete reference, Springer, 2000.
K. Sayood, Introduction to Data Compression, Pearson Education, 2000.
M.Nelson, The data compression book, BPB Publications, 2002.
Jayant & Noll, Digital coding of waveforms-Principles and applications to speech & video, PH, 1984.
Zi Nian Li, Fundamentals of Multimedia, Pearson Education, 2003.

CE821 Error Control Coding (3–0–0) 3

Coding for reliable digital transmission and storage. Groups, Rings, Vector Spaces, Galois Fields, Polynomial rings, Channel models, Linear Block codes, Cyclic codes, BCH codes, Reed Solomon Codes, Berlekamp-Massey and Euclid decoding algorithm, Decoding beyond the minimum distance parameter, Applications of Reed-Solomon codes, Convolutional codes, Decoding algorithms for Convolutional codes, Viterbi, Stack and Fano algorithms, Application of Convolutional codes. Codes based on the Fourier Transform, Algorithms based on the Fourier Transform, Trellis coded modulation, Combinatorial description of Block and Convolutional codes, Algorithms for the construction of minimal and tail biting trellises, Soft decision decoding algorithms, Iterative decoding algorithms, Turbo-decoding, Two-way algorithm, LDPC codes, Use of LDPC codes in digital video broadcasting, belief propagation (BP) algorithms, Space-Time codes.

Shu Lin and Daniel J. Costello Jr., Error Control Coding: Fundamentals and Applications, Prentice Hall, 2003.
S. B Wicker, Error Control Systems for Digital Communication and Storage, Prentice Hall International, 1995.
Blahut R. E, Theory and Practise of Error Control Codes, Addisson Wesley, 1983.
Blahut R.E., Algebraic codes for Data transmission, Cambridge University Press, 2003.
Johannesson R and Zigangirov K.S ,Fundamentals of Convolutional codes, IEEE press, 1999.
V. S Pless and W. C Huffman, A. Vardy, Trellis structure of codes, Chapter 24 of Handbook of Coding Theory.

CE822 Wireless Communications & Networks (3–0–0) 3

Radio Propagation Characteristics: Models for path loss, shadowing and multipath fading (delay spread, coherence band width, coherence time, Doppler spread), Jakes channel model, Digital modulation for mobile radio, analysis under fading channels: diversity techniques and RAKE demodulator, channel coding techniques, multiple access techniques used in wireless mobile communications. Space time propagation, wireless channel, channel as a space time random field, space time channel and signal models, capacity of space time channels, spatial diversity, space time receivers, space time coding with channel knowledge, space time OFDM. Wireless networks – WLAN, Bluetooth. Suitable mini-projects in the areas of Space-Time codes and OFDM. The cellular concept: Frequency reuse; The basic theory of hexagonal cell layout: Spectrum efficiency, FDM / TDM cellular systems; Channel allocation

- RRM -

schemes, Handover analysis, Erland capacity comparison of FDM / TDM systems and cellular CDMA. Discussion of GSM and CDMA cellular standards, Signaling and call control: Mobility management, location tracking. Wireless data networking, packet error modeling on fading channels, performance analysis of link and transport layer protocols over wireless channels: mobile data networking (Mobile IP): wireless data in GSM, IS - 95 and GPRS.

Space time Wireless Communications

J.G. Proakis, Digital Communication, McGraw Hill, 2000.
G.L. Stuber, Principles of Mobile Communications, Kluwer Academic, 1996.
T.S. Rappaport, Wireless Communications: Principles and Practice, Prentice Hall, 2002.
Kumar, D. Manjunath and J. Kuri, Communication Networking, an Analytical Approach, Elsever, 2004
Paulraj, R. Nabar & D. Gore, Introduction to Space Time Wireless Communications, Cambridge University Press, 2003
C Sivarama Murthy and B S Manoj, Ad-Hoc Wireless Networks, Architectures and Protocols, PH, 2004.

CE823 Cryptography (3-0-0) 3

Elementary Number Theory, Finite series, Arithmetic and Algebraic Algorithms, Secrete key and Public key Cryptography, Pseudo Random bit generators, Block and Stream Ciphers, Hash functions and Message digests, Public key encryption, Authentication, Digital Signatures, Zero Knowledge Interactive Protocols, Elliptic curve cryptosystems, formal verification, Crypt analysis, Hard Problems.

Koblitz N., A Course on Number Theory and Cryptography, Springer Verlag, 1986.
Menezes A. et. all, Handbook of Applied Cryptography, CRC Press, 1996

CE824 Radar Signal Processing (3–0–0) 3

Radar and its composite environment, Review of Radar range performance computations, Detection Processes, Sequential and adaptive processes, Atmospheric effects, Sea and land Back scatter, Signal Processing concepts and waveform designs MTI & CW radars, phase coding techniques, FM pulse compression waveforms, Mateorogical radar and system performance analysis.

R.J Sullivan, Radar Foundations for imaging and Advanced Concepts, PMI, 2004.
F.E Nathanson, Radar Design Principles, Signal Processing and The Environment, PMI, 2004.
J.C. Toomay, Principles of radar, PMI, 2004.

CE825 Optical Networks (3–0–0) 3

Introduction to Optical Networks, Propagation of Signals in an optical fiber, Optical Components, Modulation and demodulation, Transmission system engineering, client layer of the optical layer, WDM network Elements, WDM network designing, DWDM networks

R. Ramaswami and K.N. Sivarajan, Optical Networks, A Practical Perspective, Harcourt Asia Pvt. Ltd., 2000.

CE826 Image & Video processing (3–0–0) 3

Digital image fundamentals – image acquisition, representation, visual perception, quality measures, sampling and quantization, basic relationship between pixels, imaging geometry, color spaces, Video spaces, analog and digital video interfaces, video standards. Two dimensional systems – properties, analysis in spatial, frequency and transform domains. Image transforms - DFT, DCT, Sine, Hadamard, Haar, Slant, KL transform, Wavelet

transform. Image enhancement – point processing, spatial filtering, Image restoration – inverse filtering, de-blurring Video processing – display enhancement, video mixing, video scaling, scan rate conversion, Image compression – lossless and lossy compression techniques, standards for image compression – JPEG, JPEG2000. Video compression – motion estimation, intra and interframe prediction, perceptual coding, standards - MPEG, H.264 Image segmentation – feature extraction, region oriented segmentation, descriptors, morphology, Image recognition

R. C. Gonzalez and R E Woods, Digital Image Processing, Pearson Education, 2002
A K Jain, Fundamentals of Digital Image Processing, Pearson Education, 1989
W Pratt, Digital Image Processing, Wiley, 2001
Al Bovik, Handbook of Image and Video, Academic Press, 2000
Keith Jack, Video Demystified, LLH, 2001

CE827 Speech & Audio processing (3-0-0) 3

Speech Production – human speech production mechanism, acoustic theory of speech production, digital models for speech production. Speech perception – human hearing, auditory psychophysics, JND, pitch perception, auditory masking, models for speech perception. Speech Analysis – Time and frequency domain analysis of speech, speech parameter estimation, Linear prediction. Speech compression – quality measures, waveform coding, source coders, Speech compression standards for personal communication systems. Audio processing – characteristics of audio signals, sampling, Audio compression techniques, Standards for audio compression in multimedia applications, MPEG audio encoding and decoding, audio databases and applications. Speech synthesis – text to speech synthesis, letter to sound rules, syntactic analysis, timing and pitch segmental analysis. Speech recognition – Segmental feature extraction, DTW, HMMs, approaches for speaker, speech and language recognition and verification

Douglas O'Shaugnessy, Speech Communication – Human and Machine, IEEE Press, 2000
L R Rabiner, Digital Processing of Speech Signals, Pearson, 1978
T.F Quatieri , Discrete-time speech signal processing: Principles and Practise Pearson, 2002
Zi Nian Li, Fundamentals of Multimedia, Pearson Education, 2003

CE828 Multimedia Communications (3-0-0) 3

Representation of Multimedia Data, Concept of Non-Temporal and Temporal Media, Basic Characteristics of Non-Temporal Media, Images, Graphics, Text, Basic Characteristics of Temporal Media, Video, Audio, Animation, Basics of Morphing, Hypertext and Hypermedia, Multimedia Presentations, Synchronization. Compression of Multimedia Data, Basic concepts of Compression, Still Image Compression JPEG Compression, Natural Video Compression, MPEG-1&2 Compression Schemes, MPEG-4 Video Compression, Audio Compression Introduction to Speech and Audio Compression, MP3 Compression Scheme, Management of Coded Data ,Stream management in MPEG-4 , BIFS, DMIF Multimedia System Design, General Purpose Architecture for Multimedia Processing, Operating System Support for Multimedia, Data, Resource Scheduling with real-time considerations, File System, I/O Device Management, Delivery of Multimedia data, Network and Transport Protocols, QoS issues, RTP and RSVP, Video-conferencing and video-conferencing standards, Overview of Voice over IP, Multimedia Information Management, Multimedia Data base Design, Content Based Information Retrieval, Image Retrieval, Video Retrieval, Overview of MPEG-7.

Ralt Steinmetz and Klara Nahrstedt, Multimedia : Computing, Communication & Applications, Pearson Education Publications, 2004.

CE829 MIMO Communication Systems (3-0-0) 3

Overview of fundamentals of Digital Communications, The Wireless Channel, Detection, Diversity and Channel Uncertainty, Capacity of Wireless channels, Spatial Multiplexing and Channel modeling, Capacity and Multiplexing architectures, Diversity-Multiplexing tradeoff and Universal Space Time Codes, Multi-user Communication.

David Tse, Pramod Viswanath, Fundamentals of Wireless Communications, Cambridge University Press, 2005.

E. Biglieri, Coding for Wireless Channels, Springer, 2007

E. Biglieri et al., MIMO Wireless Communications, Cambridge University Press, 2007.

CE 830 Information Theory (3-0-0) 3

Entropy, Relative Entropy and Mutual Information, Asymptotic Equipartition Property, Entropy rate of a stochastic process, Data Compression, Channel Capacity, Differential Entropy, Gaussian Channel, Rate Distortion Theory, Information Theory and Statistics, Network Information Theory.

T. M Cover and Joy A Thomas, Elements of Information Theory, John Wiley 2006.

R.E Blahut, Principles and Practice of Information Theory, Addison Wesley, 1987.

CE831 Computer Communication Networks (3-0-0) 3

Overview of OSI and TCP/IP models; TCP/IP Networks: The TCP/IP Architecture, The Internet Protocol, IPv6, User Data gram Protocol, Transmission Control Protocol, Internet Routing Protocols, Multicast Routing, DHCP and Mobile IP, Internet Routing protocols, Multicast Routing; ISDN and ATM Networks: Overview of ISDN (ISDN Channels, User Access, ISDN protocols, Broadband ISDN), BISDN Reference Model, ATM Layer, ATM adaptation Layer, ATM Signaling, PNNI Routing; Network Security and distributed applications: Security requirements and attacks, Encryption, authentication, digital signatures, Ipv4 and Ipv6 security, ASN.1, SNMP, SMTP, MIME, HTTP; Advanced Network Architectures/Protocols: IP forwarding Architectures, Overlay Model, MPLS, Integrated services in the Internet, RSVP, Differentiated Services, Real-Time Transport Protocol, Session Control Protocols; Queuing models, Little's Theorem, Markov chains – M/M/1, M/M/m, infinite server and m server loss systems, M/G/1, priority queuing, Networks of Queues Multiple Access Communication, Random Access Protocols. Scheduling: Stochastic Analysis: Stochastic traffic models, performance measures, Little's theorem, Brumelle's Theorem and applications, multiplexer analysis with stationary and Ergodic traffic, multi loop networks.

Leon Garcia and Widjaja., Communication Networks, Tata McGraw-Hill,2003

Stallings W. Data and Computer Communications. PHI, 2003

Kumar, D. Manjunath and J. Kuri. Communication networking, An analytical approach, Elsevier, 2004.

J.F. Hayes, Modelling and analysis of Computer Communications Networks, Plenum, 1984.

Bertsekas and Gallanger, Data Networks, PH, 1992

CE 832 Advanced Antenna Theory (3-0-0) 3

Planar Antennas - Microstrip rectangular and circular patch antennas- Analysis and design, Feeding methods; Circularly polarized microstrip antennas, Broadbanding techniques. Printed slot antennas. Array Theory – Linear array; Broadside and end fire arrays; Self and mutual impedance of between linear elements, grating lobe considerations. Planar array- Array factor, beamwidth, directivity. Example of microstrip patch arrays and feed networks. Electronic scanning. Broadband Antennas- Folded dipole, Sleeve dipole, Biconical antenna- Analysis, characteristics, matching techniques. Yagi array of linear elements and printed

version, Log-periodic dipole array. Frequency Independent Antennas- Planar spiral antenna, Log periodic dipole array. Aperture Antennas- Field equivalence principle, Babinet's principle. Rectangular waveguide horn antenna, Parabolic reflector antenna. Antennas for mobile communication - Handset antennas, Base station antennas. Beam steering and antennas for MIMO applications. Active and smart microstrip antennas, Design and analysis of microstrip antenna arrays.

C. A. Balanis, Antenna Theory and Design, John Wiley & Sons, 1997.
J.D. Kraus, Antennas, McGraw-Hill, 1988.
R.A. Sainati, CAD of Microstrip Antennas for Wireless Applications, Artech House, 1996.
R. Garg, P. Bharhia, I. Bahl, and A. Ittipiboo, Microstrip Antenna design Handbook, Artech House.
J. R. James, P.S. Hall and C.Wood, Microstrip Antennas: Theory & Design, Peter Peregrinns , UK

CE 833 Photonic Devices (3-0-0) 3

Importance of optical/photonic devices and OEICs, Thin film or channel waveguides and their fabrication techniques; Electro-optic modulation; Acousto-optic modulation; Magneto-optic modulation. Optical processes in semiconductors:e-h pair formation and recombination;Franz-Keldish & Stark effect; Quantum well structures. LEDs and LDs: Structure, device performance, modulation Characteristics, drive circuits.Photo-detectors: pin & APDs(review);noise and sensitivity. High speed operation. Modulation and switching of LDs: SEEDs, Electro-optic modulators,QW modulators, Bistable devices. OEICs: fabrication, some specific OEICs(integrated LD,modulators,transmitter) Amplifiers: Semiconductor amplifiers, EDFA

Pallab Bhattacharyya, Semiconductor OE devices, PHI, 1995
A.K.Ghatak and K.Thyagarajan, Optical Electronics, Cambridge University Press, 1989
B. E. A. Saleh, M. C. Teich, Fundamentals of photonics, Wiley Inter science, 1991.
J. Singh, Optoelectronics: An introduction to materials & devices, McGraw Hill, 1996.
J. Wilson & J. F. B. Hawkes, Optoelectronics: An introduction, Prentice Hall India, 1992.

CE 834 . Active RF Devices and Circuits (3-0-0) 3

Transistor Amplifiers - Types of amplifiers. S- parameter characterization of transistors; MESFETs - Equivalent circuit model. Single stage amplifier design- unilateral and bilateral cases, Amplifier stability, Constant gain and noise circles, DC bias circuits for amplifiers;Detectors and Mixers - Point contact and Schottky barrier diodes- Characteristics and equivalent circuit, Theory of microwave detection, Detector circuit design. Types of mixers. Mixer theory and characteristics. SSB versus DSB mixers. Single-ended mixer and single-balanced mixer- Design and realization in microstrip. Double balanced and image rejection mixers;Oscillators - Oscillator versus amplifier design, Oscillation conditions;Gunn diode – Modes of operation, Equivalent circuit. Design of Gunn diode oscillator in microstrip. FET oscillators. Frequency tuning techniques. Switches and Phase Shifters - PIN diode– Equivalent circuit and Characteristics, Basic series and shunt switches in microstrip; SPST and SPDT switches, Switched line, branchline coupled and loaded line phase shifters in microstrip. Applications in phased arrays. Oscillators - Oscillator versus amplifier design, Oscillation conditions. Gunn diode – Modes of operation, Equivalent circuit. Design of Gunn diode oscillator in microstrip. FET oscillators. Frequency tuning techniques. .

D. K. Misra, Radio Frequency and Microwave Communication Circuits – Analysis and Design, John Wiley, 2004.
G. Gonzalez, Microwave Transistor Amplifiers – Analysis and Design, Prentice Hall, 1997.
D. M. Pozar, Microwave Engineering, John Wiley, 1998.

S.K. Koul and B. Bhat, Microwave and Millimeter Wave Phase Shifters, Vol.II-Semiconductor and Delay Line Phase Shifters, Artech House, 1991
G.D. Vendelin, A.M. Pavio and U.L. Rhode, Microwave Circuit Design using Linear and Non-linear Techniques, 1990.

CE835 Soft Computing (3–0–0) 3

Introduction to learning systems - Feed forward Neural Networks - Perception - Multilayer Perception. Propagation algorithm and its variants - Improving generalization by various methods. Recurrent Neural Networks Hopfield net Boltzmann machine and Mean field learning solving combinational optimization problems using recurrent Neural Networks. Unsupervised Neural Networks. Competitive learning Self-organizing maps Growing cell structures Principal component analysis. Basics of fuzzy sets. Genetic algorithms: Population based search techniques, evolutionary strategies, mathematical foundations of genetic algorithms, search operators, genetic algorithms in function and combinational optimization, hybrid algorithms, application to pattern recognition

S. Haykin, Neural Networks: A comprehensive foundation, Pearson, 1999
J. M. Zurada, Introduction to artificial neural networks, Jaico publishing, 1997.
B. Yejnanarayana, Artificial Neural Networks, PHI, 1999
C. Mohan and S. Ranka, Neural networks, Benram publications, 2004.

CE836 Adaptive Signal Processing (3-0-0) 3

Introduction to Adaptive Processing: General properties, filtering, prediction and smoothing, Applications in Communications: Equalisation, Echo cancellation, Noise cancellation. Optimal Signal Processing, Principles of orthogonality, minimum square error, Wiener Hopf equations, state space model, innovations process, Kalman filter equations. Linear Adaptive Equalisation, Gradient search and steepest descent adaptation algorithms, effect of eigenvalue spread on stability and rate of convergence, stochastic gradient descent using Least Mean Squares (LMS) algorithms, transient and steady state properties including convergence rate and mis-adjustment, least square estimation, normal equations, Recursive Least Squares (RLS) algorithms, relationship between RCS and Kalman filters. Introduction to Fast Recursive Algorithms for Equalization, Adaptive linear prediction, lattice filtering for RLS. Tracking time-varying systems, Nonlinear adaptive filtering

S.J. Orfanidis, Optimum Signal Processing, McGraw Hill, 1989.
S. Haykin, Adaptive FilterTheory, Pearson, 1996

VL720 Digital IC Design (3-0-2) 4

Introduction to MOSFETs. MOSFET logic circuits. CAD tools for VLSI design. MOSFET logic gates. Interfacing CMOS and Bipolar logic families. Circuit characterization and performance estimation – Resistance, Capacitance estimation – Switching characteristics – Delay models – Power dissipation – Packaging – Scaling of MOS transistor dimensions – Yield and Reliability. CMOS testing – Need for testing – Fault models – design strategies. CMOS subsystem design – Datapath operations – Addition, Multiplication, Counters, Shifters, Memory design. Interconnect design, Powergrid and clock design. Simulation exercises on MOSFET- characteristics and parameter extraction, logic gates, subsystems, timing and power dissipation.

Jan M. Rabaey, Anantha Chandrakasan, and Borivoje Nikolic Digital Integrated Circuits – A design perspective, Pearson, 2003
S. M. Kang & Y. Leblebici, CMOS Digital Integrated Circuits, McGraw Hill, 1999.
David A Hodges, Horace G. Jackson and Resve Saleh, Analysis and Design of Digital Integrated Circuits, Mc Graw Hill, 2003

N. Weste and K. Eshrangian, Principles of CMOS VLSI Design: A systems perspective, Addison Wesley, 1993.

VL721 Analog IC Design (3 -1- 0) 4

Current mirrors – basic current mirror, Widlar, Wilson biasing, Cascoded current mirrors; Noise – Types, Representation of noise in circuits; Basic Single-stage amplifiers - CS, CD and CG amplifier; noise analysis; Differential amplifiers – current mirror load, current source load, CMR, CMRR, folded cascode amplifier, noise analysis, common-mode feedback circuits; Two-stage amplifiers – analysis, frequency response, stability, compensation; Band gap references; Constant–Gm biasing; Distortion in amplifiers; Introduction to switched capacitor circuits – MOSFET as a switch, charge injection and its cancellation, switched capacitor amplifiers

Behzad Razavi, Design of Analog CMOS Integrated Circuits, McGraw-Hill International Edition, 2001
David A. Johns and Ken Martin, Analog Integrated Circuit Design, John Wiley, 2002
Phillip E. Allen and Douglas R. Holberg, CMOS Analog Circuit Design, Oxford University Press, 2003.

VL722 Advanced Computer Architecture (3– 1– 0) 4

Instruction set architectures of CISC, RISC and DSP Processors. CISC Instruction set implementation, Microprogramming approaches. Pipeline implementation of RISC instruction set. Implementation of DSP instruction set. Instruction level parallelism – Dynamic scheduling, Dynamic hardware prediction, hardware based speculation, ILP through software approaches – VLIW, IA64 architecture as a case study, Memory hierarchy design, Multiprocessors, thread level parallelism and multi-core architectures, I/O buses. Arithmetic: Fixed point, Floating point and residue arithmetic, Multiply and Divide Algorithms, Issues in arithmetic system design Issues in the applications (optimizing the hardware – software interface), ASIP, reconfigurable computing, Future microprocessor architectures.

D. A. Patterson and J. Hennessy, Computer Architecture: A Quantitative Approach, Harcourt Asia, 2003.
D. A. Patterson and J. Hennessy, Computer Organization and Design, Harcourt Asia, 1998.
Flynn and Oberman, Advanced Computer Arithmetic Design, Wiley 2001
Behrooz Parhami, Computer Arithmetic Algorithms and Hardware Design, Oxford, 2000.

VL723 Advanced Mixed Signal Design (3-1-0) 4

Sample and Hold Circuits: Basic S/H circuit, effect of charge injection, compensating for charge injection, bias dependency, bias independent S/H. D/A Converter – General considerations, Static non-idealities and Dynamic non-idealities; Current-steering DAC – Binary weighted DAC, Thermometer DAC, Design issues, Effect of Mismatches. A/D converter – General considerations, static and dynamic non-idealities. Flash ADC – Basic architecture, Design issues, Comparator and Latch, Effect of non-idealities, Interpolative and Folding architectures. Successive Approximation ADC; Pipeline ADC. Over sampling ADC – Noise shaping, Sigma-Delta modulator

Behzad Razavi, Principles of Data Conversion System Design, Wiley-IEEE Press, 1995
Rudy J. van de Plassche, CMOS Integrated Analog-to-Digital and Digital-to-Analog Converters, Springer, 2003

VL724 VLSI Design Automation (3-1-0) 4

Introduction to VLSI CAD: VLSI design methodologies, use of VLSI CAD tools, Algorithmic Graph Theory, computational Complexity and ROBDD; Partitioning and

placement: KL algorithm, FM algorithm etc.; Floor planning: Sliced and non-sliced planning, Polish expression, Simulated annealing, partition based placement; Routing: Global routing, detailed routing, graph models, Line Search, Maze Routing, Channel routing; High Level Synthesis: Introduction to HDL, HDL to DFG, operation scheduling: constrained and unconstrained scheduling, ASAP, ALAP, List scheduling, Force directed scheduling, operator binding; Static Timing Analysis: Delay models, setup time, hold time, cycle time, critical paths, Topological vs logical timing analysis, False paths, Arrival time (AT), Required arrival Time (RAT), Slacks.

Sabih H. Gerez, Algorithms for VLSI Design Automation, John Wiley, 1998.

Majid Sarrafzadeh and C. K. Wong, An Introduction to VLSI Physical Design, McGraw Hill, 1996.

Naveed Sherwani, Algorithms for VLSI Physical Design Automation, . Kluwer Academic Pub., 1999.

VL725 Digital VLSI Testing & Testability (3-1-0) 4

Overview of testing and verification, Defects and their modeling as faults at gate level and transistor level. Functional V/s. Structural approach to testing. Complexity of testing problem. Controllability and observability. Generating test for a signal stuck-at-fault in combinational logic. Algebraic algorithms. Test optimization and fault coverage. Logic Level Simulation – Delay Models, Event driven simulation, general fault simulation (serial, parallel, deductive and concurrent). Testing of sequential circuits. Observability through the addition of DFT hardware, Adhoc and structured approaches to DFT – various kinds of scan design. Fault models for PLAs, bridging and delay faults and their tests. Memory testing, Testing with random patterns. The LFSRs and their use in random test generation and response compression (including MISRs), Built-in self test.

M. Abramovici, M. A. Breuer, and A. D. Friedman, Digital Systems Testing and Testable Design, IEEE Press, 1994.

M. L. Bushnel and V. D. Agarwal, Essentials of Testing for Digital, Memory and Mixed – Signal VLSI Circuits, Kluwer Academic Publishers, 2000.

Ajai Jain, Learning Module for the course - VLSI Testing and Testability, IIT, Kanpur, 2001.

VL820 Logic Synthesis Techniques (3– 0 – 0) 3

Introduction to Computer aided synthesis and optimization. Hardware Modeling. Two level combinational logic optimization. Multiple level combinational optimization. Sequential logic optimization. Cell Library Binding. State of the art and future trends: System level synthesis and hardware software co-design.

Giovanni De Micheli, Synthesis and Optimization of Digital Circuits, McGraw Hill, 1994.

Srinivas Devadas, Abhijith Ghosh and Kurt Keutzer, Logic Synthesis", Kluwer Academic, 1998.

G. D. Hachtel and F. Somenzi, Logic Synthesis and Verification Algorithms, Kluwer Academic Publishers, 1996.

S. Hassoun and T. Sasao, (Editors), Logic Synthesis and Verification, Kluwer Academic publishers, 2002.

VL821 Low Power VLSI Design (3- 0 -0) 3

Introduction to Low Power VLSI. Modeling and Sources of Power consumption. Power estimation at different design levels. Power optimization for combinational circuits and sequential circuits Voltage scaling Approaches. Low energy computing using energy recovery techniques. Low Power SRAM architectures. Software design for low power.

Computer Aided Design Tools. Case studies Recent trends in low-power design for mobile and embedded application.

Kaushik Roy, Sharat Prasad, Low-Power CMOS VLSI design, John Wiley, 2000.
Anantha P.Chandrakasan & Robert W. Brodersen, Low Power Digital CMOS Design, Kluwer Academic Publications, 1995.
Gary K. Yeap, Practical Low Power Digital VLSI Design, Kluwer Academic Publications, 1998

VL822 Modeling and Simulation (3-0-0) 3

Introduction to Modeling and simulation concepts. Levels of simulation for digital, analog & mixed mode circuits. IC CAD Overview. Device Simulation. Electrical simulation techniques. Relaxation based simulation techniques. Gate level simulation, Switch level timing simulation. Mixed mode interface, simulation and implementation, analog multi-level simulation. Discrete time models, Event driven simulation, Logic simulation, timing verification in ICs,

R. Saleh, S. Jou & A.R.Newton, Mixed mode simulation and analog multilevel simulation, Kluwer Academic Publications, 1994.
V.Litovski & M. Zwolinski, VLSI circuit simulation & Optimization, Chapman & Hall publications, 1997.
J Baker, Li & Boyce, CMOS Circuit Design & Simulation, PHI, 2000.

VL823 Submicron Technology (3 -0- 0) 3

Review of basic device physics, MOS capacitor. Transistor theory. Scaling - Moore's law on technology scaling, MOS device scaling theory, Short channel effects, sub threshold leakage, Punch through, DIBL, High field mobility, Velocity saturation and overshoot. Reliability. Various definitions of channel length, Performance metric of digital technology, Transistor design trade-offs, Technology case studies, Silicon on Insulator (SOI) devices, Partially depleted and fully depleted SOI, Floating body effects, SOI for low power, Interconnects in sub micron technology, Foundry technology, International Technology Roadmap for Semiconductors (ITRS)

Yaun Taur, Tak H. Ning, Fundamentals of modern VLSI devices, Cambridge university press, 1998.
B. G. Streetman & S. Banerjee, Solid State Electronic Devices, Prentice Hall, 1999.
M. K. Achuthan and K. N. Bhat, Fundamentals of Semiconductor Devices, McGraw Hill, 2006
A. K. Dutta, Semiconductor Devices and Circuits, Oxford Univ. Press, 2008.
M. S. Tyagi, Introduction to Semiconductor Materials and Devices, John Wiley, 1991
ITRS Road map - http://public.itrs.net/

VL824 Advanced VLSI Design (3– 0– 0) 3

Introduction to digital systems engineering, Modeling and analysis of wires; Circuits; Power distribution; Noise in digital systems; Signaling conventions; Advanced signaling techniques; Timing conventions; Synchronization; Signaling circuits; Timing circuits; Packaging of digital systems

Neil Weste and David Harris, CMOS VLSI Design : A Circuits and Systems Perspective, Addison Wesley, 2005
William J. Dallly and John W. Poulton, Digital Systems Engineering, Cambridge Univ. Press, 2004

-832-

VL825 Hardware Software Co-design (3–0– 0) 3

Codesign Overview, Models and Methodology of Embedded System Codesign, UML based modeling of reactive system behaviors, Modeling behaviors via transition systems, Temporal Logics for specifying system properties, Explicit state model checking, Hardware Software partitioning and Scheduling, Cosimulation, High level Synthesis (HW) and functional verification, Architecture Mapping, Hardware/Software Interfaces, reconfigurable logic and devices, System on Chip (SoC) and IP cores, Hardware/Software Codesign for application specific processor, Codesign tools and case studies.

G. Micheli, R. Ernst, and W. Wolf, , Readings in Hardware/Software Co-Design, Morgan Kaufman Publications, 2002.

Balarin et al., Hardware-Software Co-Design of Embedded Systems: The POLIS Approach, Kluwer Academic 1997.

Wayne Wolf, Computers as components: Principles of Embedded Computing System Design, Harcourt India, 2001.

VL826 Sensor Technology and MEMS (3–0–0) 3

Sensor types and Classification – Mechanical, acoustic, magnetic, thermal, chemical, radiation and bio sensors; Micro-sensor; sensors based on surface acoustic wave devices; Micro-machining technology, bulk, surface and other micro-machining techniques' MEMS for automotive, communication, signal processing applications; Modeling and simulation of Micro-sensors and actuators; sensors and smart structures; micro-opto-electromechanical sensors.

Ristic L (Ed), Sensor Technology and Devices, Artech House, 1994.

Sze S.M. (Ed), Semiconductor Sensors, John Wiley, 1994.

Wise K.D., Integrated Sensors, Microactuators and Microsystems (MEMS), Special Issue of Proceedings of IEEE, Vol. 86, No. 8, August-1998.

Stephen D. Senturia, Microsystem Design, Kluwer Academic Press, 2001

Baltes et. Al (Eds.), CMOS – MEMs, Advanced micro and nano systems, Vol. 2, Wiley-VCH, 2005

VL827 Embedded Systems (3–0–0) 3

Introduction: Overview of embedded systems, embedded system design challenges, common design metrics and optimizing. Survey of different embedded system design technologies & trade-offs. Embedded microcontroller cores, embedded memories, Examples of embedded systems. Architecture for embedded system, High performance processors – strong ARM processors, programming, interrupt structure, I/O architecture, Technological aspects of embedded systems: interfacing between analog and digital blocks, signal conditioning, Digital signal processing, Sub-system interfacing, interfacing with external systems. Software aspects of embedded systems: real time programming languages and operating systems for embedded systems – RTOS requirements, kernel types, scheduling, context switching, latency, inter-task communication and synchronization, Case studies

Jack Ganssle, The Art of Designing Embedded Systems, Elsevier, 1999.

J.W. Valvano, Embedded Microcomputer System: Real Time Interfacing, Brooks/Cole, 2000.

David Simon, An Embedded Software Primer, Addison Wesley, 2000.

H. Kopetz, Real-time Systems, Kluwer, 1997

R. Gupta, Co-synthesis of Hardware and Software for Embedded Systems, Kluwer 1995.

Gomaa, Software Design Methods for Concurrent and Real-time Systems, Addison-Wesley, 1993.

VL 828 VLSI Technology (3-0-0) 3

Environment for VLSI Technology: Clean room and safety requirements. Wafer cleaning processes and wet chemical etching techniques. Impurity incorporation: Solid State diffusion modelling and technology; Ion Implantation modelling, technology and damage annealing; characterisation of Impurity profiles. Oxidation: Kinetics of Silicon dioxide growth both for thick, thin and ultrathin films. Oxidation technologies in VLSI and ULSI; Characterisation of oxide films; High k and low k dielectrics for ULSI. Lithography: Photolithography, E-beam lithography and newer lithography techniques for VLSI/ULSI; Mask generation. Chemical Vapour Deposition techniques : CVD techniques for deposition of polysilicon, silicon dioxide, silicon nitride and metal films; Epitaxial growth of silicon; modelling and technology. Metal film deposition: Evaporation and sputtering techniques. Failure mechanisms in metal interconnects; Multi- level metallisation schemes. Plasma and Rapid Thermal Processing: PECVD, Plasma etching and RIE techniques; RTP techniques for annealing, growth and deposition of various films for use in ULSI. Process integration for NMOS, CMOS and Bipolar circuits; Advanced MOS technologies.

C.Y. Chang and S.M.Sze, ULSI Technology, McGraw Hill, 1996.
S.K. Ghandhi, VLSI Fabrication Principles, John Wiley Inc., 1983.
S.M. Sze, VLSI Technology, McGraw Hill, 1988.
M. K. Achuthan and K. N. Bhat, Fundamentals of Semiconductor Devices McGraw Hill, 2006

VL829 Digital Design using FPGAs (2-0-2) 3

Digital system design options and trade offs, Design methodology and technology overview, High Level System Architecture and Specification: Behavioral modeling and simulation, Hardware description languages, combinational and sequential design, state machine design, synthesis issues, test benches, Overview of FPGA architectures and technologies: FPGA Architectural options, granularity of function and wiring resources, coarse vs fine grained, vendor specific issues (emphasis on Xilinx and Altera), Logic block architecture: FPGA logic cells, timing models, power dissipation I/O block architecture: Input and Output cell characteristics, clock input, Timing, Power dissipation, Programmable interconnect - Partitioning and Placement, Routing resources, delays; Applications - Embedded system design using FPGAs, DSP using FPGAs, Dynamic architecture using FPGAs, reconfigurable systems, application case studies. Simulation / implementation exercises of combinational, sequential and DSP kernels on Xilinx / Altera boards.

M.J.S. Smith, Application Specific Integrated Circuits, Pearson, 2000
Peter Ashenden, Digital Design using VHDL, Elsevier, 2007
Peter Ashenden, Digital Design using Verilog, Elsevier, 2007
W.Wolf, FPGA based system design, Pearson, 2004
Clive Maxfield, The Design Warriors's Guide to FPGAs, Elsevier, 2004

VL830 Active Filter Design (3-0-0) 3

Butterworth, Chebyshev & Inverse-Chebyshev filter response and pole locations; LC ladder filter – prototype & synthesis; Frequency transformation of lowpass filter. Impedance converters; Gm-C filters – Gm-C biquad, Q-enhancement, Automatic Tuning; Active-RC filters – Comparison with Gm-C filter, Issues in realizing high frequency active-RC filters; Characterization of on-chip integrated continuous time filters.

R. Schaumann and M.E. Van Valkenburg, Design of Analog Filters, Oxford University Press, 2003.
P. V. Ananda Mohan, Current-Mode VLSI Analog Filters - Design and Applications, Birkhauser, 2003
M.E. Van Valkenburg, Analog Filter Design, Oxford University Press, 1995.

– 2014 –

VL831 RF Integrated Circuits (3-0-0) 3

Basic concepts in RF Design – harmonics, gain compression, desensitization, blocking, cross modulation, intermodulation, inter symbol interference, noise figure, Friis formula, sensitivity and dynamic range; Receiver architectures – heterodyne receivers, homodyne receivers, image-reject receivers, digital-IF receivers and subsampling receivers; Transmitter architectures – direct-conversion transmitters, two-step transmitters; Low noise amplifier (LNA) – general considerations, input matching, CMOS LNAs; Downconversion mixers – general considerations, spur-chart, CMOS mixers; Oscillators – Basic topologies, VCO, phase noise, CMOS LC oscillators; PLLs – Basic concepts, phase noise in PLLs, different architectures.

Behzad Razavi, RF Microelectronics, Prentice Hall PTR, 1997

Thomas H. Lee, The design of CMOS radio-frequency integrated circuit, Cambridge University Press, 2006

Chris Bowick, RF Circuit Design, Newnes, 2007

VL832 Digital Signal Processing Architectures (3–0–0) 3

VLSI Architectures for DSP algorithms – Data flow representations, pipelining and parallel processing, retiming, unfolding, register minimization techniques, systolic architectures, algorithms for fast implementation of convolution, FIR, IIR and adaptive filters, DCT, analysis of finite word length effects, Low power design strategies; Architecture, programming and applications of general purpose digital signal processors (Emphasis on TI & AD processors); Application case studies: Speech coding, image and video compression, Viterbi decoding, wireless communication.

K.K. Parhi, VLSI Digital signal processing systems: Design and implementation, John Wiley, 1999.

Lars Wanhammar, DSP Integrated Circuits, Academic Press, 1999

S.M. Kuo; B.H.Lee, Real-Time Digital Signal Processing: Implementations, Applications, and Experiments with the TMS320C55X, Wiley, 2001

VL833 Reconfigurable Computing (2–0–2) 3

Reconfigurable computing systems - Introduction to fine grained reconfigurable systems such as field programmable gate arrays and coarse grained architectures and technology. Design and implementation - Algorithms and steps (design entry, functional simulation, logic synthesis, technology mapping, place and route, bit stream generation) to implement (map) algorithms to FPGAs. Temporal partitioning; Temporal placement; On-line communication; Designing reconfigurable applications on Xilinx Virtex FPGAs – dynamic reconfiguration of FPGA using Xilinx tools. Applications of reconfigurable computing - reconfigurable supercomputers, reconfigurable massively parallel computers and application domains such as distributed arithmetic, signal processing, network packet processing, control design, and cryptography

S.Hauck, A. DeHon, Reconfigurable Computing: The Theory and Practice of FPGA-Based Computation, Elsevier, 2008

M.Sc (Physics) (Revised Curriculum-2012)

Suggested Plan of Study

S.No.	Semester			
	I	II	III	IV
1	PH701	PH751	PH801	Elective 2
2	PH702	PH752	PH802	Elective 3
3	PH703	PH753	PH803	Elective 4
4	PH704	PH754	Elective 1	PH899
5	PH705	PH755	PH893	
6	PH891	PH892	PH898	

Credit Requirements:

Category	Minimum Credit to be Earned
Program Core	52
Elective Courses	12
Seminars	06
M.Sc Project	20
Total	90

Program Core (PC)

PH701 Mathematical Physics – I (3-1-0) 4
PH702 Classical Mechanics (3-1-0) 4
PH703 Quantum Mechanics – I (3-1-0) 4
PH704 Electronics (3-1-0) 4
PH705 Physics Lab – I (0-0-6) 4
PH751 Condensed Matter Physics – I (3-1-0) 4
PH752 Atomic & Molecular Spectroscopy (3-1-0) 4
PH753 Statistical & Thermal Physics (3-1-0) 4
PH754 Electromagnetic Theory (3-1-0) 4
PH755 Physics Lab – II (0-0-6) 4
PH801 Condensed Matter Physics – II (3-1-0) 4
PH802 Nuclear Physics (3-1-0) 4
PH803 Physics Lab – III (0-0-6) 4

Elective (Ele) Courses

PH860 Cryogenics & Low Temp. Phys. (3-0-0) 3
PH861 Vacuum Technology & Thin Films (3-0-0) 3
PH862 Semicond. Device & Applications (3-0-0) 3
PH863 Materials Prep. Techniques (3-0-0) 3
PH864 Physics of Thin Films (3-0-0) 3
PH865 Crystallography (3-0-0) 3
PH866 Magnetism & Superconductivity (3-0-0)3
PH867 Nanomaterials (3-0-0) 3
PH868 Charact. Techniques of Materials (3-0-0)3
PH869 Fiber Optics (3-0-0) 3
PH870 Lasers & Applications (3-0-0) 3
PH871 Nonlinear Optics (3-0-0) 3
PH872 Integrated Optics (3-0-0) 3
PH873 Optical Interferometry (3-0-0) 3
PH874 Optical Data Processing (3-0-0) 3
PH875 Quantum Mechanics – II (3-0-0) 3
PH876 General Theory of Relativity (3-0-0) 3
PH877 Mathematical Physics – II (3-0-0) 3
PH878 Experimental Techniques (3-0-0) 3

Mandatory Learning Courses (MLC)

PH891 Seminar 1 2
PH892 Seminar 2 2
PH893 Seminar 3 2

PH898 M.Sc. Project (3rd sem) 8
PH899 M.Sc Project (4th sem) 12

12-1-2012
विभागाध्यक्ष / H.O.D
भौतिकी विभाग / Physics Dept.
राष्ट्रीय प्रौद्योगिकी संस्थान कर्नाटक सुरत्कल
NITK SURATHKAL
मंगलूर - 575 025, कर्नाटक
MANGALORE - 575 025, KARNATAKA

Submitted to Dean (Academic)
12-6-2012

DEPARTMENT OF PHYSICS

PH 701 Mathematical Physics-I (3 1 0) 4

Vector calculus, Kronecker delta, Levi-Civita tensor; Curvilinear coordinates. Gradiant, Divergence, Curl, Laplacian. Linear Vector spaces. Bra-Ket notation orthogonality, Gram-Schmidt orthonormalization, Linear operators. Hilbert space. Differential equations - singular points, Frobenius method, examples. Orthogonal functions. Legendre, Bessel, Laguerre and Hermite differential equations and their solutions, Legendre, Bessel, Laguerre and Hermite functions and their properties, Spherical Harmonics. Beta and gamma functions. Properties of beta and gamma functions. Fourier Series, Fourier integral; Laplace transform. Solving differential equations using LT. Fourier Transform, Convolution Theorem, Solving differential equations using FT. Green's function technique to solve differential equations. Functions of complex variables: Analytic functions, power series, Taylor series, poles, Cauchy's theorem, Cauchy's integral formula and simple applications of calculations of residues.

G. Arfken & H. J Weber - "Mathematical Methods for Physicist", Acad. Press 6th edition (2005)

E. Kreyszig - "Advanced Engineering Mathematics, Wiley Eastern, 5th edition (1991)

K. F. Riley, M.P. Hobson and S. J. Bence, Mathematical methods for physics and engineering",; Cambridge University Press. (2004)

Jon Mathews and R.L.Walker, Mathematical Methods of Physics", second edition, , Addison-Wesley Publishing Com. (1969)

PH702 Classical Mechanics (3 1 0) 4

Mechanics of a particle, Mechanics of a system of Particles, Constraints, D'Alembert's Principle and Lagrange's Equation, Velocity Dependent Potentials and the Dissipation Function, Variational Principles and Lagrange's Equation- Hamilton's Priciple, Conservation Theorems and Symmetry Properties: The Central Force Field Problem-Reduction to Equivalent One Body Problem, The Virial Theorem, The Kepler Problem – Inverse Square Law Force, Scattering in a Central Force Field. The Hamilton Equation of Motion – Legendre Transformations and the Hamilton Equations of Motion, Cyclic Coordinates and Conservation Theorems, The Principle of Least Action. Canonical Transformations. Poisson's Brackets and Other Canonical Invariants. Hamilton – Jacobi Theory and Action Angle Variables- The Hamilton Jacobi Equation for Hamilton's Principle Function. Special theory of relativity. Lorentz transformation equations, length contraction, time dilation, velocity addition formula, mass-energy equivalence, invariance of spherical wave.

Herbert Goldstein, Charles Poole and John Safco,. Classical Mechanics by (Third Edition) Pearson Education.

Arthur Beiser, Concepts of Modern Physics by (sixth edition).

David Morin, Introduction to Classical Mechanics with Problems & Solutions, Cambridge Univ. Press, 1st Ed. 2009.

R.G. Talwale and P.S. Puranik, Introduction to Classical Mechanics, , Tata McGraw Hill, 8th reprint 1987.

PH703 Quantum Mechanics-I (3 1 0) 4

Introduction to Quantum Mechanics. Planck's radiation law, Photoelectric effect, Compton effect, Stability of atoms and Atomic spectra, Wave particle duality: matter waves. de Broglie's hypothesis, Wave packets. Uncertainty Principle. Concept of wave function, Probability density function and statistical interpretation. Expectation values. General formalism of Quantum Mechanics : Fundamental postulates of wave mechanics. Commutation relations. Operators. Degeneracy, Dirac-delta function. Schrödinger wave equation. Applications of Schrödinger's time-independent wave equation : Bound states of a particle in a square well potential ($E < 0$) and non-localized states ($E > 0$) with Examples. Barrier problems and Tunnel effect. (STM) (Qualitative). Exactly soluble eigen value

problems : Simple harmonic oscillator. Angular momentum and parity. Schrödinger Wave Equation in three dimensions. The Hydrogen atom, Separation of variables and quantum numbers. Energy spectrum. Space quantization, Electron probability density. Variational method. WKB Approximation.

P. M. Mathews and K. Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw-Hill (1977).
R. Shankar, Principles of Quantum Mechanics, Plenum Press, New York, 1980.
A. K Ghatak, S. Lokanathan, Quantum Mechanics: Theory and Applications, Macmillan India Ltd (1984).

PH 704 Electronics (3 1 0) 4

Network theorems. Mesh and node analysis, Star-Delta conversion. Passive Circuits. Diode Circuits. rectifier circuits, diode clipping and clamping circuits, Zener diodes, DC power supplies. Bipolar Junction Transistors: transistor as an amplifier, CB, CE and CC configuration and characteristic curves, limits of operation. BJT Biasing circuits: Operating (Q-point), load-line analysis, fixed bias, emitter stabilized bias, voltage divider bias, bias stabilization. BJT Small signal analysis: Two port analysis of a transistor amplifier, h-parameter and r_e parameter model. Field Effect Transistors (FETs): Construction and characteristics of JFETs, pinch-off voltage, I-V characteristics, FET small signal model, FET biasing, common-source and common drain low-frequency amplifiers. MOSFETs. Operational Amplifiers: Difference amplifier, basic operational amplifier and its features, inverting and non-inverting amplifier, summer, integrator, differentiator, comparator. Introductory Digital Electronics: Boolean theorem and identities, OR, AND, NOT, NOR, NAND, Ex-OR/Ex-NOR gates, de Morgan's theorem.

David A. Bell, Electronic Devices and Circuits, Oxford Univ. Press, 5th Ed (2008).
Jacob Millman & Christos Halkias, Integrated Electronics, Tata McGraw Hill, 6th Reprint.
Nashelsky & Boylstad, Electronic Devices & Circuit Theory, Prentice Hall India, 7th Ed.
A.P. Malvino, Electronics Principles, McGraw Hill, 6th Ed.

PH 751 Condensed Matter Physics – I (3 1 0) 4

Crystal structures : Space Lattice, Unit Cell & Lattice Parameters, Crystal Systems, Bravais Lattices, Crystal Structure & Packing Fraction, Planes in Crystals. Reciprocal lattice, Diffraction of X-rays by Crystal Planes, Bragg's Law, Structure Factor, Principle of diffraction Techniques, Brillouin zones. Lattice vibrations: The 'Balls and Springs' Model of a Harmonic crystal, Normal Modes of a One-dimensional Monatomic Chain: The Periodic Boundary Condition, Salient Features of the Dispersion Curve. Normal Modes of One-dimensional Diatomic Chain. Atomic cohesion and crystal binding. Classical Free Electron Theory of Metals, Theory of Thermal conductivity. Franz law. Quantum Free Electron Theory, Optical properties of solids. Exitons, Polarons, Color Centers, Luminescence and Photoconductivity. Imperfections in Crystals. , Point Defects, Thermodynamics of Point Defects, Schottky Defects, Frenkel Defects, Line Defects. Dislocations.

Ali. Omar, Elementary Solid State Physics, Addison Wesley.
C. Kittel, Introduction to solid state physics, Wiley Eastern Edition, 5/e, 1998.
L.V. Azaroff, Elements of X-ray crystallography, McGraw Hill publication, 1986.
A.J. Dekker, Electrical Engineering Materials, Prentice Hall of India, 1990

PH 752 Atomic and Molecular Spectroscopy (3 1 0) 4

Absorption and emission of radiation, Basic elements of practical spectroscopy. Microwave spectroscopy : The rotation of molecules, The rigid diatomic molecule. Intensity of spectral lines, Effect of isotopic substitution. Non-rigid rotator. Rotational spectra and Analysis. Infrared Spectroscopy : The vibrating diatomic molecule, The diatomic vibrating rotator,. Raman spectroscopy : Introduction pure rotational Raman spectra, Polarization of light and the Raman Effect, Vibrational- Raman spectra, Structure determination from Raman and Infra-red spectroscopy. Electronic spectroscopy of atoms : Electronic angular momentum, Many-electron atoms, The angular momentum of

many-electron atoms, Photoelectron spectroscopy, Zeeman effect, The influence of nuclear spin. Elements of Spin Resonance Spectroscopy. Nuclear magnetic resonance spectroscopy (NMR), Electron spin resonance spectroscopy (ESR).

J. Michael Hollas, Basic Atomic and Molecular Spectroscopy, RSC, Cambridge, UK, 2002
Colin N. Banwell and Elaine McCash, Fundamentals of Molecular Spectroscopy (Fourth Edition) Tata McGraw – Hill Pub. Co. New Delhi (1994)
Gerhard Herzberg, Atomic Spectra and Atomic Structure, Dover publications, New York, 1945

PH 753 Statistical & Thermal Physics (3 1 0) 4

Probability - Discrete and continuous probability distribution, mean, variance, random walk problem Binomial, Gaussian, Poisson distribution functions. Review and statistical basis of Thermodynamics: Macroscopic and Microscopic systems, Phase Space, laws of Thermodynamics, Entropy, Specific heat, Thermodynamic potentials-Helmholtz free energy, Gibbs free energy, chemical potential, Maxwell's equations. Ensembles, Partition Function and Applications. Classical and quantum mechanical distribution functions: Equilibrium distribution, properties of distribution functions. Quantum statistical mechanics-postulates of Quantum statistical mechanics, Phase space, Density matrix, Liouvllie's theorem. Black body thermal radiation: Bose-Einstein statistical distribution function, Density of states for photons in a cavity. Fermi-Dirac distribution function: Fermi gas in metals, Fermi energy, Thermal properties of solids - Specific heat. Application to degenerate Fermi-gas. Elements of Phase Transitions. Phase diagram, Van der Waals gas, I and II order phase transitions, formation of

R K Pathria, Statistical Mechanics, Butterworth-Heinemann, Indian Edition
F. Rief, Fundamentals of Statistical and Thermal Physics, Tata-McGraw Hill
Palash B. Pal, An Introductory Course of Statistical Mechanics, Narosa, 2008
C. Kittel and Kroemer Thermal Physics

PH 754 ELECTROMAGNETIC THEORY (3 1 0) 4

Electrostatics: Review of vector calculus, Calculation of E-field, Calculation of electrostatic potential, Laplace and Poisson's equation, Multipole expansion of potential, Magnetostatics: Ampere's law and Biot-Savart's law, Computation of magnetic fields, Vector & scalar potentials, Magnetic dipole, Magnetostatics: Ampere's law and Biot-Savart's law, Computation of magnetic fields, Vector & scalar potentials, Magnetic dipole, Electrodynamics: Maxwell's equations, Wave equations and its solutions, Reflection & Refraction at a plane boundary, Potential formulation; Scalar and vector potentials, Waveguides: Rectangular waveguides, Modes of propagation, Resonant cavities and their modes, Dipole radiators, Covariant formulations of Maxwell's equations.

David J. Griffiths, Introduction to Electrodynamics, Prentice Hall, 3rd Ed.
John D. Kraus, Electromagnetics, McGraw Hill, 4th Ed.
M.N. O. Sadiku, Elements of Electrodynamics, 2nd Ed., Oxford Univ., 1995.
R.P. Feynman, Lectures on Physics, Vol. 2, Narosa Publ. Pvt. Ltd. 2002.

PH 801 Condensed Matter Physics-II (3 1 0) 4

Band theory of solids : Bloch theorem, Kronig - Penney Model, Energy Bands of Solids, The Motion of Electrons in One Dimensions according to the Band Theory. Effective Mass of Electron. Dielectric properties: Polarization in static field – static dielectric constants, polarization mechanisms, Monatomic gases, polyatomic gases, the Internal Field (local field) in dense dielectrics, Clausius - Mosotti equation, ferroelectric materials, polarization catastrophe, hysteresis, Domain theory, Applications, pyroelectric, piezoelectric materials, Behavior of Dielectrics in alternating fields, complex dielectric constant, Clausius-Mosotti equation, Dipolar relaxation, Dielectric loss and loss angle. Magnetism – Classification of Magnetic Materials Dia, Para, Ferro, Antiferro and Ferri Magnetic Materials, Weiss

molecular field theory. Superconductivity : Meissner effect, type I and II superconductors, Theoretical interpretation of BCS Theory. High temperature superconductors and Applications.

Ali Omar, Elementary Solid State Physics, Pearson Education
C. Kittel, Introduction to Solid State Physics, Wiley Eastern edition, 1998.
A. J. Dekker, Electrical Engineering Materials,Prentice Hall of India, 1990.
B D Culity & CD Graham, Introduction to Magnetic Materials, Wiley

PH 802 Nuclear Physics (3 1 0) 4

General properties of Nuclei-Nuclear radius, charge distribution, Deuteron problem- Nuclear force, Nuclear binding energy, Electric and magnetic moments, Nuclear models, Radioactivity and Nuclear decay-Alfa decay-Gamow's theory, Beta decay-Fermi's theory, Gamma decay, Nuclear Reactions. Scattering theory (Qualitative)-Rutherford scattering, Nucleon-nucleon scattering, partial wave analysis, Cross section, Optical theorem. Experimental Nuclear Physics-Detectors-Gas and solid state detectors, Mass spectroscopy, Particle accelerators. Particle physics-Elementary particles, classification, Quark model.

Kenneth Krane, Nuclear Physics, John Wiley and Sons, latest edition
Griffith, Introduction to Elementary Particles
R.D. Evans, Atomic Nucleus
Kaplan, Nuclear Physics

PH 860 Cryogenics & Low Temperature Physics (3 0 0) 3

Low temperature production and measurement, liquefaction of gases, Joule-Thomson effect, Heat transfer mechanisms, Cryostats, Superfluidity, B-E Condensation, Quantum Hall effect, Superconductivity, BCS theory, High Tc Superconductors, Josephson effect, SQUIDS, Metal insulator transitions, Superconducting magnets for Accelerators, NMR and Detectors, Laser cooling,

M.S.Thyagi, Electronic devices and circuit theory, Prentice Hall India, 1991 ,54/e.
S.M.Sze, Semiconductor Devices - Physics and Technology, John Wiley,200.

PH861 Vacuum Technology and Thin Films (3-0-0) 3

Behaviour of gases at low pressures, sources of gas release into vacuum systems – adsorption and desorption, diffusion, permeation, dynamic gas balance and ultimate pressure obtainable in vacuum system. Production of vacuum – different pumps, rotary pump, diffusion pump, turbomolecular pump. Sorption pump, cryopump, getter pumps. Measurement of reduced pressures – McLeod's gauge, thermal conductivity gauges, thermo couple gauge and pirani gauge, ionization gauges – triode gauge, Bayard-Alpert gauge, Klopfer gauge, Helmer gauge, Lafferty magnetron gauge, Penning gauge, Redhead gauge. Thin films – Methods of preparation- vacuum evaporation, sputtering electro deposition, chemical methods, liquid phase epitaxy, molecular beam epitaxy. Measurement of film thickness – optical interference technique, gravimetry, quartz crystal oscillator, other magnetic and electrical methods.

Maissel L.I and Glang R: Hand book of thin film technology, McGraw Hill Publications
Brunner Jr.W.F and Batzer T. H : Practical vacuum techniques, Reinhold Publications.

PH 862 Semiconductor Devices and Applications (3 0 0)3

p-n junction – basic fabrication steps, abrupt junction and linearly graded junction, varactor diode, heterojunction. Breakdown – zener and avalanche breakdown, applications. Bipolar transistor, static characteristics, CE amplifier, frequency response and switching of BJT, hetero-junction bipolar transistors. Field effect transistor – JFET characteristics, MOSFET fundamentals, MOS memory structures – DRAM, SRAM and non volatile memory, Power

-RBO-

MOSFET. Microwave diodes – Tunnel diode, IMPATT diode, transferred electron devices, quantum effect devices, hot electron devices. Photonic devices – Light emitting diodes, visible and infra-red LEDs, organic LED, semiconductor laser, photo-detector, solar cells.

Sze S.M : Semiconductor Devices – Physics and Technology, John Wiley Publication 2002

Tyagi M.S : Introduction to Semiconductor Materials and Devices, John Wiley Publication 2003

PH 863 Materials Preparation Techniques (3-0-0) 3

Crystal growth equilibrium, classification of growth processes, growth from solution, growth by chemical reaction, growth from meta stable phases, kinetics of crystal growth, crystal growth by solid-solid equilibria, liquid-solid equilibria, zone melting techniques, other crucible-less techniques, other liquid-solid methods, dendrite growth,crystal growth by vapour-solid equilibria, growth from liquid solution-aqueous-solution growth, hydrothermal growth, molten-salt growth, composite growth methods, vapour-liquid-solid-growth

R.A. Laudise,The Growth of Single Crystals - Prentice Hall, 1970. Crystal

J.C.Brice, Crystal Growth Processes - John Wiley, 1986.

PH 864 Physics of Thin Films (3 0 0) 3

Thin film deposition and Layered structures, Surface energies, diffusion in solids, stress in thin films, Surface Kinetic Processes, Homo-epitaxy : Si and GaAs, Hetero-epitaxy and Super-lattices, Electrical and Optical Properties of hetero-structures, Quantum wells, Schottky Barriers and Interface Potentials, Inter-diffusion, Thin film reactions, Morphological changes in thin films.

King-Ning Tu, James W. Mayer and Leonard C. Feldmann, Electronic Thin Film Science for Electrical Engineers and Materials Scientists, Macmillan Pub. Co, New York, 1987

PH 865 Crystallography (3 0 0) 3

Production and properties of x-rays, the characteristic spectrum, detection of x-rays, Geometry of crystals, Crystal systems, Symmetry in crystals, Crystal structure, Diffraction, Bragg's Law, Intensities of diffracted beam, Structure Factor, Lorentz Factor, Absorption Factor, Intensities of Powder Pattern Lines, Measurement of X-ray Intensity, Laue method, Rotating Crystal method. Moving Film method, Powder method, X-ray Diffractometer.

B.D. Cullity. Elements of X-ray Diffraction

Leonid.V.Azaroff. Elements of X-ray Crystallography,

PH 866 Magnetism & Superconductivity (3 0 0) 3

Introduction to Magnetism : Magnetic fields, Magnetic Forces and Magnetic materials. Diamagnetism, Langevin's theory of Diamagnetism, Quantum theory of Paramagnetism. Ferromagnetism and antiferromagnetism-Ferromagnetic order, Curie point and exchange integral, Magnons, Neutron Magnetic Scattering, Neutron Diffraction, Magnetic storage Devices. Nanomagnets- multi domain and single domain particles, super paramagnetism. Magnetic superlattices, Giant Magnetoresistance, Hysteresis Measurement-Vibrating sample magnetometer(VSM), Magnetic Force Microscopy(MFM). Introduction to Superconductivity, Properties of Superconductors, thermodynamics of superconducting transition, London Equations, Coherence Length, BCS theory. Flux Quantization, Types of Superconductors, High Temperature Superconductors, DC and AC Josephson effect, Quantum Interference, Superconducting Quantum Interference Device(SQUID)

C. Kittel, Introduction to solid state physics, Wiley Eastern Edition

David Jiles, Introduction to Magnetism and Magnetic Materials Taylor & Francis.

B D Cullit,y Introduction to Magnetic Materials, Wiley

PH 867 Nanomaterials (3 0 0) 3

Introduction to Nanoscience and Nanotechnology. Scaling laws. A few Examples from mechanics, electricity and magnetism, optics, etc. Size dependence of particles. Excitons. Electron confinement, quantum wells, quantum wires and quantum dots. Preparation of quantum nanostructures. Semiconductor heterostructures, Confining excitons. Single electron tunneling phenomena. Photonic properties of nanomaterials. Quantum dot lasers. Optical tweezers. Methods of synthesis, properties and characterization of nanomaterials. Applications.

Charles P. Poole Jr. & Frank J. Owens, Introduction to Nanotechnology, Wiley, Interscience (2003)

Rogers, Pennathur and Adams, Nanotechnology :Understanding small system. CRC Press, Taylor and Francuis Group, New York. (2008)

PH 868 Characterization Techniques of Materials (3 0 0) 3

Metallographic techniques, Optical microscopy, X-ray diffraction, Crystal size, lattice parameter measurements, Phase diagram determination, Electron microscopy – TEM, SEM, STEM, Thermal analysis, Electric and Dielectric measurements.

Edington J. , Practical electron microscopy, Vol – 1

B.D. Cullity, Elements of X-ray diffraction

PH 869 Fiber Optics (3 0 0) 3

Optical fiber types, Ray propagation in optical fibers, Fiber fabrication, Modes of propagation in optical fibers, Dispersion and attenuation in optical fibers, Fiber couplers and power splitters, fiber interferometers, PM fibers, Fiber Bragg gratings, Fiber amplifiers, Nonlinear effects in optical fibers.

A.K.Ghatak and K.Thyagarajan, An Introduction to Fiber Optics, McGraw Hill

G.P.Agrawal, Nonlinear Fiber Optics, Academic Press

PH 870 LASERS AND APPLICATIONS (3 0 0) 3

Electromagnetic interaction of matter; spontaneous absorption and emission, Einstein's coefficients. Process, techniques and properties of stimulated emission, concept of population inversion and techniques. Properties of laser radiation, coherence length and coherence time. Line broadening mechanisms, Doppler broadening, spectral hole burning. Optical resonators, resonator configuration, stable and unstable resonators, laser threshold and gain equations. Laser Models - Two level, three level and four level lasers, rate equations. Types of lasers: Gas lasers (He-Ne, CO_2, Ar, N_2, etc.) Types of lasers: Solid-state lasers (Ruby, Nd:YAG, Erbium –doped lasers, etc.). Semiconductor lasers; single and multiple quantum well lasers, VCSELS, Semiconductor laser amplifiers. Dye-lasers and their properties. Q-switching and Mode-locking in lasers. Applications of lasers: Scientific and Technical, Commercial, Industrial, Military, Medical, etc. Classification of lasers and laser safety.

A. Ghatak and K. Thyagarajan, Optical Electronics, Cambridge Univ. Press (1989)

J. T. Verdeyen, Prentice Hall, 2nd Ed. (1993)

A. Yariv, Photonics : Optical electronics in Modern Communications, Oxford University (2006)

PH 871 NONLINEAR OPTICS (3 0 0) 3

Introduction to nonlinear optics and description of the nonlinear optical processes. Review of wave propagation in isotropic and anisotropic media; index ellipsoid. Nonlinear susceptibility of classical anharmonic oscillator; time domain descriptions of Optical Nonlinearities. Wave description of nonlinear optical interactions; coupled wave equations, phase matching, material requirements. Quasi-phase matching, sum-frequency generation, second harmonic generation (bulk and powder-SHG). Difference frequency generation, optical parametric amplification and

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oscillation. Laser induced damage assessment in materials. Nonlinear optics of interfaces. Third order nonlinear optical processes; optical phase conjugation; Intensity dependent refractive index; nonresonant electronic nonlinearities, nonlinearities due to molecular orientation, optical bistability and power limiters. Nonlinear optical properties of liquid crystals and conjugated polymers. Nonlinear optical effects in optical fibres. Stimulated Brillouin scattering, Stimulated Rayleigh scattering. Stimulated Raman scattering, Ultrafast optics.

R.W. Boyd, Nonlinear Optics, Academic Press, Press (2006)

Saleh & Teich, Fundamentals of Photonics, Wiley Interscience 2nd Ed., (2007)

PH872 Integrated Optics (3 0 0) 3

Maxwell's equations, plane waves in dielectric, Poynting vector, Wave propagation in isotropic and anisotropic media. Reflection and refraction of light at a single interface. The slab waveguide: metal waveguide, dielectric slab waveguide, weak-guidance approximation, symmetric and asymmetric waveguide analysis. Waveguide mode orthogonality. Fabrication techniques of optical waveguides and case studies. Optical characterization of waveguides, material and modal dispersion. The channel waveguide – fabrication and methods of analysis of channel waveguides. Channel waveguide integrated optic devices. Coupled mode devices – couplers and waveguide gratings, other coupled mode interactions. Semiconductor optoelectronics. Crystal optics, electrooptic effect, linear and quadratic electrooptic effect, transverse and longitudinal electrooptic effect, amplitude and phase modulators. Acousto-optic effect, Bragg diffraction and acousto-optic modulators

A. Ghatak and K. Thyagarajan, Optical Electronics, Cambridge Univ. Press (1989)

R. Syms and J.Cozens, Optical Guided Waves and Devices; McGraw Hill (1992)

PH 873 Optical Interferometry (300)3

Theory of partial coherence, auto- and cross-correlation functions, Michelson Interferometer, Length and density measurement, Jamin's interferometer, measurement of RI of gases, Fabry-Perot interferometer, Interference spectroscopy, Multi-layer mirrors, Sagnac interferometers, Optical Gyroscopes.

M.Born and Wolf, Principles of Optics, Pergamon Press

Ajoy Ghatak, Optics, 3rd ed.,Tata McGraw Hill, 2005.

E.Hecht, Optics, 2nd ed., Addison Wesley Publ. Co.,1987.

PH 874 Optical Data Processing (3-0-0) 3

Diffraction theory of image formation; Fresnel and Fraunhofer Diffraction, Fourier transforming and Imaging properties of lenses, Frequency analysis of optical imaging systems, spatial frequency filtering, Spatial light modulators, Diffractive optical elements, Optical data processing, Analog optical processors.

J W Goodman, An Introduction of Fourier Optics McGraw Hill M.Born and Wolf, Principles of Optics, Pergamon Press.

PH 875 QUANTUM MECHANICS- II (3 0 0) 3

Orbital and spin angular momentum. Eigen states and eigenvalues of angular momentum. Clebsch-Gordon coefficients. Irreducible tensor operators and the Wigner-Eckart theorem. Perturbation Theory: Time independent first order and second order perturbation theory (non degenerate case). Degenerate case-removal of degeneracy. Stark effect. Variational method. Time dependent approximation, Fermi-Golden rule. Adiabatic and sudden approximations. Systems of identical particles. Second quantization, occupation number representation. Non-relativistic scattering theory. Scattering amplitude and cross section. Born approximation. Partial wave analysis. The optical theorem. Elements of relativistic quantum mechanics. The Klein-Gordon equation. The Dirac equation. Dirac matrices, spinors. Positive and negative energy solutions, physical interpretation. Nonrelativistic limit of the Dirac equation.

J.J. Sakurai, Modern Quantum Mechanics, Benjamin / Cummings (1985).
P.M. Mathews and K. Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw-Hill(1977).
R. Shankar, Principles of Quantum Mechanics, 1984. Plenum Press, New York.

PH 876 General Theory of Relativity (3 0 0) 3

Theory of Gravitation: Review of the special theory of relativity and the Newtonian theory of gravitation. Non-Euclidean space time. General Relativity and gravitation, desirable features of gravitational theory. Principle of equivalence and principle of covariance. Tensor Analysis. Christoffel symbols, covariant derivative of tensors, intrinsic derivative, covariant derivative of second order, Curvature tensor and its symmetric properties, Riemann Christoffel tensor, Ricci Theorem, Ricci tensor, Einstein tensor, Local inertial coordinate system, Bianchi identities, Contracted Bianchi identities. Geodesic and Field Equations. Riemannian metric. The LeviCivita tensor, Dual tensor. Parallel transport and Lie derivative. The first integral of geodesic and types of geodesics. Geodesic deviation and geodesic deviation equation. Einstein field equation and its Newtonian approximation, Energy momentum tensor of perfect fluid. Crucial Tests of General Relativity, Schwarzschild Solution. Einstein field equations under spherical symmetry. Schwarzchild Space time

Weinberg. S, Gravitation and Cosmology Wiley, 1972
Wald R. M, General Relativity, University of Chicago Press, 1984.
J V Narlikar, Lectures on General Relativity and Cosmology, McMillan, 1978
R Adler, M. Bazin and M Schiffer, Introduction to General Relativity, McGraw Hill, 1975.

PH 877 Mathematical Physics-II (3 0 0) 3

Complex variables : Laurent series. Branch points and Branch cuts and Integrals involving them; analytic continuation. Contour integrals. Principal value integrals, Hilbert transforms. Greens functions and applications to electromagnetic fields. Integral equations, Volterra and Fredholm. Transforming and an ODE into an integral equation; method of successive approximation and Nueman series, resolvent kernel. Group theory: Representation of a group – reducible and irreducible. Discrete groups, Schur's Lemma, Orthogonality theorem; Lie algebra and groups, Examples of SU(2) and O(3). Vectors and Tensors: Rotations, Lorentz transformations and General coordinate transformations, Covariant and Contravariant objects.

G. Arfken & H. J Weber, "Mathematical Methods for Physicist", Acad. Press 6th edition,(2005) E. Kreyszig, "Advanced Engineering Mathematics, Wiley Eastern, 5th edition (1991)
K. F. Riley, M. P. Hobson and S. J. Bence , Mathematical methods for physics and Engineering", Cambridge University Press.(2004)
Jon Mathews and R. L. Walker, Mathematical Methods of Physics", Second Edition, Addison-Wesley Publishing Com. (1969)

PH 878 Experimental Techniques (3 0 0) 3

An Introduction to Absorption and Emission Spectroscopy - Ultraviolet and Visible Absorption Methods, Fluorescence and Phosphorescence Spectrophotometry, Flame Emission and Atomic Absorption Spectrometry, Atomic emission spectroscopy, Infrared Spectrometry, Raman Spectroscopy, X-Ray Methods, Radiochemical Methods, Chemical analysis of surfaces, Thermal Analysis.

Willard, Merritt, Dean & Settle, Instrumental Methods of Analysis- (Sixth Edition) CBS Publ. & Distrib., New Delhi.

M.Sc. in Chemistry

Suggested plan of Study

Sl. No	Semester			
	I	II	III	IV
1	CY701	CY751	CY801	CY893
2	CY702	CY752	CY802	CY898
3	CY703	CY753	CY803	*Elective 3*
4	CY704	CY754	CY804	*Elective 4*
5	CY705	CY755	CY805	*Elective 5*
6	CY706	CY756	CY892	
7	CY707	CY757	*Elective 1*	
8		CY891	*Elective 2*	

Program Core (Pc) Courses 63

CY 701 Analytical Chemistry I	(3-1-0) 4
CY 702 Inorganic Chemistry I	(3-1-0) 4
CY 703 Organic Chemistry I	(3-1-0) 4
CY 704 Physical Chemistry I	(3-1-0) 4
CY 705 Spectroscopy	(3-1-0) 4
CY 706 Inorganic Chemistry Practical I	(0-0-6) 3
CY 707 Organic Chemistry Practical I	(0-0-6) 3
CY 751 Analytical Chemistry II	(3-0-0) 3
CY 752 Inorganic Chemistry II	(3-1-0) 4
CY 753 Organic Chemistry II	(3-1-0) 4
CY 754 Physical Chemistry II	(3-1-0) 4
CY 755 Spectroscopy-Applications in Chemistry	(3-1-0) 4
CY 756 Inorganic Chemistry Practical II	(0-0-4) 2
CY 757 Physical Chemistry Practical I	(0-0-4) 2
CY 801 Inorganic Chemistry III	(3-0-0) 3
CY 802 Organic Chemistry III	(3-0-0) 3
CY 803 Physical Chemistry III	(3-0-0) 3
CY 804 Organic Chemistry Practical II	(0-0-4) 2
CY 805 Physical Chemistry Practical II	(0-0-6) 3

Credit Requirements

Category	Minimum credits to be earned
Program Core (Pc)	63
Elective Courses (Ele)	15
Major project (MP)	9
Mandatory learning courses (MLC)	03
Total	90

Elective (Ele) Courses 15

CY 860 Environmental Chemistry	(3-0-0) 3
CY 861 Organometallic Chemistry	(3-0-0) 3
CY 862 Bio-Inorganic Chemistry	(3-0-0) 3
CY 863 Novel Inorganic Compounds	(3-0-0) 3
CY 864 Chemistry of Nano-materials	(3-0-0) 3
CY 865 Chemistry of Macro Molecules	(3-0-0) 3
CY 866 Chemistry of Natural Products	(3-0-0) 3
CY 867 Medicinal Chemistry	(3-0-0) 3
CY 868 Synthetic methods in Organic Chemistry	3-0-0) 3
CY 879 Molecular Modeling & Drug design	(3-0-0) 3
CY 870 Surface Chemistry	(3-0-0) 3
CY 871 Chemical & Electrochemical Energy Systems	(3-0-0) 3
CY 872 Bio-Physical & Photo Chemistry	(3-0-0) 3
CY 873 Nuclear & Radiation Chemistry	(3-0-0) 3
CY 874 Solid State Chemistry	(3-0-0) 3
CY 875 Corrosion Science	(3-0-0) 3
CY 876 Advanced Organic Synthesis	(3-0-0) 3
CY 877 Biochemistry	(3-0-0) 3
CY 878 Supra-molecular Chemistry	(3-0-0) 3
CY 879 Green Chemistry	(3-0-0) 3
CY 880 Computational Chemistry	(3-0-0) 3
CY 881 Applied Organic Chemistry	(3-0-0) 3
CY 882 Polymer Chemistry & Catalysis	(3-0-0) 3

CY 898 Major Project (MP) 9

Mandatory Learning courses (MLC) 3

CY891 Seminar 1	1
CY892 Seminar 2	1
CY893 Seminar 3	1

DEPARTMENT OF CHEMISTRY

M.Sc. (Chemistry) Course Contents

CY701 Analytical Chemistry I (3-1-0) 4

Analytical Chemistry: Basic concepts, statistical treatment of errors. Sampling in analysis: Various techniques of sampling, statistical criteria, storage of samples. Gravimetric analysis: Basic concepts, conditions of precipitation, co- & post-precipitation. Volumetric analysis: acid-base, redox, precipitation, complexometric titrations. Electroanalytical methods: conductometry, potentiometry, Ion selective electrodes in potentiometry,,potentiometric titrations, Polarography and voltammetry, DC & AC polarography, Rapid scan polarography, Pulse polarography, Square wave polarography, Cylic voltammetry, Chronopotentiometry, Stripping analysis, Amperometric titrations, Coulometry, Thermal methods of analysis: TG, DTG, DTA and DSC, Nuclear methods of analysis. Nephelometry, Turbidometry

S.M. Khopkar, Basic Concepts of Analytical chemistry, 2002.
D. A. Skoog and D. M. West, Principles of Instrumental Analysis, Holt Rinahart Winston, New York, 1988.
D.A. Skoog, F.J. Holler, S.R. crouch, Instrumental Analysis, 2008.
R.D. Braun, Introduction to Instrumental Analysis, Parma Book, 2006.
G.H. Jeffery, J. Bassett, J. Mendhem, R.C. Denney, Vogel's Textbook of quantitative Chemical analysis, ELBS, 5th Edn, 1989.

CY702 Inorganic Chemistry - I (3-1-0) 4

Modern Periodic Table: Periodic properties, trends and underlying principles. Chemical Bondings: Ionic bond, Lattice energy. Covalent bond: Molecular orbital theory for diatomic and polyatomic molecules, hybridization, VSEPR theory. Metallic bond: Band theory, semiconductors and insulators. Hydrogen bond. Structure of solids: Symmetry in crystal systems, radius ratio, shapes of crystals, solid state defects, physical properties of solids. Symmetry of molecules: Elements of symmetry and symmetry operations.

F. A. Cotton & G. Willkinson, 6th edn., Advanced Inorganic Chemistry, Willey Eastern, 1977.
H. T. Huheey, 3 rd Edition, Inorganic Chemistry, Principles of Structure and Reactivity, 2002.
M. F. C. Ladd, Structure and bonding in solid state chemistry, Chickester, Ellis, Horwood, 1974.

CY703 Organic Chemistry – I (3-1-0) 4

Basic concepts: Review of inductive, electromeic, resonance, hyperconjugative and field effects, tautomerism. H-bonding, EDA complexes, inclusion compounds, Crown ethers, Catenanes, Rotaxanes. Hammett & Taft equations. Aromaticity: Huckel's rule, Organic acids and bases, factors affecting. Reaction mechanisms, structure and reactivity, organic reactions & reagents. Kinetic and thermodynamic control, transition states, Hammond postulate, kinetic isotope effect. Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, nitrenes, carbenes, benzynes. Determination of reaction mechanism. Aliphatic/aromatic nucleophilic, electrophilic, substitution reactions, types & mechanisms, Additions to C-C and Carbon-Heteroatom multiple bonds, Elimination reactions, Free radical reactions, Formation and hydrolysis of esters, Base catalyzed condensation reactions. Photochemistry: Jablonski diagram & quantum yield, Photochemical synthesis.

F. A. Carey & R. I. Sundberg, Advanced Organic Chemistry, Part A and B, 3rd. edition, Plenum Press, New York, 1990.
J. March, Advanced Organic Chemistry, Reactions, Mechanism & Structure, 4th edition, Wiley Interscience, 1994
R. H. Lowry and K. S. Richardson, Mechanism and Theory in Organic Chemistry, 2nd edition, Harper and Row Publishers, New York, 1981.
P. Sykes, A Guide book of Mechanisms in Organic Chemistry, Orient-Longman, 1985.
I. L. Finar, Volume 1, The Fundamental Principles, 6th edition, ELBS, England, 1989.
N. S. Isaacs, Physical Organic Chemistry, ELBS, Longman, UK, 1987.
I. Ninomiya, T. Naito, Photochemical Synthesis, Academic Press, New York, 1989.

CY704 Physical Chemistry – I (3-1-0) 4

Quantum Chemistry: de-Broglie concept, uncertainly principle, Schroedinger equation, Solution of Schroedinger wave equation for exactly solvable problems. Chemical Thermodynamics: Combined form of 1st and 2nd laws, Maxwell's relations. Third law of thermodynamics, Gibbs-Duhem equation Quantitative treatment of Le-Chatelier principle. Chemical Dynamics: Transition state theory and the Arrhenius equation. Marcus theory of electron transfer. Reactivity and selectivity principles. Lindemann, Hinshelwood and RRKM theories. Fast reaction Techniques, Complex reactions, Opposing, parallel, consecutive reactions. reactions in solution: Ionic reactions-kinetic salt and solvent effects. Substituent effects on the rates of reactions-Hammett and Taft equations, linear free energy relationships. Isokinetic temperature. An introduction to kinetic isotope effect. Theories of reaction rates: Collision

theory of reaction rates, steric factor, activated complex theory and its applications to reactions in solution. Phase equilibria.

G.M. Barrow-Physical Chemistry (V Edition) McGraw Hill international Series 1988.
A.W. Atkins Physical Chemistry ELBS (IV Edition) Oxford University Press, Oxford 1990.
J. Rajaram and J.C. Kuriacose, Thermodynamics for Students of Chemistry, Shobanlal Nagin Chand Co. 1986.
Donald A Mc Quarrie, Quantum Chemistry, University Science Books, Mill Valley, California, 1983.
A.K. Chandra, Introductory Quantum Chemistry (Tata MeGraw Hill) 1994.
K.J. Laidler, Chemical Kinetics. (Harper and Row) 1987.
S.K. Jain, Kinetics of Chemical Reaction (Vishal Publications) 1982.

CY 705 Spectroscopy (3-1-0) 4

Atomic and Molecular Spectroscopy: Interaction of electromagnetic radiation with matter, absorption and emission spectroscopy, molecular spectra, quantization of energy levels and transitions. Microwave-Spectroscopy: Spectra of diatomic & polyatomic molecules, rigid and non-rigid rotator models, isotope effects, Stark effect, instrumentation. IR spectroscopy: Vibrational frequency, modes of vibration, instrumentation, FTIR. Raman spectroscopy: Basic principles, Raman Spectroscopy. Electron transition spectroscopy: Beer-Lambert's law, chromophores, oxochromes, instrumentation. Molecular luminescence spectroscopy, Chemiluminescence, Fluorescence, and phosphorescence, Atomic absorption spectroscopy. X-ray diffraction techniques: X-ray structural analysis.

D. A. Skoog and D. M. West, Instrumental methods of Analysis, Holt Rinahart Winston, New York, 1988.
C. N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy, Tata-McGraw Hill, 1994.
Barrow, Introduction to Molecular Spectroscopy.
Drago, Physical Methods in Inorganic Methods.
Walker & Straughan, Spectroscopy, Vol I and II.
J. M. Hollas, Modern Spectroscopy, Wiley Chichester, 1992.

CY706 Inorganic Chemistry Practicals – I (0-0-6) 3

Qualitative analysis salts/salt mixture of less familiar elements – semimicro analysis. Analysis of commercially important ores, alloys, limestone, cement. Instrumental methods, pH-metry, potentiometry, polarography, amperometry, spectrophotometry, turbidimetry, flame photometry, atomic absorption spectrometry, fluorometry, coulometry, and electrogravimetry. Statistical analysis of data.

G. Srehla, Vogel's Textbook of Macro and Semimicro Qualitative Inorganic Analysis, Orient Longman, New Delhi, 1982.
J. Basset, R.C. Denny, C.H. Jeffery and J. Mendham, Vogel's Textbook of Quantitative Inorganic analysis, including Elementary Instrumental Analysis, ELBS, London, 1978.

CY707 Organic Chemistry Practicals – I (0-0-6) 3

Separation of binary mixture & their qualitative analysis. Quantitative determination of sugars, amino acids, phenols, carboxylic acids, amides, amines, esters, aldehydes, ketones, alcohols, enols, unsaturation, urea. Single step organic synthesis involving isolation, purification and characterization of organic compounds with an emphasis on reactions like alkylation, acetylation, nitration, halogenations, sulphonation, cyclization, diazotization, condensation, oxidation, reduction, hydrolysis, dehydration, elimination etc. with stress on different techniques set-up (air-sensitive, moisture sensitive etc).

B. S. Furniss et al., Vogel's Text Book of Practical Organic Chemistry including Qualitative Organic Analysis, Longman-ELBS, London, 1989.
F .G. Mann and B. C. Saunders, Practical Organic Chemistry, ELBS, England, 2001.
Cheronis et al, Semimicro Qualitative Organic Analysis, Wiley-Eastern, New Delhi, 1964
R. L.Shriner, The Systematic Identification of Organic Compounds-A Lab. Manual, Wiley, 1969.
In-house laboratory manual with the experimental procedures and relevant literature.

CY 751 Analytical Chemistry II (3-0-0) 3

Surface analysis: Electron spectroscopy, XPS, Augur electron spectroscopy, Photo acoustic spectrometry. SEM, TEM, Scanning probe microscopy – AFM, SECM, SCM and SMFM Separation methods: Solvent extraction, Chromatography – theoretical concepts, migration parameters, column efficiency, separation factor, Paper and thin layer chromatography, Partition chromatography, Gas chromatography, HPLC, Exclusion chromatography, Gel permeation chromatography, Super critical fluid chromatography & Extraction capillary electrophoresis.

D.A. Skoog, F.J. Holler, S.R. crouch, Instrumental Analysis, 2008.
R.D. Braun, Introduction to Instrumental Analysis, Parma Book, 2006.
G.H. Jeffery, J. Bassett, J. Mendhem, R.C. Denney, Vogel's Textbook of quantitative Chemical analysis, ELBS, 5th Edn, 1989
Ray F. Egerton, Physical principles of electron microscopy- An introduction to TEM, SEM and AEM, Springer Publicatons, 2005.

Wells O. C, Scanning Electron Microscopy, McGraw-Hill, New York 1974.
Weilie Zhou, Robert P. Apkarian, Zhong Lin, Wang, and David Joy, Fundamentals of Scanning Electron Microscopy, Springer publications, 2004.

CY752 Inorganic Chemistry – II (3-1-0) 4

s-Block elements: General discussions, synthesis and properties of their compounds. Alkali and alkaline earth metal complexation, cyclic and crown ethers, cryptands and calixeranes, biological significance. p-Block elements: Chemistry of non metals: B, Si, P & S, E-H, E-X, E-O & E-N bond types in different molecules, Chemistry of boranes, silanes, phosphanes and sulphanes, borazine, boron and silicon nitrides. P-N & S-N rings: synthesis, structure, bonding and reactions of N3P3Cl6 & S4N4. Halogen and noble gas chemistry: Inter halogens, pseudo halogens, ionic oxy halogen species. Organometallics of s- and p- block elements Specific reagents of main group elements: synthesis, structure and reactions Industrial Chemicals: Urea and poly phosphates, production, structure, property, analysis and uses.

F.A.Cotton and G. Wilkinson, Advanced Inorganic Chemistry, 6th edn., J. Wiley. New York, 1999.
D.F.Shriver, P.W. Atkins and C.H. Lingford, Inorganic Chemistry, ELBS, 1990
W.L. Jolly, Modern Inorganic Chemistry, Mcgraw-Hill, 1985.
N.N.Greenwood and E.A. Earnshaw, Chemistry of Elements, Pergmann Press, 1984.
H. T. Huheey, 3rd edition, Inorganic Chemistry, Principles of Structure and Reactivit, 2002.

CY753 Organic Chemistry - II (3-0-0) 4

Stereochemistry: Molecular symmetry, optical activity, enantiomers, absolute configurations, threo & erythro isomers, resolution, diastereomers, stereospecific, stereoselective, asymmetric synthesis, chiral reagents, Cram's and Prelog's rules. Optical activity in biphenyls, allenes, spiranes. Stereochemistry of N, S & P compounds. Conformational analysis: Cycloalkanes and decalins, Winstein-Eliel equation, Curtin-Hammett principles, CD, ORD, Cotton effect. Geometrical Isomerism: monocyclic compounds, fused ring systems, determination of configuration. Classification & general mechanistic treatment of nucleophilic, electrophilic & free radical rearrangement reactions. Mechanism, stereochemistry & applications of important named reactions. Pericyclic reactions: Woodward-Hoffmann correlation approach, FMO approach, cycloadditon reactions. Photochemistry: Principles, photo-dissociation, -reduction, -isomerization, -cyclization. Norrsih type-I & Type-II reactions. Photochemical cells.

E.L.Eliel, Stereochemistry of Carbon Compounds, Tata McGraw Hill, New. Delhi, 1994.
D.Nasipuri, Stereochemistry of Organic Compounds -Principles and Applications, Second edition, Ch-2-6, Wiley Eastern, New Delhi, 1994.
J. March, Advanced Organic Chemistry-Reactions, mechanisms & structure, Wiley, NY, 2000.
K. K. Rohatgi-Mukherjee, Fundamental of Photochemistry, New Age International (P) Ltd, New Delhi, 1986.
P.S.Kalsi, Stereochemistry, Conformation and Mechanism, Wiley Eastern, New Delhi, 1993.
F.J.Carrey & R.J.Sundberg, Advanced Organic Chemistry-IV-Ed. Part A & B, Kluwer Academic/Linum publishers, 2001.
N.Carruthers, Modern Methods of Organic Synthesis, Cambridge University, 1996.

CY754 Physical Chemistry – II (3-1-0) 4

Quantum Chemistry: Need of approximate methods in quantum chemistry. Approximate methods of solving Schroedinger equation for problems of chemical interest, Introduction to SCF methods. Born-Oppenheimer aproximations. Statistical Thermodynamics: Concept of distribution. M-B, B-E and F-D statistics. Partition functions, Irreversible Thermodynamics:. Entropy production. Electrokinetic phenomena. Photochemistry: Quantum yield and its determinations, experimental methods in photochemistry, Frank- Condon principle, hotophysical pathways- Jablonski diagram, Radiationless transitions and selection rules. Flourescence and phosphorescence- theory and applications. Applications in synthesis, solar energy utilization and atmospheric chemistry.

B.C. McClelland, Statistical Thermodynamics, Chapman and Hall, London 1973.
M.C. Gupta, Statistical Thermodynamics, Wiley Eastern Limited 1993.
N. D. Smith, Elementary Statistical Thermodynamics, Plenum Press, New York 1982.
Donald A Mc Quarrie, Quantum Chemistry, University Science Books, Mill Valley, California, 1983.
P.W. Atkins, Molecular Quantum Chemistry Mechanics, 2nd edition, Oxford University Press, 1983.
I. N. Levine, Quantum Chemistry, 5rd edition, Allyn and Bacon, Boston, 2000.
A.K. Chandra, Introductory Quantum Chemistry (Tata MeGraw Hill) 1994.
K.K. Rohatgi Mukherjee, Fundamentls of Photochemistry, Wiley Eastern Ltd., New Delhi, 1978.

CY755 Spectroscopy, Applications in Chemistry 3-1-0) 4

Electronic transitions, spectra of conjugated systems, complexes. Woodward–Fieser rules, H-bonding & solvent effects. IR spectroscopy: fingerprint region, functional group analysis, H-bonding & solvent effects, overtones, Fermi

resonance, analysis of organic & coordination compounds. Raman spectroscopy and its applications. NMR spectroscopy: ^{1}H NMR, Zeeman splitting, δ, spin-spin coupling, Instrumentation & experimental techniques. J values, 1st & 2nd order patterns. AB, AX & ABX systems, stereochemical assignments. 2D NMR, MRI. ^{13}C NMR: Theory & applications. NMR of B, Al, Si, F & P nuclei-structure and dynamics of inorganic molecules. ESR spectra of organic free radicals, metal complexes, spin traps. NQR spectroscopy: Townes-Dailey theory, techniques, instrumentation, applications. Mass spectroscopy: Instrumentation, molecular ions, meta-stable, isotope abundance, fragmentation types & rules. McLafferty rearrangement. ESI-MS & MALDI-MS. Single crystal X-ray analysis.

Silverstein, Bassler&Monnill, Spectrometric Identification of Organic Compounds, Wiley, 1981.
W.Kemp, Organic Spectroscopy-3rd Ed. Pagrave Publishers, New York, 1991.
P.S.Kalsi, Spectroscopy of Organic Compounds-3rd Ed. New Age, New Delhi, 2000.
E.A.V. Ebsworth, D.W.H.Ranklin and S.Cradock: Structural Methods in Inorganic Chemistry, Blackwell Scientific, 1991.
J. A. Iggo: NMR Spectroscopy in Inorganic Chemistry, Oxford University Press, 1999.
D. H. Williams, I. Fleming, Spectroscopic methods in organic chemistry, Tata McGraw Hill. 1988.
Jack D. Dunits, x-ray analysis & the structure of organic molecules, Wiley-VCH; 2 edition, 1996.
Lund A., Shiotani M., Principles and Applications of Electron Spin Resonance, Springer Verlag, 2008.

CY756 Inorganic Chemistry Practicals – II (0-0-4) 2

Preparation and analysis of metal complexes, characterization by spectroscopic, magnetic, thermal and x-ray diffraction methods. Instrumental methods, pH-metry, potentiometry, polarography, amperometry, spectrophotometry, turbidimetry, flame photometry, atomic absorption spectrometry, fluorometry, coulometry, and electrogravimetry. Solvent extraction and Chromatography.

G. Pass and H. Sutcliffe, Practical Inorganic Chemistry, Chapman-Hall, London, 1974.
D.M. Adams and J.B. Raynor, advanced Practical Inorganic Chemistry, John Wiley and Sons, New York, 1967.
G. Brauer (Ed.) Handbook of Preparative Inorganic Chemistry, 2nd Edition, Vols. I and II, Academic Press, New York, 1963.

CY757 Physical Chemistry Practicals – I (0-0-4) 2

Experiments involving Thermodynamics, Kinetics, Electrochemistry, Spectroscopy, Crystal structure analysis, Photo chemistry, Refractometry and Polarimetry.

D.P. Shoemaker and C.W. Garland, Experiments in Physical Chemistry, McGraw-Hill, New York 1962.
F. Daniels, J.W. Williams, P. Bender, R.A. Alberty and C.D. Cornwell, Experimental Physical Chemistry, McGraw-Hill 1962.
J. B. Yadav, Advanced Practical Physical Chemistry, 1989.

CY801 Inorganic Chemistry – III (3-0-0) 3

Chemistry of transition and inner transition metals. Co-ordination Chemistry: Theories of metal ligand bonding-Valence Bond Theory, crystal field theory, spectrochemical series. Jahn-Teller distortion. Pi-bonding and molecular orbital theory. Spectral properties of complexes, term symbol of d^n ions. Orgel and Tanaber-Sugano diagrams. Charge transfer transitions. Magnetic properties - types of magnetic behavior, crystal field and M.O. interpretation, spin-orbit coupling, Gouy and Faraday methods. Isomerism in complexes. Kinetics and Mechanism of Ligand displacement and addition reactions in octahedral and square planar complexes. Coordination Chemistry of Inner transition Metals. Metal ions in biological systems.

S.F.A. Kettle, Coordination Chemistry, ELBS & NELSON, 1969.
F.A. Cotton and Wilkinson, Advanced Inorganic Chemistry, 3rd Edn., Wiley Eastern, 1977.
J.E. Huheey, Inorganic Chemistry, Principles of Structure and Reactivity, 4th Edn., Harper & Row, 1978.
H.J. Emeleen and A.G. Sharpe, Modern Aspects of Inorganic chemistry, 4th Edn.,ELBS & Roultedge of Kegan Paul, 1978.
P. Powell, Principles of Organometallic Chemistry, ELBS, Chapman and Hall, London, 1988.

CY802 Organic Chemistry – III (3-0-0) 4

Carbohydrates: Configuration & conformation, derivatives of monosaccharides-ethers, esters, acetals, ketals, deoxysugars, structure of disaccharides-maltose, cellobiose and sucrose, structures of cellulose, chitin, starch, glycogen & their degradation. Amino acids, peptides & proteins: peptide bond synthesis, solid phase peptide synthesis-Merrifield method. Structure of proteins. Lipids: Classification, structure, properties and synthesis of fatty acids. Heterocyclic compounds: Classification, nomenclature, structure, reactivity, synthesis and reactions of three, four, five and six membered heterocycles, fused heterocycles and bridged heterocycles. Mesoionic compounds. Synthesis of bases of nucleic acids. Structural elucidation caffeine. anthocyanins & flavones. Natural products: Alkaloids - isolation and

methods of structural determination, physiological activity, taxonomy, biogenesis. Terpenoids – isolation, isoprene rule, structural elucidation. Carotenoids. Steroids. Vitamins - B-complex & K group.

J. Joule & G. Smith, Heterocyclic Chemistry, Van-Nostrand, ELBS, 1978.
Acheson, An Introduction to the Chemistry of Heterocyclic Compounds, Wiley –Eastern, 1987.
Katritzky & Rees, Comprehensive Heterocyclic Chemistry, Vol-I-VI Ed. Pergamon, 1984.
O.P.Agarwal, Chemistry of Natural Products – Vol-I & II, Goel Gorakhpur, 1985.
I. .L.Finar, Organic Chemistry-Vol-I-II, Longmann ELBS London, 2000.

CY 803 Physical Chemistry – III (3-0-0) 3

Ionics-Ion-solvent interactions, ion–dipole theory of solvation, ion-ion interaction, Debye-Huckel theory, Mass transport in solution. - Fick's laws of diffusion, Limiting current density, Einstein relation between diffusion coefficient and ionic mobility, Electrodics-electrical double layer, electrode-electrolyte interface. Thermodynamics of electrified interfaces, electrocapillary curves, Lipmann equation, surface excess, structure of electrified interfaces: Helmholtz-Perrin, Guoy-Chapman and Stern models. Applications of electrochemistry in supercapacitor study, Corrosion and corrosion prevention- Thermodynamics and kinetics of corrosion, methods of prevention to corrosion, theories of overvoltage, mixed potential theory, polarization, exchange current density, Pourbaix diagram, Buttler-Volmer equation, kinetics of electron transfier, Stearn Geary equation, Tafel equation, Linear polarization, Electrochemical impedance spectroscopy and its applications.

J. O'M Bockris and AKN Reddy, Modern Electrochemistry- Vol. I & II, Plenum Press; N.Y.
Nestor Perez, Electrochemistry and Corrosion, Kluwer Academic Publishers, 2001.
Jones, D.A., Principles and prevention of corrosion, Prentice Hall, New York. (1996).
Mars G Fontana, Corrosion engineering, McGraw Hill Book Co., New York, Third edition(1987).
Bard, A. J., and Faulkner, L. R., Electrochemical Methods, second edition, Wiley, New York

CY804 Organic Chemistry Practicals – II (0-0-4) 2

Separation of ternary mixtures. Quantitative determination of nitrogen, carbon, hydrogen, sulphur of an organic compound. Multi-step organic synthesis involving dyes, polymers, drugs etc. Isolation and characterization of natural products like caffeine, vitamin C, casein, lipase etc. Extraction of oil from oil seed and characterization of oil. Purification of organic compounds by column and TLC, steam distillation, fractional distillation etc. Protein analysis and antimicrobial studies.

P. R. Singh et al, Experimental Organic Chemistry–Vol. I & II TMH New Delhi, 1981.
Dey & Sitaraman, Laboratory Manual in Organic Chemistry, Allied-New Delhi, 1992.
B. S. Furniss et al., Vogel's Text Book of Practical Organic Chemistry including Qualitative Organic Analysis, Longman-ELBS, London, 1989.
F .G. Mann and B. C. Saunders, Practical Organic Chemistry, ELBS, England, 2001.
Cheronis et al., Semimicro Qualitative Organic Analysis, Wiley-Eastern, New Delhi, 1964.
In-house laboratory manual with the experimental procedures and relevant literature.

CY805 Physical Chemistry Practicals – II (0-0-6) 3

Experiments involving instruments like Electrochemical work station, IR spectrometer, UV-Visible spectrophotometer, NMR spectrometer, TGA and DSC, Stripping analysis, Ionometers, Cyclic voltammetry experiments, Surface area analysis.

D.P. Shoemaker and C.W. Garland, Experiments in Physical Chemistry, McGraw-Hill, New York 1962.
F. Daniels, J.W. Williams, P. Bender, R.A. Alberty & C.D. Cornwell, Experimental Physical Chemistry, McGraw-Hill 1962.
Journal of Chemical Education, latest issues.

CY860 Environmental Chemistry (3-0-0) 3

Environmental segments, hydrological, oxygen, nitrogen, phosphate and sulphur cycle. Atmosphere: Composition, structure and evolution. Chemical and photochemical reactions in the atmosphere. Water resources, complexation in natural and waste water, microbially mediated aquatic reactions. Composition of Lithosphere, water, air, organic and inorganic components in soil. Nitrogen pathways, NPK, wastes and pollutants in the soil. Air pollutants: CO, NO_X, Hydrocarbons, Photochemical smog, SO_2, acid rain, particulates, radioactivity. Tropospheric chemistry. Water pollution, aquatic environment, water pollutants, pesticides insecticides, detergents, sediments , radioactive materials and thermal pollution. Wastewater treatment. Water quality parameters and standards, sampling, monitoring techniques and methodology, pH, Conductivity, DO, NH_3, Cl^-, F^-,CN^- , S^{2-}, SO_4^{2-}, PO_4^{3-}, B, Si, metals and metalloids, hardness, COD,BOD,TOC, phenols, pesticides, surfactants, tannin, lignin and E.coli. Chemical toxicology: Toxic chemicals in the environment, Biochemical effects of As, Cd, Pb, Hg, CO, NOx, SO_2,O_3, PAN,CN, pesticides and carcinogens.

A. K. De, Environmental Chemistry, New Age Intl.(Pvt) Ltd.,1998.
C.N.Sawyer, P.L.McCarty and G.F. Parkin, Chemistry for Environmental Engineering, McGraw-Hill, 1990.

– 850 –

S.E.Manahan, Environmental Chemistry, Lewis Publishers, 2001.
JO'M – Bockris (ed), Environmental Chemistry, Plenum Press, New York, 1977.

CY861 Organometallic Chemistry (3-0-0) 3

Organometallic compounds: Classification, nomenclature, and characteristics. General properties, 18-electron rule, Organometallic compounds of main group elements: Preparative routes, structural aspects, multiple bonded silicon and arsenic organometallics, cyclopentadienyl complexes. Organometallic compounds of transition elements: Synthesis and structural properties, reactivity. Transition metal pi-complexes with unsaturated organic molecules: Preparation, properties and structural features. Applications of organometallics in oxidative addition, oxidative coupling, reductive elimination, insertion and deinsertion reactions, hydrogenation, carbonylation, hydroformylation, isomerization, aasociative substitution, dissociative substitution, activation of C-H bond, polymerization of olefins, Fischer-Tropsch process, Water Gas Shift reaction. Biological applications and environmental aspects.

R. C. Mehrotra and A.Singh: Organometallic Chemistry, New Age International, 1999.
J. P. Collman, L. S. Hegedus, J.R.Norton and R.G.Finke: Principles and Applications of Organotransition Metal Chemistry, University Science Books, 1987.
F.A.Cotton and G.Wilkinson: Advanced Inorganic Chemistry (5th Ed.), Wiley,1991.
R.H.Crabtree: Organometallic Chemistry of Transition Metals, Wiley, 1998.

CY862 Bioinorganic Chemistry (3-0-0) 3

Metal ions in biology, their vital role in the active-site structure and function of metallo-proteins and-enzymes. Heme and non-heme systems with one, two or multi-metal centers, photosynthesis and photosystem II. Peptide and nucleotide hydrolytic enzymes, metal environment, electronic, magnetic and redox properties; functions such as electron-transfer, O_2-binding, reduction to O_2^-, O_2^{2-} and O^{2-}species their utilization of hydroxylation and epoxidation, fixation of N_2, water – oxidation (Oxygen Evolving Complex) reactions. Synthetic models: design and strategy in the synthesis of ligand-metal complexes, redox potentials, reactivity of O_2, CO, NO, N_2; mechanistic aspects, high-valent metal-oxo systems. Interaction of metal ions with nucleotides and peptides, hydrolysis of phosphate and amide groups and related mechanistic aspects. Metal based drugs, environmental applications and toxic effects (Cd, Hg, Cr) of metal ions. Physical techniques in bioinorganic chemistry: Spectrophotometry X-ray crystallography, paramagnetic, NMR and EPR spectroscopy, magnetic susceptibility, electrochemistry.

Lippard, S.J. and Berg, J.M. Principles of Bioinorganic Chemistry, University Science Books, 1994.
Fenton, D.E., Biocoordination Chemistry (Chemistry Primer 26), Oxford University Press, 1996.
Bertini, I., Gray, H.B.; Lippard, S.J.; Valentine, J.S.,Bioinorganic Chemistry, University Science Books, 1994.
Siegel, H. and Spiro, T.G. Metal ions of Biological Systems, Mercel-Dekker, 1980 to present.
Lehniger, A.L., Principles of Biochemistry, New York, Worth, 1982.

CY863 Novel Inorganic Compounds (3-0-0) 3

Acylic & cyclic systems from the periodic table - Inorganic homo-& heterocycles, saturated and unsaturated ring systems, π-electron precise and rich rings, synthesis, structure and reactivity. Metallocycles - Chemistry of individual rings. Cages & clusters of Elements, structural variety, properties and implications of borides, carbides, silicides, nitrides, phosphides, oxides and sulphides of transition elements, multiple bonds and cluster variety of transition metals. Higher boranes, carboranes and metalloboranes. Inorganic polymers, definition, variety and merits, P, Si, S, N & O based polymers. Polyphosphazenes, polythiazenes, poly siloxanes and poly silanes.

D.M.P. Mingos and D.J.Wales, Introduction to Cluster Chemistry, Prentice Hall, New Jersey, 1990.
N.N. Greenwood and E.A. Earnshaw, Chemistry of Elements, Pergamann Press, 1984.
F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, John Wiley, New York 1988.
I. Haiduc & D.B. Sowerby (Eds,), Inorganic Homo-and Heterocycles, Vols. 1 & 2, Acad. Press, (NY), 1987.
J.E. Mark, R. West & H.R. Allcock, Inorganic polymers, Acad. Press, (NY) 1992.

CY 864 Chemistry of Nano-Materials (3-0-0) 3

Nanomaterials, size effects, general methods of preparation, sol-gel, solvothermal, sonochemistry and other novel methods of synthesis, properties and uses of nanomaterials. Growth of nanocrystals in solution, structure, energy bands, methods of measuring properties, particle size determination. Characterization techniques, metal and semiconductor nanocrystals, oxide nanoparticles, nanotubes and nanowires, nanostructured polymers and composites, nanoporous materials, nanocatalysts, industrial applications.

C.N.R. Rao, A. Muller and A.K. Cheetham,(Eds.), The Chemistry of Nanomaterials, Vol I & II, Wiley – VCH, 2004.
C.N.R. Rao, A. Muller and A.K. Cheetham,(Eds.), The Chemistry of Nanomaterials, Wiley – VCH, 2004.
Charles P Poole Jr and Frank J Owens, Introduction to Nanotechnology, Wiley Interscience, 2003.

CY865 Chemistry of Macromolecules (3-0-0) 3

Classification, nomenclature, molecular weights, glass transition, degree of crystallinity, morphology, and viscosity, structure-property relationship. Mechanisms and methods of polymerization – mechanism of step polymerization, reactivity. Chain polymerization, radical polymerizations (INIFERTER, ATRP, RAFT, SET). Living polymerizations. Ziegler-Natta & metathesis polymerizations. Polymer characterization. Polymer degradation. Polymer membranes. Conducting polymers. Liquid crystal polymers. Polyelectrolytes. Polymer adhesives. Hydrogels. Polymers for high temperature applications. Biodegradable polymers. Drug delivery polymers. Polymers for electronics.

R. J. Young and P. A. Lovell, Introduction to Polymers, 2nd Edition, Chapman and Hall, 2002.
F. W. Billmeyer, Textbook of Polymer Science, 3rd Edition, John Wiley, 1994.
G. Odian, Principles of Polymerization, Fourth edition, Wiley-Interscience, 2004.
L. H. Sperling, Introduction to Physical Polymer Science, Wiley- Interscience, 1986.
M. Rubinstein and R. A. Colby, Polymer Physics, Oxford University Pres
J.R. Fried, Polymer Science & Technology, Prentice Hall of India Pvt. Ltd, New Dehli, 1999.

CY866 Chemistry of Natural Products (3-0-0) 3

Alkaloids: Detailed study of structural elucidation, stereochemistry, rearrangement, synthesis & biogenesis of alkaloids - Papaverine, Adrenaline, Ephedrine, Piperine, Cinchonine, Quinine, Morphine and Reserpine. Terpenoids: Structural elucidation & synthesis of terpenoids - Geraniol, Menthol, α-pinene, Camphor; Farnesol, Zingiberene and α-Santonin. Diterpenoids: Abietic and Pimaric & Gibberillic acid;.Triterpenoids: Squalenes Steroids: Blanc's rule, Barbier-Wieland degradation. Chemistry of Cholestrol, Ergosterol, Vitamin-D & bile acids. Steroidal hormones: Oestrone, esterdiol, estriol & their relationship. Progesterone, androsterone & testosterone, Synthesis of cortisone, cortisol & aldosterone. Transformations in steroids and hormones. Porphyrins: Synthesis, structure and degradation products of Hemoglobin and Chlorophyll.

G.R Chatwal, Natural Products Chemistry Vol-I & II. Himalaya Bomba), 1990.
O.P.Agarwal, Chemistry of Natural Products – Vol-I & II, Goel Gorakhpur, 1985.
I.L.Finar, Organic Chemistry-Vol-I-II, Longmann ELBS London, 2000.

CY867 Medicinal Chemistry (3-0-0) 3

Concepts, definitions, pharmacophores, pharmacodynamics and pharmacokinetics, drug targets: proteins, enzymes, receptors, nucleic acids, miscellaneous targets. Enzymes & receptors. ADMET of drugs: Factors affecting ADMET. Drug discovery, design and development, drug optimization, structure-activity relationships, strategies in drug design. QSAR and combinatorial synthesis. Optimization of drug-target interactions and access to drug targets. Pro-drugs and drug delivery systems. Illustration of drug development through specific examples. Drug resistance, Drug synergism and combination therapy. General anesthetics, anticonvulsants, antipyretic, analgesic, cardiovascular, NSAIDs, antfertility, anticancer & antiviral drugs.

Ashutoshkar, Medicinal Chemistry, New Age Int. Publications, 2005.
G.R.Chatwal, Medicinal Chemistry, Himalaya Publishing House, 2002.
Patric, G. L., An Introduction to Medicinal Chemistry. 3rd ed.; Oxford University Press: 2005.
Silverman, R. B., The Organic Chemistry of Drug Design and Drug Action. 2nd ed.; Academic Press: 2004.
Williams, D. A.; Lemke, T. L., Foye's Principles of Medicinal Chemistry. 5th ed.; Wolters Kluwer Health (India) Pvt. Ltd.: 2006.

CY868 Synthetic Methods in Organic Chemistry (3-0-0) 3

Oxidation: oxidation of alcohols & ketonic compounds, oxygen addition at C=C, oxidative cleavage of C=C bonds, transition metal oxidants. Ozonolysis. Reduction: catalytic, metal hydride and electron transfer reductions, hydrogenolysis. Retrosynthetic analysis: Principles & terminology, disconnection approach, C-X disconnections, one group C-C & two group C-C disconnections. Protecting groups: protection & deprotection of hydroxy, carboxyl, carbonyl, carboxy amino groups & carbon-carbon multiple bonds. Organometallic reagents: Organolithium, organo magnesium, organo zinc, organo cadmium & organo mercury compounds. Silicon and boron containing reagents. Peterson reaction. Hydroborations, organoboranes. Organotin compounds: synthesis & utility of organostannanes.

F. A. Cary and R. J. Sundberg, Advanced Organic Chemistry, Part A and B, 5th Edition, Springer, 2009.
S. Warren, Organic Synthesis, The disconnection Approach, John Wiley & Sons, 2004.
J. Tsuji, Palladium Reagents and Catalysts, New Perspectives for the 21st Century, John Wiley & Sons, 2003.
Advanced Organic Chemistry- Reaction Mechanisms, Reinhard Bruckner, (Academic press, USA), 2005.
N.Carruthers, Modern Methods of Organic Synthesis, Cambridge University, 1996.

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CY869 Molecular Modelling & Drug Design (3-0-0) 3

Computational programming. Use of standard analysis softwares to solve chemistry problems. Structure & dynamics of bio-molecules, protein folding, free energy, molecular simulation, dielectric continuum method, empirical approaches, rate constants, docking, elucidation of enzyme structure & mechanism, kinetic, spectroscopic, isotopic & stereo-chemical studies. Molecular modeling, conformational analysis. Chemical models & mimics for enzymes, receptors, peptides, carbohydrates, nucleic acids & other bioactive molecules, catalytic antibiotics. Design, synthesis & evaluation of enzyme inhibitors. Structure based drug design, physical & chemical based factors associated with biological activities. Computer aided drug design: Captopril, substrate based drug design of protease inhibitors. Qualitative and quantitative structure-activity relationships.

Richard B. Silvermann, The Organic Chemistry of Drug Design and Drug Action, Academic Press, 1992.
O. M. Dean, Molecular Foundations of Drug-Receptor interactions, Cambridge Univ. Press, Cambridge, 1987
T. A. Clark, A Handbook of Computational Chemistry, Wiley, New York 1985.
D. DeCamp, R. Ogden, I. Kuntz and C. S. Craik in: Protein Engineering Principles and Practice (Eds J. L. Cleland and C. S. Craik) Wiley-Liss Inc New York, 1996.

CY870 Surface Chemistry & Catalysis (3-0-0) 3

Basic concepts Surface vibrations, General aspects Surface reactions, co-adsorption, poisoning and promotion effects, model reactions, Chemistry of bimetallic surfaces, surface alloys, surface segregation and faceting. Surface modification. Techniques for surface investigation. BET theory of adsorption. Determination of surface area (BET equation). Surface films on liquids (Electro-kinetic phenomenon) Catalytic activity at surfaces. Preparation of catalyst and their behavior: Role of supports, preparation & structure of supports, silica, alumina, silica-alumina, zeolities, carbon manufacture, catalyst size & shape, pre-treatments. Deactivation process, sintering, poisoning & catalyst fouling. Definition of performance criteria of catalysts: Activity, selectivity, temperature response, catalyst life. Homogeneous and heterogeneous catalysis, mechanisms and applications ocillatory reactions, autocatalysis.

A.W. Adamson, Physical Chemistry of Surfaces, 6th ed., New York, Wiley, 1997.
John. C. Vickerman(ed.), Surface Analysis: The principal Techniques, John Wiley & Sons, New York, 1997.
G.A. Somorjai, Introduction to Surface Chemistry and Catalysis. , John Wiley, New York, 1994.
K. Christmann, Introduction to Surface Physical Chemistry, (Topics in Physical Chemistry Vol. 1), Springer-Verlag, 1991.
R. Pearce and W.B. Patterson, Catalysis and Chemical Process: (Blackie & Sons.), 1981.

CY871 Chemical & Electrochemical Energy Systems (3-0-0) 3

Available energy options, their advantages and disadvantages. Fossil fuels petroleum natural gas and coal-Origin, processing and production of value added products-available current conversion technologies. Nuclear Energy Principles of Fission – Fission reactors. Electrochemical power sources-theoretical background on the basis of thermodynamic and kinetic considerations. Primary electrolyte cells, Secondary electrolyte cells- classification based on electrolyte type temperature of operation on the basis of electrodes. Fuel cells-classification-chemistry of fuel cells. Solar energy conversion devices-photovoltaic cells-photoelectrochemical cells-semiconductor electrolyte junctions photocatalytic modes for fuel conversion process-photobiochemical options. Hydrogen as a fuel production (Thermal, electrolysis, photolysis and photo-electrochemical) storage and applications of hydrogen storage. Other methods of energy conversion processes especially in the form of storage as chemical energy.

C.A. Vincent Modern Batteries, Edward Arnold, 1984.
R. Narayan and B. Viswanathan, Chemical and Electrochemical Energy systems, University Press 1998.
K. Sriram, Basic Nuclear Engineering, Wiley Easter, 1990.
D. Linden Hand book of batteries and fuel cells, McGraw Hill Book Company 1984.
T. Ohta, Solar Hydrogen energy systems, Peragamon Press, 1979.

CY872 Biophysical & Photochemistry (3-0-0) 3

Bioenergetics, Biopolymer Interactions: Forces involved in biopolymer interactions-electrostatic changes and molecular expansions, hydrophobic forces, dispersion force interactions. Thermodynamic of Biopolymer solutions: Osmotic pressure, membrane equilibrium muscular contractions and energy generation in mechano-chemical system. Cell Membrane and Transport, Photochemical region and energy associated with uv-vis region, laws of photochemistry, Stem Volmer analysis, photofragmentation, photoaddition, type I and type II cleavages, photosubstitution, cycloaddition, Paterno-Buchi reaction, isomerization and rearrangement reactions, photoreduction and photooxidation reactions, singlet oxygen and chemiluminescence, Photoinduced electron transfer reactions (PET), application to solar energy conservation and artificial photosynthetic systems. Photochemical substitution in transition metal complexes.

K.K. Rohatgi Mukherjee, Fundamentls of Photochemistry, Wiley Eastern Ltd., New Delhi, 1978
N.J. Turro, Modern Molecular Photochemistry, The Benjamin Cummings Publishing Co. Ltd. Menlo Park 1978.
J. Clavert and J. Pitts, Photochemistry, John Wiley, New York 1965.
D.O. Ccowan and R.L. Drisko, Elements or Organic Photochemistry Plenum Press, New York 1976.
I. Ninomiya and T. Naito, Photochemistry Synthesis, Academic Press, New York 1989.

- 25 -

CY873 Nuclear & Radiation Chemistry (3-0-0) 3

Nuclear chemistry: Basic concepts, Radioactivity and Nuclear Decay- Radioactive decay modes of natural and artificial nuclides, Radiation Detection and Measurement: Experimental techniques in the assay of radioactive isotopes. Radiation Detectors-Gas filled (ion chambers, proportional and GM counters), scintillation and semiconductor detectors (NaI-Tl and Ge(Li), HPGe solid state detectors)- important features of detectors. Nuclear Reactions and Radiosotopes ,Nuclear reactos-Power(types and basic features) and breeder reactors. Production and separation methods of radioisotopes and labeled compounds, Szilard-Chalmer process , Radiation Sources and Dosimetry-units, radiation dose, radiation chemical yield and primary dosimeters, Health and Safety Aspects: Biological effects of radiation, Hazards in radiochemical work. Radiation protection, permissible exposure doses, radioactive waste management.

Friedlander, Kennedy Macias & Miller, Nuclear and Radiation Chemistry, Wiley, 1985.
H J. Amikar, Essential of Nuclear Chemistry, Wiley Eastern, 1987.
Spinks and Woods, An Introduction to Radiation Chemistry, Wiley, New York, 1990.
Farhataziz and Rodgers, Radiation Chemistry: Principles and Applications, VCH, Weinheim.
G. F. Knoll,Radiation Detection and Measurement, John Wiley, New York, 1989.

CY874 Solid State Chemistry (3-0-0) 3

Crystal Structure: Crystalline solids, crystal systems space groups: methods of characterising crystal structure-Powder x-ray diffraction, electron and neutron diffraction; Types of close packing-hcp and ccp. Packing efficiency, radius ratios; structure types-NaCl, ZnS, Na_2O, $CdCl_2$, wurtzite, nickel arsenide, CsCl, CdI_2, rutile and Cs_2O, perocskite ABO_3, K_2NiF_4, spinels. Thermal analysis, microscopy and spectroscopy as tools of characterization,Development of free electron theory to band theory of solids-metals and their properties; semiconductors-extrinsic and intrinsic, Hall effect; Insulators-Dielectric, Ferroelectric, Pyroelectric and Peizoelectric properties and the relationship between them. Magnetic properties: Dia, para, ferro, ferri, antiferro and antiferri magnetic types- selected magnetic materials such as spinels, garnets and perovskites. Superconductivity, Amorphous materials-glasses and refractories. New Materials - Zeolites, Fullerenes. Defects-color centers-reactivity.

A.R. West, Solid State Chemistry and its applications John Weley & Sons, Singapore 1984.
Lesley Smart and Elaine Moore, Solid State Chemistry-An Introduction Chapman & Hall, London,1992.
H.V. Keer, Principles of the Solid State, Wiley Eastern Limited, New Delhi, 1993.
D.K. Chakrabarty, Solid State Chemistry, New Age Publication, 1996.
L.Azaroff, An Introduction to Solids. McGraw Hill, 1985.

CY 875 Corrosion Science (3-0-0) 3

Introduction to corrosion,vation and diffusion controlled corrosion, potential-pH diagrams, passivity, different forms of corrosion, Theories of corrosion, Environmental aspects, Atmospheric corrosion monitoring methods, corrosion testing by NDT. Electrochemical AC and DC techniques, Electrochemical noise study, Corrosion control methods, Design aspects in corrosion control, corrosion resistant materials, corrosion inhibitors, Electrochemical methods – cathodic and anodic protection, protective coatings, organic, inorganic and metal coatings. Corrosion control methods in fertilizer, petrochemical and chemical industries.

S.N. Banerjee, An Introduction to Corrosion and Corrosion Inhibition, Oxonian Press Ltd., 2000.
L.L. Shrier, Corrosion Vol I & II, George Nownons Ltd, London, 2nd Edn.,1998.
M.G. Fontana, and N.D. Greens,Corrosion Engineering, McGraw Hill, New York, 3rd Edn., 2004.
H.H. Uhlig, Corrosion and Corrosion Control, Wiley-Interscience, 2002.
D. A. Jones, Principles and Prevention of Corrosion, Prentice-Hall, 2nd Ecn., 1996.

CY 876 Advanced Organic synthesis (3-0-0) 3

Alkylation of enolates & other carbon nucleophiles, control of enantioselectivity, the nitrogen analogs of enols & enolates, enamines & imine anions, reductive amination. 1,3-Dipolar cycloaddition. Modern methods of reduction & oxidation reactions. Organometallic reagents in organic synthesis: Pd, Rh, Ru & Ni based reagents, Suzuki, Stille, Sonogoshira, Heck & Negeshi couplings. Modern methods: Baylis-Hillman, Henry, Nef, Kulinkovich, Ritter, Sakurai, Tishchenko and Ugi reactions. Brook rearrangement. Tebbe olefination. Stereoselective & stereospecific reactions, stereochemical control in acyclic, cyclic & other bicyclic systems. Controlling geometry of double bonds, determination of stereochemistry. Asymmetric synthesis: chiral pool strategy, chiral auxiliaries, chiral reagents and catalysts.

R.E.Ireland, Organic Synthesis, Prentice Hall India, 1969.
Anand, Bindra & Ranganath, Art in Organic Synthesis, Wiley New Delhi, 1970.
M. B. Smith, Organic Synthesis, 2nd Edition, 2005
P.S.Kalsi, Organic Reactions and their mechanisms, New Age, New Delhi, 1996.
S. Warren, Organic Synthesis, The disconnection Approach, John Wiley & Sons, 2004.
I. Ojima, Catalytic Asymmetric Synthesis, 2nd edition, Wiley–VCH, New York, 2000.

R. Noyori, Asymmetric Catalysis in Organic Synthesis, John Wiley & Sons, 1994

CY 877 Biochemistry (3-0-0) 3

Cell structure and functions: Overview of metabolic processes, ATP- the biological energy currency, ETS, metabolism of glucose, amino acids and lipids, Digestion. Biological membranes, Fluid mosaic model of membrane structure. Enzymes: Types, specificity, mechanism & conjugated proteins. Hemoglobin & its function. Carbohydrates: Polysaccharides.. Nucleic acids: Flow of genetic information, nature of genetic code, replication of DNA, transcription and translation, regulation of gene expression. Biochemical reactions of TPP, PLP, Lipoic acid, Vitamins: A, B, C, D, E, K. Coenzyme A. Recombinant DNA technology. Bioinformatics.

Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, Principles of Biochemistry 6th edition, W.H. Freeman & Co., 2006.

D. L. Nelson & M. M. Cox. Lehninger, Principles of Biochemistry 5th edition, W. H. Freeman &Co. 2008.

Outlines of Biochemistry 5th edition 2001- Conn, E.E., Stumpf, P. K. Bruening, G. and Doi, R.H. (John Wiley and Sons).

R.K. Murray et al., Harper's Illustrated Biochemistry, McGraw Hil.

D. Voet et al., Fundamentals of Biochemistry, 2006.

CY 878 Supramolecular Chemistry (3-0-0) 3

Definition. Binding interactions: ion-ion, ion-dipole, dipole-dipole, H-bonding, cation-p, anion-p, p-p, and van der Waals interactions. Synthesis of crown ethers, lariat ethers, podands, cryptands, spherands, calixarenes, cyclodextrins, cyclophanes, cryptophanes, carcerands & hemicarcerands. Host-Guest interactions, pre-organization & complimentarity, lock and key analogy. Crystal engineering: Role of weak interactions. Self-assembly molecules: Design, synthesis & properties, self assembling by H-bonding, metal-ligand interactions & other weak interactions, metallomacrocycles, catenanes, rotaxanes, helicates & knots. Molecular electronic devices, molecular-wires, -rectifiers, -switches, -logic. Supramolecular chemistry to enzyme mimics, ion channel mimics, supramolecular catalysis etc.

J. M. Lehn, Supramolecular Chemistry-Concepts and Perspectives Wiley-VCH, 1995.

P. D. Beer, P. A. Gale, D. K. Smith; Supramolecular Chemistry Oxford University Press, 1999.

J. W. Steed and J. L. Atwood; Supramolecular Chemistry Wiley, 2000.

CY 879 Green Chemistry (3-0-0) 3

Importance, principle and scope. Green reagents-Dimethyl carbonate, polymer supported reagents, peracids, chromic acid. Green catalysts-acid catalysts-oxidation catalysts, basic catalysts, polymer supported catalysts & phase transfer catalysts. Ionic liquids: Reactions in acidic & neutral ionic liquids. Synthetic organic transformation under RT. Microwave assisted reactions in water- Hoffmann elimination, hydrolysis, oxidation, saphonification reactions, Microwave assisted reactions in organic solvents-esterification, Fries rearrangement, Deils-Alder reactions, decarboxylation. Ultrasound assisted reactions. Aqueous reactions: Aldol & Benzoin condensations, Diels-Alder & Knovenegol reactions, Solid state reactions- without solvents, solid supported synthesis.

Paul T. Anastas, John Charles Warner, Green Chemistry: Theory & Practice ISBN13:9780198506980.

V.K. Ahulwalia & M. Kidwai, New trends in green chemistry. ISBN 1-4020-1872-X Anamaya publishers.

Clark, James & Macquarrie, Duncan, Handbook of green chemistry & technology, Blackwell Publishing ISBN 0-632-05715-7.

CY 880 Computational Chemistry (3-0-0) 3

Basic structure and functioning of computers: Principles of programming. algorithms and flow charts. ORIGIN, SIGMA PLOT, CHEM SKETCH etc. & solve physical/organic/polymer chemistry related problems. Plotting curves. Writing the structures, chemical equations, determining molecular parameters such as bond lengths, bond angles, dihedral angles etc. Bound-state *ab initio* quantum mechanical & density functional calculations, understanding of basis set types & sizes, computational scalability, Hartree-Fock and Post-Hartree-Fock calculations for determining electronic energies & associated molecular properties, electronic structure & thermochemical properties, geometry optimization, study of reaction mechanism, transition-state optimizations. Computer aided drug design. Molecular docking.

Franck Jensen, Introduction to computational chemistry, 2nd Ed., John Wiley & Sons Ltd. 2007.

Ramesh Kumari, Narosa, Computers and their applications to Chemistry.

Mc graw Hill, Theory and Problems of Programming with Basic, NY, 1987.

Ram Kumar, Programming with Fortran 77, Tata McGraw Hill, 1989.

K. J. Johnson, Marcel Dekker, Numerical methods in chemistry, NY, 1980.

CY 881 Applied Organic Chemistry (3-0-0) 3

Manufacture, properties & applications of Polyethene, Polypropylene, PVC, Polystyrene & Acrylic polymers, Teflon, Phenol-formaldehyde, Urea-formaldehyde, Nylon, Polyesters, Caprolactums. Dyes: Colour and constitution, methods

of applying. Azo dyes, orange –II, mordant brown, congo red and methyl orange; triphenyl methane dyes- malachite green, rosaniline, crystal violet and phenolphthalein; cyanin dyes - cyanin blue and quinaldine; reactive dyes and optical brightners. Pigments: Fast violet, lake red and orange R. Pesticides and Insecticides: Classification. Nicotine, pyrethrins, rotenone and allethrin, DDT, methoxychlor, BHC, aldcin, malathion and parathion. Fumigents and repellants. Soap & detergents. Production of acetic acid, formic acid, acetone, methanol etc., Pharmaceuticals.

Heinrich Zollinger, Color Chemistry: Synthesis, properties & applications of synthetic organic dyes & pigments, Helvetica chemical acta, 2003.

K.M. Dunn, Scientific soap making: The chemistry of the cold process, Amezon.com.

W.B. Weeler, Pesticides in agriculture and the environment, Amezon.com, 2002.

R.W. Dyson et. al, Speciality polymers, Chapman & hall, New-York, 1987.

CY 882 Polymer Chemistry and Catalysis (3-0-0) 3

Monomers, Polymerisation Process, Kinetics of Polymerisation, Polymer Molecular weights, Stereochemistry of polymers, Analysis and Identification of polymers: X-ray diffraction, thermal analysis and microscopy. Phase transitions in polymers. Polymers in solution. Catalysis: Homogeneous catalysis-equilibrium and steady state treatments, activation energies of catalysed reactions. Kinetics of enzyme catalysed reactions-Michaelis-Menten equation. Effect of pH, temperature & inhibitors. Surface reaction kinetics:BET equation and its application in surface area determination. semiconductor catalysis, n-and p-type. Mechanism of surface reactions. Uni-& bi-molecular reactions. Industrial application of catalysts.

F.W. Billmeyer, Text book of Polymer Science: (Wiley)

Gowariker, viswanathan and Sreedhar, Polymer Science: (Wiley Eastern)

J.R. Fried, Polymer science and Technology, (Prentice Hall)

K.J. Laidler, Chemical Kinetics. (Harper and Row) 1987.

Puri and Sharma, Principles of Physical Chemistry, Vishal Publications, 2010.

PROPOSAL PLACED BEFORE THE BOS/SENATE FOR COMPREHENSIVE REVISION OF MBA CURRICULUM - 2012

The MBA program was initially conceived in the year 2002 , just before receiving the autonomy status for KREC and upgraded to NITK, Deemed University on 26th June 2002.The curriculum was based mostly on MBA programs curriculum followed at IIT Bombay and some leading B-Schools. However, the MBA program at NITK actually commenced from the year 2007, with a sanctioned intake of 40, it has now increased to 64. Almost 4 batches of students have graduated so far. Based on the feedback received from the employers and students and comparing with other B-Schools curriculum, it was felt that the syllabus framed in 2002 which is about 10 years old , needs to be updated and hence this revision was initiated in 2012, which was also as per the recent decision of the Senate. A workshop was organized to revise the syllabus with participation of experts Prof. Saji Gopinath, IIMK, Mr. Srirang Srikanktha , Consultant, AON Hewitt & Mr. P A Jose ,DGM, MRPL.

Some of the highlights of the proposed revision are as follows:

1. Total credits reduced from 100 to 90, keeping in tune with other PG programs elsewhere and at NITK , Surathkal.
2. Total number of courses a student would study (foundation, functional & electives) during 2 years will be 26 instead of 22.
3. Major project in full 4th semester is replaced by Summer Internship Project of 8 credits and minimum 8 weeks duration.
4. Total number of electives a student would study increased from 4 to 8 electives , of which atleast 3 electives shall be from the same group of specialization, instead of previously 2 electives.
5. Seminar introduced in first, second and third semester with 1 credit each as a MLC .
6. Term paper introduced in final semester with 3 credits , where a student would do a self- study on certain emerging topic under the guidance of a faculty.

The proposal is placed before BOS/ Senate for consideration and approval.

REGULATIONS
specific to
M.B.A. Degree Programme

{also refer: REGULATIONS (General) – Common to all Degree Programmes}

1. ADMISSION

1.1 **Student Status** — There is only one type of student status in the MBA degree Programme, namely, full-time.

1.2 **Duration** — The duration of study shall be a minimum of FOUR semesters and a maximum of FOUR years.

1.3 Admissions will be made in accordance with the instructions received from MHRD from time to time. Seats are reserved for candidates belonging to Other Backward Classes Scheduled Castes and Scheduled Tribes, Physically challenged candidates, children of defence personnel and other categories as per the guidelines issued by MHRD.

1.4 The admissions will be on the basis of CAT score and performance in the qualifying examination and interview. The prescribed qualifying examinations are given separately in the Institute prospectus for M.B.A. Programme.

1.5 Admission to M.B.A. Programme shall be open to candidates who have -

(a) passed the prescribed qualifying examination with a Cumulative Grade Point Average (CGPA) of at least 6.0 in the 0-10 scale grading system, OR not less than 60% marks in the aggregate (taking into account the marks scored in all the subjects of all the public/university examinations conducted during the entire prescribed period for the degree programme). However, this prescribed minimum shall be a CGPA of 5.5 OR 55% marks in the aggregate for SC/ST candidates.

1.6 A limited number of admissions is offered to Foreign Nationals and Indians Living Abroad in accordance with the rules applicable for such admission, issued from time to time, by MHRD.

1.7 If, at any time after admission, it is found that a candidate had not in fact fulfilled all the requirements stipulated in the offer of admission, in any form whatsoever, including possible misinformation etc., this matter shall be reported to the Senate, recommending revoking the admission of the candidate.

1.8 Candidates have to fulfil the medical standards required for admission as prescribed in the *Information Brochure* or the *Prospectus*.

1.9 The Institute reserves the right to cancel the admissions of any student and ask him to discontinue his studies at any stage of his career on the grounds of unsatisfactory academic performance or indiscipline or any misconduct.

1.10 The decision of the Senate regarding the admissions is final and binding.

1.11 Student Exchange Programmes and the Transfer of Credits in such cases shall be as per the corresponding MoU approved by Competent Authority.

2. COURSE STRUCTURE:

2.1 The total course package for a M.B.A. Programme will typically consist of the following components.

(a)	Foundation Courses	>= 20 Credits
(b)	Functional Courses	>= 25 Credits
(c)	Elective Courses(Ele)	>= 20 Credits
(d)	Mandatory Learning course (MLC)	= 03 Credits
(e)	Term Paper	=03 Credits
(e)	Summer Internship Project	= 08 Credits

2.2 The Department Post Graduate Committee (DPGC) will discuss and recommend the exact credits offered for the programme for the above components, the semester-wise distribution among them, as well as the syllabi of all postgraduate courses offered by the department from time to time before sending the same to the Board of Studies (BOS). The BOS will consider the proposals from the departments and make recommendations to the senate for consideration and approval.

2.3 **The Minimum Credit Requirement for the M.B.A Degree is 90.**

2.4 Summer Internship Project:

The Summer Internship Project of 8 weeks minimum duration shall be completed during vacation after second semester and carries 8 credits. The progress of the Summer Internship Project Work shall be monitored by the Project Guide.

(a) The method of evaluation of the project work shall be evolved by the DPGC.
(b) A candidate shall submit 3 copies of the Summer Internship Project Work to Chairman, DPGC, on or before the specified date. The dissertation shall be in the format prescribed by the Institute.
(c) The final evaluation is done at the end of third semester by a Project Work Evaluation Committee (PWEC) constituted by the DPGC. There shall be an open seminar followed by a viva-voce examination as part of the final evaluation. After the final evaluation, appropriate double-letter grade is awarded, which will not however be considered for SGPA and CGPA calculations.
(d) If in the opinion of the PWEC, the Project Report is acceptable with minor modifications for the passing grade 'DD', the PWEC shall value and instruct the candidate suitably to incorporate the necessary modifications and to resubmit it to the Chairman, PWEC.
(e) The title of the Summer Internship Project Report shall be indicated in the Student Progress Report.

2.4 Term Paper

The term paper shall be undertaken by each student during the fourth semester and carries 3 credits. Each student will be attached to a Faculty who would guide the student to take up a topic for self -study on any emerging area of interest related to the program.

(a) The method of evaluation shall be evolved by the DPGC .
(b) There shall be an open seminar followed by a viva-voce examination conducted by the concerned Faculty in-charge of the term paper for each student , as part of the final evaluation.
(c) After the final evaluation, appropriate double-letter grade is awarded, which will not however be considered for SGPA and CGPA calculations.

3. DEGREE REQUIREMENTS:

3.1 The degree requirements of a student for the M.B.A. programme are as follows:

(a) Institute Requirements:

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(i) Minimum Earned Credit Requirement for Degree is 90.
(ii) Securing a CGPA of at least 5.50 in the Course Work.

(b) Programme Requirements:
Minimum Earned Credit Requirements on all Foundation Courses, Functional courses , Elective Courses ,Term paper , MLC and Summer Internship Project as specified by the DPGC and conforming to Clause No: 2 (Course Structure).

(c) The Maximum duration for a student for complying to the Degree Requirement from the date of registration for his first semester, is FOUR years.

4. ATTENDANCE REQUIREMENTS:

4.1 All students must attend every lecture, tutorial and practical classes.

4.2 To account for approved leave of absence (eg. representing the Institute in sports, games or athletics; placement activities, NCC/NSS activities, etc.) and/or any other such contingencies like medical emergencies, etc., the attendance requirement shall be a *minimum of 75%* of the classes actually conducted.

4.3 A student with less than 75% attendance in a course during a semester, in lectures, tutorials and practicals taken together as applicable, will not be permitted to appear in the end semester examination of the course in which the shortfall exists, irrespective of his academic performance, and irrespective of the nature of his absence. He shall be awarded '*FA*' grade in that course.

5. TERMINATION FROM THE PROGRAMME:

A student shall be required to leave the Institute without the award of the Degree, under the following circumstances:

(a) If a student fails to earn the minimum credit specified below:

Check Point	Credit Threshold
End of FIRST year	25
End of SECOND year	50

Note: The period of temporary withdrawal is not to be counted for the above Credit Threshold.

(b) If a student is absent for more than 6 (Six) weeks in a semester without sanctioned leave.

(c) Based on disciplinary action suggested by the Senate, on the recommendation of the appropriate committee.

(d) Fails to get the minimum cutoff CGPA of at least 5.50 in the Course Work

NOTE: Under any circumstances of termination, the conditions specified in Permanent Withdrawal (refer: Clause No: G9.2) shall also apply.

6. COMMITTEES / FUNCTIONARIES:

The following committees shall be constituted for the Post Graduate Degree programme:

6.1 Board of Studies (BOS-PG):

Constitution:

Constitution:

(a)	Dean (A)	...	*Chairman*
(b)	Dean (FW)	...	Member
(c)	Dean (P&D)	...	Member
(d)	Dean (R&C)	...	Member
(e)	Dean (SW)	...	Member
(f)	Chairpersons of all Divisions	...	Members
(g)	Chairman of each DPGC/ his nominee	...	Member
(h)	BOG members representing the faculty	...	Members
(i)	Associate Dean (PG&R)	...	*Convenor*
(j)	Associate Dean (UG)	...	Member
(k)	Dy. Registrar (Academic)	...	*Secretary*
(l)	TWO External Experts	...	Members

Note:

- There shall be one BOS-PG for the entire Institute.
- The Chairman may co-opt and/or invite more members including outside experts.
- The quorum of each meeting will be *NINE*.

Functions (Highlights):

i. To consider the recommendations of the DPGC on matters relating to postgraduate programme and to make suitable recommendations to the Senate.

ii. To approve curriculum framed/revised by DPGC for the postgraduate courses of study.

iii. To ensure that all norms and Regulations pertaining to postgraduate programme are strictly followed.

iv. To make periodic review of these Regulations pertaining to postgraduate programme and to recommend to the Senate any modifications thereof.

v. To review the academic performances and make suitable recommendations to the Senate regarding declaration of results, award of degrees etc.

vi. To recommend to the Senate, the award of stipends, scholarships, medals & prizes etc.

vii. To draw up general time table for the postgraduate course and finalise the PG academic calendar to be put up to the Senate for approval.

viii. To review the cases of malpractice in examinations and to recommend to the Director the punishment in such cases.

ix. To constitute a sub-committee for monitoring the implementation of the academic curriculum provided by the BOS and to provide guidance in curriculum assessment, evaluation process.

x. To conduct at least one meeting each semester and send the Resolutions to the Chairman of the Senate, and also to maintain a record of the same in the office of the Dean.

xi. Any appropriate responsibility or function assigned by the Senate or the Chairman of the Senate.

6.2 Departmental Post Graduate Committee (DPGC):

Constitution:

(a)	H.O.D. / Programme Co-ordinator	...	Chairman
(b)	Two Professors (by rotation for one year)	...	Members
(c)	Two Associate Professors (by rotation for one year)	...	Members
(d)	Two Assistant Professors (by rotation for one year)	...	Members

Note:

- There shall be one DPGC for every department that is involved in the teaching for any of the PG degree programmes.
- The Secretary (DPGC) shall be nominated by the Chairman on rotation basis for a period of one year.
- The Chairman may co-opt and/or invite more members including at most three outside experts.
- The quorum for each meeting shall be *FIVE*.

Functions (Highlights):

i. To monitor the conduct of all postgraduate courses of the department.

ii. To ensure academic standard and excellence of the courses offered by the department.

iii. To oversee the evaluation of the students in a class, for each of the courses.

iv. To evolve the methods of evaluation of major project including intermediate assesment

v. To develop the curriculum for postgraduate courses offered by the department, and recommend the same to the BOS.

vi. Moderation (only if and when found necessary) in consultation with the Course Instructor, and approval of the finalized grades, before submission of the same to the Academic Section of Dean (A).

vii. To consolidate the registration of the student and communicate to Course Instructors, and also to the Academic Section of the Dean (A).

viii. To conduct performance appraisal of Course Instructors.

ix To provide feedback of the performance appraisal to the Course Instructor and concerned authorities.

x. To consider any matter related to the postgraduate programme of the department.

xi. In cases where a course is taught by more than one faculty member, or by different faculty members for different sections of students, DPGC shall co-ordinate (only in case of need) among all such faculty members regarding the teaching and evaluation of such courses.

xii. To conduct at least two meetings each semester and send the Resolutions of the meeting to the Academic Section of the Dean (A), and also to maintain a record of the same in the department.

xiii. Any appropriate responsibility or function assigned by the Senate or the Chairman of the Senate or the BOS or the Chairman of the BOS.

6.3 **Project Work Evaluation Committee (PWEC)**

Constitution:

(a)	Chairman of DPGC or his nominee	...	Chairman
(b)	Project Guide(s)	...	Member(s)
(c)	One Professor or Associate Professor within the Department.	...	Member

Note: The DPGC may invite an External Examiner for the viva voce with prior approval from the Institute authorities and the TA / DA may be paid as per the Institute norms.

Functions (Highlights):

(o) To evaluate Summer Internship Project work and to award an appropriate letter grade. The chairman of PWEC shall submit the report, signed by all the members of the PWEC, to DPGC. The DPGC Chairman shall forward this report to the Academic Section of the Dean (A) without moderation.

6.4 **Project Guide:**

Functions :

i. He will help the student under him in selecting the Summer Internship Project topic.

ii. He shall monitor the progress of the student working under him.

iii. He shall report to the DPGC the performance of the student from time to time.

iv. He will coordinate with the HOD/DPGC to arrange for facilities to carry out the project work.

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Master of Business Administration (MBA)

Suggested Plan of Study

Sl.No.	Semester			
	I	II	III	IV
1.	MBA711	MBA721	MBA731	MBA741
2.	MBA712	MBA722	MBA732	Elective V
3.	MBA713	MBA723	MBA733	Elective VI
4.	MBA714	MA 724	Elective I	Elective VII
5.	MA 715	MBA725	Elective II	Elective VIII
6.	MBA716	MBA726	Elective III	MBA748
7.	MBA718	MBA727	Elective IV	
8.	MBA719	MBA729	MBA 738	
9.			MBA 739	

Credit Requirements:

Category	Minimum Credits to be Earned
Foundation Courses	23
Functional Courses	29
Elective Courses	>= 24
Mandatory Learning Courses (MLC)	03
Term Paper	03
Summer Internship Project	08
Total	90

Foundation Courses	Credits
MBA711 Business Research	(3-0-0)3
MBA712 Organization Behavior	(3-0-0)3
MBA713 Financial Accounting	(3-0-0)3
MBA714 Managerial Economics	(3-0-0)3
MA 715 Statistics for Business Management	(3-0-0)3
MBA716 Corporate Communication	(3-0-1)3
MBA718 Spreadsheet Modeling for Business	(2-0-2)2
MBA741 Ethics and Sustainability	(3-0-0)3

Functional Courses	
MBA721 Managerial Accounting	(3-0-0)3
MBA722 Marketing Management	(3-0-0)3
MBA723 Strategic Analysis	(3-0-0)3
MA724 Operations Management	(3-0-0)3
MBA725 Financial Management	(3-0-0)3
MBA726 Human Resource Management	(3-0-0)3
MBA727 Business Analytics and Decision Making	(3-0-0)3
MBA731 Strategic Management	(3-0-0)3
MBA732 Corporate Information System	(3-0-0)3
MBA733 Legal Environment	(2-0-0)2

Mandatory Learning Courses (MLC)	
MBA719 Seminar	1
MBA729 Seminar	1
MBA739 Seminar	1

Project	
MBA738 Summer Internship Project	8
MBA748 Term Paper	(0-1-2) 3

Elective Courses

Group 1 : Human Resource Management

MBA811 Organization Development and Management of Change	(3-0-0) 3
MBA812 Industrial Relations	(3-0-0) 3
MBA813 Compensation Management	(3-0-0) 3
MBA814 Training & Development	(3-0-0) 3
MBA815 Performance Management	(3-0-0) 3
MBA816 Multicultural Workforce Management	(3-0-0) 3

Group 2 : Marketing

MBA821 Advertising	(3-0-0) 3
MBA822 Business-To-Business Marketing	(3-0-0) 3
MBA823 Brand Management	(3-0-0) 3
MBA824 Consumer Marketing	(3-0-0) 3
MBA825 Marketing Research	(3-0-0) 3
MBA826 Retail Marketing	(3-0-0) 3
MBA827 Rural Marketing	(3-0-0) 3
MBA828 Sales and Distribution Management	(3-0-0) 3
MBA829 Services Marketing	(3-0-0) 3

Group 3 : Finance

MBA831 International Financial Management	(3-0-0) 3
MBA832 Banking, Financial Services and Insurance	(3-0-0) 3
MBA833 Financial Derivatives	(3-0-0) 3
MBA834 Corporate Taxation	(3-0-0) 3
MBA835 Fixed Income Security	(3-0-0) 3
MBA836 Security Analysis & Portfolio Management	(3-0-0) 3
MBA837 Project Finance	(3-0-0) 3
MBA838 Working Capital Management	(3-0-0) 3

Group 4 : Operations

MBA841 Service Operations	(3-0-0) 3
MBA842 Operations Strategy	(3-0-0) 3
MBA843 Project Management	(3-0-0) 3
MBA844 Six Sigma	(3-0-0) 3
MBA845 Materials Management	(3-0-0) 3

Group 5 : Analytics

MBA851 Customer Relationship Management	(3-0-0) 3
MBA852 System Thinking and Strategic Modeling	(3-0-0) 3
MBA853 Enterprise Resource Computing	(3-0-0) 3
MBA854 Product Pricing	(3-0-0) 3

Group G : General Electives

MBA8G1 Business Process Design and Reengineering	(3-0-0) 3
MBA8G2 Contemporary Issues in Management	(3-0-0) 3
MBA8G3 Economic Environment & Policy	(3-0-0) 3
MBA8G4 International Business Management	(3-0-0) 3
MBA8G5 Enterprise Risk Management (ERM)	(3-0-0) 3
MBA8G6 Entrepreneurship Lab	(3-0-0) 3
MBA8G7 E-Business	(3-0-0) 3
MBA8G8 Management Control System	(3-0-0) 3
MBA8G9 Merger and Acquisitions	(3-0-0) 3
MBA8G10 Services Management	(3-0-0) 3
MBA8G11 Supply Chain Management	(3-0-0) 3

Note : 1) Students shall select total 3 electives for third and fourth semesters, from any one group of specialization , ie from 5 groups: Human Resources, Marketing , Finance, Operations & Analytics.
2) Remaining 5 electives shall be selected from any group other than specialization.

DEPATMENT OF HUMANITIES, SOCIAL SCIENCES AND MANAGEMENT

MBA COURSE CONTENTS

MBA711 Business Research (3-0-0) 3

Introduction to Research, Research and Scientific Method, Research Ideas and Literature Review, Research Proposal, Language of Research, Ethics in Research, Research Process, Sampling Design: Probability and Non Probability, Data Collection, Analysis and Interpretation, Ethics in Business Research, Research Design and Approaches: Descriptive, Exploratory, Causal, Qualitative Research, Observation Studies, Surveys, Experiments, Measurements and Scales, Questionnaires, Data Analysis: Presentation, Exploring and Examining, Presenting Findings: Written and Oral Reports, Referencing.

Donald R. Cooper and Pamela S. Schindler, Business Research Methods, TMH, New Delhi, 9th Edition, 2006.
Earl Babbie, The Basic of Social Research, Wadsworth- Thomson Learning, 2nd Edition, 2002.

MBA712 Organization Behaviour (3-0-0) 3

Concept of Management, Leadership, Skills of Manager, Organizations as Social Systems, Effective Human Skills, Motivation and Behaviour, Theories of Motivation, Organizational Behaviour - Nature of Organizations, Organizational Effectives, Interdisciplinary Focus, Approaches to OB. Foundations of Individual Behavior, Personality, Perception, Learning, Attitudes, Values, Job Design, Socio-technical Systems, Work Stress. Group and Interpersonal Behavior, Group Dynamics, Power, Conflict, Organizational Process; Organizational Designs.

Stephen P. Robbins, Timothy A. Judge, Seema Sanghi, Organizational Behavior, Pearson Education.
Steven L Mc Shane, Mary Ann Von Gilnow and Radha R. Sharma, Organizational Behaviour, TMH
Fred Luthans, Organizational Behavior, McGraw Hill International

MBA713 Financial Accounting (3-0-0) 3

Financial Accounting — Concepts – Principles – Accounting Systems – Preparation of Financial Statements. Indian Accounting Standards – Creative . Accounting,
Annual Report, Presentation and Analysis of Audit Reports and Directors Report. Human Resource Accounting – Fixed Assets and Depreciation Accounting – Inventory Valuation (Basic). - U.S.GAAP Framework and Indian Accounting Standards Framework -. Analysis of Financial Statements –Funds Flow Analysis – Ratio Analysis – Cash Flow Analysis - Cost

DEPATMENT OF HUMANITIES, SOCIAL SCIENCES AND MANAGEMENT

MBA COURSE CONTENTS

MBA711 Business Research (3-0-0) 3

Introduction to Research, Research and Scientific Method, Research Ideas and Literature Review, Research Proposal, Language of Research, Ethics in Research, Research Process, Sampling Design: Probability and Non Probability, Data Collection, Analysis and Interpretation, Ethics in Business Research, Research Design and Approaches: Descriptive, Exploratory, Causal, Qualitative Research, Observation Studies, Surveys, Experiments, Measurements and Scales, Questionnaires, Data Analysis: Presentation, Exploring and Examining, Presenting Findings: Written and Oral Reports, Referencing.

Donald R. Cooper and Pamela S. Schindler, Business Research Methods, TMH, New Delhi, 9th Edition, 2006.
Earl Babbie, The Basic of Social Research, Wadsworth- Thomson Learning, 2nd Edition, 2002.

MBA712 Organization Behaviour (3-0-0) 3

Concept of Management, Leadership, Skills of Manager, Organizations as Social Systems, Effective Human Skills, Motivation and Behaviour, Theories of Motivation, Organizational Behaviour - Nature of Organizations, Organizational Effectives, Interdisciplinary Focus, Approaches to OB. Foundations of Individual Behavior, Personality, Perception, Learning, Attitudes, Values, Job Design, Socio-technical Systems, Work Stress. Group and Interpersonal Behavior, Group Dynamics, Power, Conflict, Organizational Process; Organizational Designs.

Stephen P. Robbins, Timothy A. Judge, Seema Sanghi, Organizational Behavior, Pearson Education.
Steven L Mc Shane, Mary Ann Von Gilnow and Radha R. Sharma, Organizational Behaviour, TMH
Fred Luthans, Organizational Behavior, McGraw Hill International

MBA713 Financial Accounting (3-0-0) 3

Financial Accounting — Concepts – Principles – Accounting Systems – Preparation of Financial Statements. Indian Accounting Standards – Creative . Accounting,
Annual Report, Presentation and Analysis of Audit Reports and Directors Report. Human Resource Accounting – Fixed Assets and Depreciation Accounting – Inventory Valuation (Basic). - U.S.GAAP Framework and Indian Accounting Standards Framework -. Analysis of Financial Statements –Funds Flow Analysis – Ratio Analysis – Cash Flow Analysis - Cost

Accounting – Cost classification Marginal Costing – Performance Budgeting – Cycle Costing – Strategic Cost Management.

Lyrich: Accounting for Management, Tata McGraw-Hill, New Delhi, 2001.
Maheswari S. N, Cost and Management Accounting, Sultan Chand and Co., New Delhi, 6th Edition 2001.
Narayan Swamy, R. Financial Accounting: A Managerial Perspective, PHI

MBA714 Managerial Economics **(3-0-0) 3**

Introduction, nature and scope of managerial economics. Business objectives and decision making. Demand analysis, law of demand, elasticity of demand, demand forecasting, supply analysis, supply elasticity. Production analysis and production function, cost concept and analysis. Market equilibrium, average revenue concept and market structure. Perfect and imperfect competition, pricing strategy. National income dynamics, theories of profit. Decision techniques and capital budgeting. Macroeconomic facts, money system and case studies.

Craig Petersen and Chris Lewis W, Managerial Economics, Prentice-Hall of India, 2000
Mcguigam, Managerial Economics Applications Strategy and tools, South Western, 2002.
Mankiw N. Gregory , Principles of Economics, Thomson, 2002.

MA715 Statistics for Business Management **(3-0-0) 3**

Role of Statistics in Decision Making, Collecting & Tabulating Data-Measure of Central Tendency and Dispersion in Frequency Distribution, Probability Theory: Classical, Objective & Subjective Approach-Addition, Multiplication & Bayes Theorem –Applications-Binomial, Poisson and Normal - Decision Making Under Certainty, Uncertainty and Risk -Sampling and Sampling Distribution: Types of Sampling - Random Sampling-Concept of Standard Error Central Limit Theorem. Estimation: Types of Estimates - Point Estimate, Interval Estimate of their Population Mean, Variance and Proportion-Student-Distribution. Testing Hypotheses, Significance Level-Type I & Type II Error- One Two Tail Tests - Regression and Correlation Analysis- Hypothesis Testing of Means, Proportion-Chi-Square Test-Analysis of Variance. Non Parametric Methods Kolmogorov Test-Median Test – Mann –Whitney Test – Wircoxon T Test – Friedman ANOVA-Mcnemar Test-Cochram's Q Test.

Levine, Stephan, Krehbiel, Berenson, Statistics for Managers, Using Microsoft Excel, PHI New Delhi, 4th Edition, 2011.
Daniel, Terrell, Business Statistics, For Management and Economics, 6th Edition, Houghton Mifflin Company, 1992.
Richard I. Levin and David S. Rubin, Statistics for Management, Prentice Hall of India, 1999.
Srivatasava, Shenoy and Sharma, Quantitative Techniques for Managerial Decision Making, 3rd Ed., Wiley Eastern, 1998

MBA716 Corporate Communication (3-0-0) 3

Importance of Communication, Nature of Communication, Communication Process and Flow; Communication Channels and their Use; Communication Climate; Communication, Culture and Work; Verbal and Non-Verbal Communication, Interpersonal Communication, Interview Skills – Principles, Planning and Conducting Interviews; Group Dynamics; Presentations, Persuasive Presentations; Keys to Functional Writing, Business Correspondence, E-Communication.

Ronald B. Adler and Jeanne Marquardt Elmhorst, Communicating at Work: Principles and Practices for Business and the Professions, McGraw-Hill, 2008

MBA718 Spreadsheet Modelling for Business (2-0-2) 2

Introduction to Spreadsheet- Functions of Spreadsheet- Spreadsheet Uses and Limitations- Entering Formulas into Excel- Control-Flow Statements-Charts in Excel- Dash Board- Sensitivity Analysis- Creating Tornado Diagrams- Pivot Tables and Charts- Modeling with IFPS and VBA- Matrix Operations - Regression Analysis- Macros - Recording and Editing- Lookup and Reference Functions- DCF-NPV and IRR Functions- Data Tables- Database Manipulation- Workbook Sharing & Merging- Customizing Toolbars And Menus- User-Defined Functions- Matrix Operations In Excel- Auditing Tools

MBA721 Managerial Accounting (3-0-0) 3

Organizations and accounting - Differences between Financial Accounting and Management Accounting - Understanding Financial Statements - Interpreting Financial Statements Financial Statement Analyses – Horizontal and Vertical Analyses – Value Chain Analysis - Significant Accounting Policies, Accounting Standards - Features of Corporate Accounting - Creative Accounting - Cash Flow and Fund Flow Techniques - Costs - Cost Estimation - Estimating Product Costs and Activity-Based Costing - Product Planning Decisions - Cost-Volume-Profit Analysis - Budgets and Budgeting - Cost Allocations - Traditional Absorption Costing Systems - Management Accounting in a Changing Environment.

Horngreen and Sundlem - Introduction to Management Accounting, PHI
Manmohan & Goyal - Principles of Management Accounting, Sahitya Bhawan Publications, 1998
Maheshwari S. N., Management Accounting and Financial Control, Sultan Chand & Sons

MBA722 Marketing Management (3-0-0) 3

Introduction to Marketing - Marketing Process - Marketing Environment - Marketing Research - Demand Forecasting - Competition - Marketing Strategy - Consumer Behaviour- Industrial Marketing -Customer Satisfaction - Segmentation - Targeting, Positioning Developing New Market Offerings - Product Life Cycle - Designing Global Market Offerings - Product and Branding Strategy - Designing and Managing Services - Developing Pricing Strategy - Advertising Strategy - Media Planning - Marketing Channels - Retailing - Marketing Communication –Advertising.

Philip Kotler and Kevin Lane Kelle,r Marketing Management, Pearson, 12th Edition, 2006.

Philip Kotler and Gary Armstrong, Principles of Marketing, Prentice Hall, 13th Edition, 2009.

Philip Kotler, Kevin Lane Keller , Abraham Koshy and Mithileshwar Jha , Marketing Management: A South Asian Perspective, Pearson Education; 12th Edition, 2007.

Tapan K Panda Marketing Management: Indian Context , Excel Books, 2008

MBA723 Strategic Analysis (3-0-0) 3

Strategy in context- strategic thinking-case study in achieving profitable growth- core differentiation strategies- vision mission and values- strategic map model. competitive edge-defining investment priorities- competitive position- environmental changes. presenting the change plans pulling everything together into a plan- leading people through change.

Arthur A Thomson and A J Stickland, Strategic Management, Tata McGraw Hill
John A.. Pearce and Richard B. Robinson, Strategic Management - Strategy Formulation and Implementation - , AITBS Publishers and Distributors.
Charles W. L. Hill and Gareth R. Jones, Strategic Management Theory , Integrated Approach, All India Publishers & Distributors.

MA724 Operations Management (3-0-0) 3

Operations Functions, Types of Operations, Time Series Analysis- Function of Production Planning and Control. Aggregate Planning - Guidelines. Operation Scheduling - Assignment Model – 'n' jobs to be Produced in 'm' machines - Run Out Time Method - Network Scheduling. Quality Control: Purpose of Inspection and Quality Control - Process Control - Control Charts for Variables- Control Charts for Fraction Defectives - Control Charts for Defects - Sampling Plan - Single Sampling Plan, OC Curve, AQL, AOQL, LTPD. Inventory Control - Deterministic Models - Probabilistic Models. Maintenance and Replacement- Breakdown Vs. Preventive Maintenance - Group vs. Individual Replacement. Just in Time Production. Simulation, Monte Carlo Simulation.

Buffa E.S. and Sarin R.K., Modern Production / Operations Management, John Wiley & Sons, 8th Ed., New York, 1990
Chary S.N., Production & Operations Management, TMH, New Delhi, 1992

MBA725 Financial Management (3-0-0) 3

General Financial Environment – Introduction – Capital, Secondary and Money Markets, Basics, Instruments, Financing and Rating Institutions, and legal environment. - Corporate Financial Objectives and Functions - Financial Analysis, Ratio analysis, Common size statement analysis, Trend analysis, Sickness prediction - Funds Flow analysis - Risk and Return Portfolio Theory - Sources of Funds , Types, Issuing and Pricing, Valuation of Stocks and bonds - Dividend Policy - Capital Structure Decision, Capital Structure Theories - Valuation Of The Firm - Evaluation Techniques, Evaluation Of Lease Contracts - Corporate Restructuring, Mergers And Acquisitions - Financial Restructuring, - Working Capital Management

Van Horne James C., Financial Management Policy, Prentice of India, (9th Edition)
Pandey I.M., Financial Management, Vikas Publications House, (7th Edition)
Chandra, P., Fundamentals of Financial Management, TMH

MBA726 Human Resource Management (3-0-0) 3

Overview Of HRM, Strategic HRM, HR Planning, Job Analysis, Recruitment And Selection, Human Resource Development, Performance Assessment And Management, Compensation System, Incentives And Benefits, Safety And Health, Labour Relations, Multinational HRM, Role Of Culture, Legislations Pertaining To Labour Acquisition, Compensation And Maintenance, Emerging Issues In HRM.

Michel Armstrong, Human Resource Management, 5th Edition, 2006
V S P Rao, Human Resource Management, PHI, 7th Edition, 2004
Cynthia D. Fisher, Human Resource Management, Biztantra, 5th Edition, 2004.
Flippo Edwin B., Principles of Personnel Management- McGraw Hill – Kogak.

MBA727 Business Analytics and Decision Making (3-0-0) 3

Analytical decision making: emerging business environment- analytical competition-embedding analytic in business process- reporting / descriptive analytics, modeling or predictive analytics, data-driven strategies- analytics and business performance- building analytical culture- industry trends in analytics-review techniques and tools. Business contexts-stages of enhanced analytics capabilities-defining metrics- categories and levels of metrics- defining KPIs- linking strategic outcomes and KPIs- KPI directories for different industry segments- aligning technologies in analytics domain. Blue printing a solution framework: identifying core KPIs- sourcing data- using high. Analysis & interpretation: gathering and reporting-use of dashboards and other

visualizations tools- interpretations of analysis- suggesting strategic and tactical programs. Project development: industry inputs- validation of models- frameworks- data analytics .

Davenport Tom, Harris Jeanne G., Morison Robert, Analytics at Work: Smarter Decisions, Better Results, (February 2010)

Davenport Thomas H., Harris Jeanne G., Competing on Analytics: The New Science of Winning, (March 2007)

MBA731 Strategic Management (3-0-0) 3

Strategic management process, firm and environment: environmental analysis – macro- micro and relevant environment – models for environmental analysis – SWOT analysis- BCG matrix- GE's stoplight matrix. strategy and resources. Pyramid of business policy. Types of strategies: dependency – generic strategies. Generation of strategic alternatives – strategic information systems. Organizational level strategies: franchising- licensing- sub contracting- diversification- concentric diversification- conglomerate expansion. strategy implementation – evaluation and control. Matching structure and control, global issues of 21st century--strategic audit-issues in non-profit organizations

Arthur A Thomson and A J Stickland, Strategic Management, Tata McGraw Hill
John A.. Pearce and Richard B. Robinson, Strategic Management - Strategy Formulation and Implementation - , AITBS Publishers and Distributors.
Jauch Lawrance R. & Glueck William F., Business Policy and Strategic Management- McGraw Hill (5t h Edition).
Johnson Gerry & Scholes Kevan, Exploring Corporate Strategy- Prentice Hall of India (4t h Edition).

MBA732 Corporate Information System (3-0-0) 3

Managerial overview of information systems, information needs and management process- information system- data information system to problem solving- data information and its attributes - level of people and information needs - types of decisions and information information system - stages in system analysis - classification of information system, technical foundations of information systems: hardware, software, telecommunications and networks, database, client server computing; business applications of information systems: DSS, EIS, artificial intelligence, expert systems, neural network, office automation, business information systems, systems analysis and design, tools for information system development, managing information resources, securities concerns - network securities.

James A O'Brien ,George M Marakas, Ramesh Behl, Management Information Systems , TMH Education Pvt. Ltd , 9th Edition, 2010
Uma G. Gupta, Management Information Systems, A Managerial Perspective, Galgotia Publications, 1998

Kenneth J Laudon, Jane P. Laudon, Management Information Systems, Pearson/PHI, 10/e
W. S. Jawadekar, Management Information Systems, Tata McGraw Hill Edition, 3/e

MBA733 Legal Environment (2-0-0) 2

Nature of contract requirements & classifications – discharge of contract – remedies for the breach- quasi contract – contingent contract. Sale of goods act - sale, agency, negotiable instruments act, nature and requisites instruments, transfer of negotiable instruments, holder in due course special rules for cheques banks, discharge of negotiable instruments. Partnership act - nature of the companies, kinds of companies – formation and incorporation of a company, memorandum of association, Articles of Association and prospectus ,company management, company meetings (board and general), majority rule and minority protection , compromises, arrangements. Reconstruction and amalgamation – winding up. Competition, / FEMA, consumer protection, right to information act. Special economic zones, environment & business, business and the ip regime, wto.

Kapoor, N.D. , Mercantile Law, Sultan Chand & Sons, 28th Ed.
Majumdar, A.K. and Kapoor, G.K., Company Law and Practice, Taxmans Publications, New Delhi, Revised 2000.

MBA741 Ethics and Sustainability (3-0-0) 3

Evolution- management structure for corporate governance-board structure-building responsive boards - issue and challenges- effectiveness of board- board committees and audit committee-legal compliance committee and stakeholders' relationship committee-appraisal of board performance- transparency and disclosure- internal control system and risk management-corporate governance in various countries – investor protection and institutional investors-corporate social responsibility -various corporate governance forums - CACG ,OECD , ICGN , NFCG organization perspectives- ethical principles in business – codes and innovations-concept of stakeholders' organization- activity analysis- process-business ethics as a strategic management tool- stakeholders' protection-sustainability reporting -stakeholder engagement-corporate sustainability management systems-legal framework- conventions and treaties on environmental- health and safety and social security issues-principle of absolute liability .

Taxmann , Corporate Governance , ICSI& Taxmann Publication
Adrian Cadbury, Corporate Governance and Chairmanship – A personal View - Publication: Oxford University Press.
Sanjiv Agarwal, Corporate Governance: Concept & Dimensions, Published by Snow White Publication.

MBA811 Organization Development and Management of Change (3-0-0) 3

Introduction to OD- organisations as systems, dimensions of organisational design, the evolution of organisational theory and design, role of organization theory and design, change management -nature of planned change, designing interventions, recruitment and selection, leading & managing change, evaluating and institutionalizing OD. Change and HR strategies-implementation and impact of change, role of HR strategies in implementing change. Structure and strategic change, HR implications of structural choice and change interpersonal group processes , organization process approaches , restructuring organizations , employee involvement , organization transformation , organizational development in global settings OD in healthcare, schools, and public sector organizational culture.

Richard H. Hall, Organizations-structures, Processes and Outcomes, 8th edition, PHI, 2002
Richard L.Daft, Organization Theory and Design, 7th edition Thomson south western. 2002
Harold Koontz and Heinz Weihrich, Essentials of Management, Tata McGraw Hill, 9th Edition, 2012.
Pradip N. Khandwalla, Corporate Creativity, Tata McGraw Hill.2005

MBA812 Industrial Relations (3-0-0) 3

An overview of historical background of industrial relations (IR). Labour movement theories. Legislations related to labour laws, attitudes and approaches. Industrial conflict. Collective bargaining. Workers' participation in management. Governments' labour policy. India and ILO.

Agnihotre V., Industrial Relations in India.
Agarwal R. D., Dynamics of Industrial Relations in India.
Srivastava S.C., Industrial Relations and Labour Law, New Delhi, Vikas 1994

MBA813 Compensation Management (3-0-0) 3

Conceptual and theoretical understanding of economic theory related to compensation management (wage concepts and wage theories). Employees satisfaction and motivation issues in compensation design. Establishing internal, external and individual equally. Strategic importance of variable day-determination of inter and intra industry compensation differentials. Individual and group incentives. Dearness allowance concept-emergence & growth in India. Role of fringe benefits in reward systems retirement plans including VRS/golden handshake schemes. Executive compensation. Compensation systems in multinational companies and it companies including ESOP. Collective bargaining strategies-long term settlements-cases of productivity settlements-exercises on drawing up 12 (3) and 18(1) settlements. Emerging trends in IR due to LPG.

Relevant Bare Acts

MBA814 Training & Development (3-0-0) 3

Introduction to training design & implementation -needs analysis and needs assessment, performance analysis, job analysis, task analysis, learner analysis, context analysis and skill gap analysis. Training objectives-training deliverables and instructional strategies, training design budgets and schedules, training project management, design blue prints and proto types. Drafting training materials- developing tests/assessments, quality control issues . Train the trainer programmes- classroom delivering of training, non class room delivering techniques. Evaluation-role of evaluation, evaluation techniques- Kirkpatrick model, CIRO model, cost benefit analysis-evaluating reactions and learning, evaluating transfer of training- learning – principles and theories, social learning.

Donald J. Ford , Bottom-Line Training, PHI, 1999 .
Craig R.L. Training and Development Hand book: A guide to Human Resource Development (4th Ed..), New York, NY:McGraw Hill 1996.
McGrath, Training for Life and Leadership in Industry, Prentice Hall of India, New Delhi.
Blanchard, P Nick, and James W. Thacker, Effective Training-Systems, Strategic and Practices,Pearson Education, New Delhi

MBA815 Performance Management (3-0-0) 3

Introduction- performance appraisal vs. performance management- PFM theatre- planning for manager's performance and development-monitoring and mentoring- annual stocktaking-appraisal for recognition and reward- organizational effectiveness-high performing teams.

Michael Armstrong & Angela Baron, Performance Management: The New Realities, Jaico Publishing House, New Delhi, 2002.
T.V.Rao, Appraising amd Developing Managerial Performance, TV Rao Learning Systems Pvt Limited, Excel Books, 2003.
David Wade and Ronad Recardo, Corporate Performance Management, Butter Heinemann, New Delhi, 2002.

MBA816 Multicultural Workforce Management (3-0-0) 3

Concept of culture, Gert Hoofstede model. comparative human resource (HR) practices: power distance, individualism, masculinity, implications for Indian manager. HR issue for the international manager: international staffing; MNC training; MNC performance appraisal; compensation and benefits; international unions. Cross cultural management approach: organizational structure and intercultural management- conventional organizational structures of global organizations; intercultural communication. . core values as for bonding between employees and corporate across the globe. Global strategy and local adaptation. Conflict

resolution strategies to handle: environmental turbulence; different attitudes to corporate culture and ethics. Cultural conflict and management style. Expatriate management.

Nina Jacob., Intercultural Management (MBA Master Class series). Kogan Page, New Delhi 2004
Peter J. Dowling, International Human Resource Management, South Western – Thomas Learning.
Heinz Weihrich, Mark V. Cannice and Harold Koontz , Management, Tata McGraw Hill, 13th Edition, 2012.
Evans, Pucik, Barsoux, The Global Challenge, Tata McGraw Hill, 2010.

MBA821 Advertising (3-0-0) 3

Introduction to Integrated Marketing Communications-Evaluating the Economic-Social and Regulatory Aspects of Advertising and Promotion-The Role of Ad Agencies and other Marketing Communication Organizations-Consumer Behavior-The Communication Process-Communications Mix. Creative Strategy- Pre Testing and Post Testing- Media Mix- Media Planning- Challenges in Media Planning. Developing the Media Objectives- The Message. Developing the Media Strategy- Media Scheduling, Calculating the Cost Efficiency. Steps in Campaign Planning-Role of Research in Advertising. Appropriation of Advertisement Budget.

Belch E. George & Belch A. Michael, Advertising and Promotion, Tata McGraw Hill, New Delhi, 2001.

Parameswaran, Brand Building Advertising: Concepts and Cases, Tata McGraw Hill, New Delhi, 2002.

William F Arens , Contemporary Advertising, Tata McGraw Hill, NewDelhi, 2008

MBA822 Business-To-Business Marketing (3-0-0)3

Fundamental of Business Markets. - Organisational Buying Process. - Org. Buyer Behavior - Differences Between Consumer Marketing and Industrial Marketing - Classification of Industrial Products - Nature of Demand - Industrial Marketing System- Models - Buying Situation -Buying Centre Concept. Demand Estimation -Industrial Marketing Segmentation. Managing Industrial Products -Strategies Involved PLC Concepts and Industrial Products. Pricing Strategies - Competitive Bidding - Negotiation. Distribution Channels - Influencing Factor. Industrial Marketing Communications - Industrial Marketing Research - Differences between Consumer Marketing Research and Industrial Marketing Research. Marketing Strategy Formation - Key Account Selling.

Michael D. Hutt, Thomas W. Speh, Business Marketing Management, Thomson, 9th Edition, 2007.

Hill- M Richard- Alexander S. Ralph- Cross James S, Industrial Marketing, AITBS, New Delhi, 4th Edition, 1991.
Dwyer, F. Robert & Tanner, John F. Jr., Business Marketing,McGraw-Hill, 4th Edition, 2009

MBA823 Brand Management (3-0-0) 3

Introduction To Brand Management and Crafting of Brand Elements - Consumer Brand Knowledge , Product Management – Role of a Product Manager, Organizing The Brand Management System, Brand Positioning and Values – Customer Based Brand Equity Model, Brand Identity, Brand Image, -Managing Brand Architecture and Brand Portfolios - Corporate Branding and Tools for Building Brand Equity - Measurement of Brand Equity, Brand Marketing Programs –Designing Marketing Programs to Build Brand Equity, Integrating Marketing Communication to Build Brand Equity. Measuring and Interpreting Brand Performance – Capturing Customer Mindset, Capturing Market Performance, Co-Branding

Kevin Lane Keller, Strategic Brand Management- Building, Measuring And Managing Brand Equity, Pearson, 2nd Edition, 2006.

Jean-Noel Kapferer, Strategic Brand Management, Free Press, 1st Edition, 1994.

Subrato Sengupta, Brand Positioning, McGraw Hill, 2nd Edition, 2005.

MBA824 Consumer Marketing (3-0-0) 3

Nature of Consumer Behaviour- Model of Consumer Decision Making — Its Implications on Consumer Behaviour-Major Models in Consumer Behavior. Individual Psychological Factors-Perception Attitudes Learning Personality and Motivation - Implications of Not Achieving the Goal. Group Factors in Consumer Behaviour - References Group Concepts - Opinion Leadership Aspects - Usage of these Concepts in Marketing Communications. Decision Process, Diffusion of Innovation in Consumer Behaviour - Its Implication on Consumer Behavior. Concepts of Customer Satisfaction - Concept of Cognitive Dissonance-Cultural Aspects in Consumer Behavior- Consumer Research

Della & Bitta, Consumer Behaviour: Concepts & Applications, Tata McGraw Hill, NewYork, 1993.

Schiffman G.Leon and Kanuk Leslie Lazar, Consumer Behaviour, 9th Edition, Prentice Hall of India Private Ltd, New Delhi, 9th Edition, 2007.

Roger D Blackwell, Paul W Miniard and James F Engel, Consumer Behavior South-Western College Pub, 10th Edition, 2005.

MBA825 Marketing Research (3-0-0) 3

Nature and Scope of Marketing Research- Conceptual Aspects Involved in Marketing Research- Marketing Information System, Marketing Research Process- Basic Research Designs, Applicability of Research Designs, Data Collection Procedures and Methods. Scaling Concepts, Scaling Techniques, Questionnaire Design and Development. Concept of Sampling, Sampling Types, Multivariate Analysis Applications in Cluster Analysis, Conjoint Analysis, Multidimensional Scaling, Factor Analysis, Discriminant Analysis , Exposure to Statistical Packages. Product Research, Advertising Research, Market and Sales Analysis Research.

Carl Mcdaniel and Roger Gates, Contemporary Marketing Research, South Western College Publishing, Singapore, 4th Edition,1999.

Tull, D.S. and Hawkins D.J., Marketing Research – Measurement and Method, Prentice Hall, New Delhi., 6th Edition, June2000.

Donald R. Lehmann, Sunil Gupta, and Joel H. Steckel, Marketing Research, Addison-Wesley Educational Publishers Inc., 1998.

MBA826 Retail Management (3-0-0)3

Introduction to Retailing – Retailing in India - Retail Formats and Theories-Understanding the Retail Consumers, Overview of Retailing Environment and Management, Strategic Planning, Structural Change, Market Structure, Retail Planning, Development and Control. Learning, Attitude. Motivation and Perception. Situational Analysis, Retail Institutions By Store-Based Strategy-Mix, Web, Nonstore-Based and other Forms of Non Traditional Retailing. CRM, Promotional Strategies Used in Retailing .Choosing a Store Location- Managing Retail Business-Service Characteristics, Branding, Perceptions of Service Quality, Retail Information Systems, Merchandise Management. Retail Pricing, Development and Implementing Plans, Internationalization and Globalization.

Michael Levi M and Barton Weitz , Retailing Management, Tata McGraw Hill, 5th Edition,2008.

Dunne Patrick M., Lusch Robert F. and Griffith David A – Retailing, Cengage Learning, 4th Edition,2010.

Barry Berman, Joel R Evans, Retail Management- A Strategic Approach, Pearson, 10th Edition, 2009.

Newman A.J. and Cullen P, Retailing: Environment and Operations, Vikas, 1st Edition .

MBA827 Rural Marketing (3-0-0) 3

Issues In Rural Marketing And Characteristics Of Rural Markets -Understanding Consumers - Researching Rural Markets -Creating And Delivering Value -Communicating And Positioning In Rural Markets -Communication And Diffusion Process : An Approach To Accelerate Consumer Acceptance -Distribution In Rural Markets -Non Conventional Methods Of Reaching Rural Markets -Developing Marketing Strategy For Rural Markets.

T.P. Goplalaswamy, Rural Marketing, Excel Books, 2nd Edition, 2003.

Pradeep Kashyap & Siddhartha Raut, The Rural Marketing Book, Biztantra Publications, 2006.

Sanal Kumar, Rural Marketing, Sage Publications, 2002.

MBA828 Sales and Distribution Management (3-0-0) 3

Conceptual Understanding of Sales Management, Importance of Sales Force Management in the Indian Context. Personal Selling Process- Prospecting, Pre Approach, Approach Presentation, Planning Sales Calls, Motivating a Sales Force and Sales Force Compensation, Sales Force Expenses and Transportation, Sales Meeting and Sales Contest, Sales Records and Reporting Systems Forecasting Sales and Developing Sales Budgets, Designing and Organizing Sales Territories. Sales Organisations, Relations with other Departments. Profiling and Recruiting Sales People- Distribution Management- The Vertical and Horizontal Marketing Systems. Wholesaler, Retailing and Retailer Marketing Decisions. Physical Distribution-Logistics & Participants in Physical Distribution Process,

Richard R. Still , Edward W. Cundiff and Norman A. P. Govoni ,Sales Management – Decision, Strategies & Cases; PHI./Pearson Education, 1988.

Krishna K Havaldar and Vasant M Cavale, Sales and Distribution Management , Tata McGraw Hill, 2nd Edition, 2011.

S.L.Gupta, Sales and Distribution Management , Excel Books, 2002.

Spiro, Stanton, Rich, Management of Sales Force, Tata – McGraw Hill, New Delhi, 7th Edition, 2003.

MBA829 Services Marketing (3-0-0) 3

Services Marketing – Nature, Need, Classification of Services, Barriers and Issues in Services Marketing in the Indian Context. Gaps Model of Service Quality, Expectations and Perceptions, Measuring Service Quality- SERVQUAL, Building Customer Relationships and Service

Recovery. Relationship Marketing, Positioning, Service Development and Designing Services, Service Blue Printing, Quality Function Deployment, Adding Value, Physical Evidence and Services Cape. Pricing Strategies for Services, Creating and Managing Service Delivery, Balancing Demand and Capacity, Waiting Lines and Reservation. Integrated Services Marketing Communication, Services Advertising Strategies, Integrated Model of Services Quality.

Christopher Lovelock, Services Marketing – People, Technology, Strategy, Addison Wesley Longman (Singapore), Pearson Education Asia, 4th Edition, 2001.

Roland T. Rust, Anthony J. Zahorik and Timothy L. Keiningham, Services Marketing, Harpercollins, 1996.

Valarie A.Zeithmal and Mary Jo Bitner, Services Marketing – Integrating Customer Focus Across the Firm, Tata McGraw-Hill, New Delhi, 2nd Edition, 2002.

Christopher H. Lovelock and Jochen Wirtz, Services Marketing, 7th Edition. Prentice Hall, 2010.

MBA831 International Financial Management (3-0-0) 3

Introduction – Introduction to Foreign Exchange Markets – Supply And Demand Conditions and Demand Factors of Currency – Exchange Rate Theories. International Financial Systems: Exchange Systems –IMF And World Bank — Capital Account Convertibility. International Financial Markets – Euro Banking and Euro Currency Market — Term structure in International Capital Markets. - International Financing — Depository Receipts – International Financing Decision - Funding And Risk Management Aspects - International Credit Instruments — International Credit Syndication Mechanism — Risk Factors Of International Financing. International Capital Budgeting– Foreign Direct Investments –Valuation of International Cash Flows – Cash Management – International Portfolio Investing.

Levi Maurice D., International Finance, McGraw Hill (3rd Edition).
Apte P. G., International Financial Management, Tata McGraw Hill.
Shapiro, A., Multinational Financial Management, Wiley India Edition

MBA832 Banking, Financial Services and Insurance (3-0-0) 3

Indian Banking System - Banking Structure and Performance Measurement - Financial Statement Analysis and Bank Performance Measurement - Banking Regulations Organisation - Bancassurance and Universal Banking - Financial Innovations - Factoring, Securitisation and Take Out Finance - International Banking Services of Custodians-Central Depository, Systems, Mutual Funds, Commercial Paper, Financial Journalism, Portfolio Management, Investment Management. Nature Of Insurances –Values And Costs Of Insurance – Basis Of Recovery. Property And Liability Loss Exposure – Life, Health And Income Exposures – Types Of Life Insurance – Channels of Distribution

Pond Keith, Lipscombe Geoffrey, The Business of Banking: An Introduction to the Modern Financial Services Industry, Financial World Publishing
Vaughan Emmet J. & Vaughan Therese M., Fundamentals of Risk and Insurance, Wiley Finance, 10th Edition.

MBA833 Financial Derivatives (3-0-0) 3

Introduction - Forward Contracts, Future Contracts, Options, Swaps And Other Derivatives; Operation Of Margins; Sources Of Financial Risk: Foreign Exchange Risk, – Options Warrants And Convertibles. – Futures - Future Contracts; Future Markets - Clearing House, Margins, Trading, Future Positions And Taxation; Future Prices And Spot Prices; - Currency Derivatives- Interest Rate Derivatives- Term-Structure and Pricing Principles, Trading Strategies. - Managing Market Risk - Hedging Schemes - Portfolio Insurance. - Derivatives Market In India

Chance, Don M: An Introduction to Derivatives, Dryden Press, International Edition.
Chew, Lilian: Managing Derivative Risk, John Wiley, New Jersey.
Hull, J.: Options: Futures and other Derivatives, Prentice Hall, New Delhi.

MBA834 Corporate Taxation (3-0-0) 3

General Principles Guiding And Direct And Indirect Taxes. Corporate Tax Structure - Direct And Indirect Treatment Of Various Items Of Receipt And Payment - Items Of Deductions. Special Provisions – Service Tax And Value Added Tax. Tax Planning For Corporate – Assessment Procedure. Case Laws Discussion.

Ahuja Girish and Gupta, Ravi, Systematic Approach to Income Tax, Service Tax and VAT, Bharath's Students' List of Publications, 19th Edition, 2008
Singhania Vinod, Taxmann students guide to income tax with service tax value added tax Taxmann, 38th Edition, 2008

MBA835 Fixed Income Security (3-0-0) 3

Fixed Income Markets, Government Securities Market - Bond Valuation, Time Value Of Money, Price And Yield Conventions, Understanding Market Linkages, Bonds And Money Market Instruments, MIFOR Curve - Risk Identification In Bonds - Yield Curve Analysis - Treasury Securities - Bond Indexing, Index Return Comparison - Portfolio Construction - Global Bond Markets - Fixed Income Derivative Markets – Interest Rate Options, Caps & Floors Pricing - Markets For Asset Backed Securities, Prime And Subprime Mortgage-Backed Securities - Fixed Income Investing.

Fabozi Frank J., The Handbook of Fixed Income Securities, McGraw Hill
Dun & Bradstreet, Fixed Income Securities, Tata McGraw Hill
John C. Hull, 2005. Options, futures, and other derivative securities. Pearson Education, Sixth edition.

MBA836 Security Analysis & Portfolio Management (3-0-0) 3

Investment Environment – Stock Exchanges – Bond Analysis – Derivative Instruments – Technical Structures And Valuation. Theoretical Framework For Investment Decisions – Analysis Of Risk & Return, Asset Pricing Models. Fundamental Analysis –Technical Analysis – Random Walk Hypothesis – Efficient Market Hypothesis. Portfolio Management – Portfolio Theory – Capital Market Theory – Utility Analysis – Portfolio Revision – Performance Analysis Of Managed Portfolios.

Fischer Donald E. & Jordan Ronald J., Security Analysis and Portfolio Management, Prentice Hall of India.
Elton Edwin J. & Gruber Martin J., Modern Portfolio Theory and Investment Analysis, John Wiley & Sons.

MBA837 Project Finance (3-0-0) 3

Characteristics - Technology Selection, Assessment Of Technical Collaborator - Market Analysis - International Competitiveness And SWOT Analysis - Assessing The Project Cost - Means Of Financing Projects - Cash Flow Valuation For Assessing Projects - Financial Analysis Common Risks In Projects - Risk Mitigation Methodologies In Projects - Securitization - Project Planning - Network Techniques For Project Implementation - Disbursement, Supervision And Follow Up Of Project By Lender - Monitoring And Follow-Up Of The Project

Vinter, G.D., Project Finance, Sweet & Maxwell Ltd., 6th Edition
Finnerty, J.D., Project Financing – Asset Based Financial Engineering, Wiley Finance
Yescombe, E.R., Principles of Project Finance, Academic Press

MBA838 Working Capital Management (3-0-0) 3

Meaning, Concepts, Classification And Importance,. Excess Or Inadequate Working Capital, Working Capital Financing - Determining The Working Capital Financing Mix - New Trends In Financing Of Working Capital By Banks - Management Of Cash - Receivables Management – Inventory Management – Classification, Codification And Valuation Of Inventories.

Rangrajan and Mishra, Working Capital Management, Excel Publications
Periasamy, P, Working Capital Management –Theory & Practice, Himalaya, 2007
Pandey, I.M., Financial Management Vikas, 9th Edition

MBA841 Service Operations (3-0-0) 3

Introduction, the service concept, customer and relationships, customer expectations and satisfactions, managing supply relations, service processes, service people, resource utilization, network technology and information, performance measurement, linking operations decisions to business performance, driving operational improvement, service strategy, service culture, operational complexity

Robert Johnston and graham clark, Service Operations Management, 2nd Edition, Pearson.
Bill Hollins & Sadie Shinkings, Managing service operations design and implementation.

MBA842 Operations Strategy (3-0-0) 3

Strategic context : strategic management, business environment, strategic design, operations strategy : role of operations management, the concept of an operations strategy, designing an operations strategy; analysis for strategy design, implementing the strategy. Strategic decisions in operation: products and innovation, quality management, process planning and improvement, capacity management, structure of supply chain, movement of materials

Donald Walters, Operations strategy, Thompson Publications.

MBA843 Project Management (3-0-0) 3

Entrepreneurship – generation of project ideas – portfolio models of planning – screening of project ideas. Market opportunity analysis – systematic market appraisal – demand forecasting methods. Technical feasibility – technology development / acquisition – decision on appropriate technology – determination of plant capacity – material inputs and sourcing, structure and civil works. environment appraisal for projects. financial feasibility – estimation of the cost of project – working capital requirement – projected cash flow statement and balance sheet – project appraisal techniques – social cost benefit analysis – Projecting scheduling – tools used in projects scheduling, PERT and CPM, resource allocation in projects – projects control – budgetary control, standard costing and other control measure in project implementation – project abandonment analysis. – organization structure for project implementation – preparation for project reports, methods and techniques – Project financing in India

Chandra Prasanna, Projects: Planning, Analysis, Selection, Implementation and Review, Tata McGraw Hill (4th Edition).

MBA844 Six Sigma (3-0-0) 3

History of six sigma , why six sigma , six sigma and applications in different industries and functions roles and infrastructures , the non-delegable , role of executives , lean and six sigma , work out and six sigma , organization culture and six sigma , the customer connection, process improvement – DMAIC , design for six sigma , process management , managing with dashboards , preparing for six sigma , launching six sigma , cross cultural aspects of deploying six sigma, stabilizing , extending and integrating six sigma, measuring the effectiveness of six sigma, deployment , change management , and communication , black belt selection and development, project selection, project review , replicating results and managing knowledge . Measuring and auditing results, developing change leadership capacity

Rath and Strong, Six Sigma A Leadership Handbook, AON Management Consultant

MBA845 Materials Management (3-0-0)3

Introduction to materials management-role of materials management in business - purchasing & quality sources of supply. International buying - importance - global sourcing - global trading - green purchasing - supply chain management (SCM) - exim policy - exchange rate management - forward contracts . contracts & pricing practices - negotiation - purchase timing - make or buy - capital equipment purchase - sourcing of projects. Strategic material planning - materials budgeting - inventory management -approach to system design. Stores and transportation. stores management - insurance - sales tax - transportation - marine insurance. Policies - standards and practices - procedures.

Gopalakrishnan P. & Sundaresan M., Materials Management: An Integrated approach, Tata-McGraw Hill, New Delhi,1996.

MBA851 Customer Relationship Management (3-0-0) 3

Marketing: Evolution and New Paradigms - CRM – Definition and The Basic Concepts. CRM and Services Marketing - Tools For CRM. Key Account Management - CRM and Knowledge Management – Life Time Value of the Customer. Data Mining and Data Warehousing - Real-World Applications. Strategies for Profitable Dialog with Customers- Sales Force Automation- Marketing Automation- Call Centers- BPO And KPO. CRM Implementation and Effectiveness – Banking- Health Care- Insurance- Travel Industries.

Stanley A. Brown , Customer Relationship Management, Wiley,1st Edition,2000.

Paul Greenberg – CRM at the speed of light – Tata Mcgraw Hill, 3rd Edition, 2004.

Jagdish N. Sheth and others, Customer Relationship Management-A strategic Perspective, Macmillan Publishers India, 1st Edition, 2005.

William G. Zikmund and McLeod, Raymond Jr, Customer Relationship Management, Wiley, 2003.

MBA852 System Thinking and Strategic Modeling (3-0-0) 3

Introduction to system thinking-system philosophy- system theory- system methodology, holistic, operational and design thinking – business architecture- system practice, membership, learning and business systems - analytic approach to system thinking- business process- decision system- introduction to strategic modeling and system feedback thinking- modeling dynamic systems- managing business growth- public sector application of strategic modeling- model validity, mental model and learning.

Jamshid Gharajedhagi, System Thinking, Morgan Kaufhann, 2011
John Morecroft, Strategic Modeling and Business Dynamics, John Wiley and Sons, 2007

MBA853 Enterprise Resource Computing (3-0-0) 3

Overview of enterprise wide software solution – evolution, concept, difference between ERP and traditional information system, overview of the ERP package – ERP market – players and characteristics. technical architecture of ERP systems – distributed computing – client server systems – concept of business objects – distributed object – computing architecture – support for data mining and warehousing. Functional architecture – salient features functional modules of ERP – marketing, finance, human resources, production and operations – comparisons of ERP packages. Implementing ERP systems – business process re engineering using ERP- business process modeling – framework for ERP implementation – extending the scope of ERP through supply chain management and CRM.

Garg V K & Venkitaraman N K, Enterprise Resource Planning: Concepts and erpPractice, Prentice Hall of India, New Delhi, 1998.
Alexis Leon, Enterprise Resource Planning.
Sadagopan, Enterprise Resource Planning.

MBA854 Product Pricing (3-0-0) 3

Key Principles: Overview of Break Even Analysis- Contribution- Discounting- Price-Contribution- Volume Relationship. Demand and Supply- Elasticity - Perfect and Imperfect Competition - Commoditization. Pricing Points - Odd and Even Endings - Sticker Shock and Other Horrors. Understanding Value: Defining Value- The Value Triad and Value Triangle-Differentiation and Value. Pricing Strategies: Cost Based Pricing- Competition Based Pricing-

Market Based Pricing- Overview of Value Based Pricing- Price Building. Assessing Pricing Choices: Impact of Pricing Policy on Business Strategy- Impact of Pricing on Profitability.

Michael V. Marn, Eric V. Roegner and Craig C. Zawada, The Price Advantage, Wiley, 2004.

Baker Ronald J., Pricing on Purpose: Creating and Capturing Value, Wiley, 2006.

MBA8G1 Business Process Design and Reengineering (3-0-0)3

Introduction to BPR - re-engineering and its relationship with functional areas of business, history of re-engineering, deterministic machines, complex dynamic system, interacting feedback loops and social constructs perspectives of BPR. - managing process flows business process and flows – through put rate, work-in-process, cycle time, little's law - cycle time and capacity analysis – cycle time reduction, theory of constraints. - implementation process - redesign of business processes – systematic or clean sheet, main and supporting processes, key enablers of BPR, technology for BPR, critical success factors, cross functional teams, tools and techniques of BPR, virtual ingredient – 'black hole', using process simulation to minimize the risk – business process map and simulation model, parameter analysis, simulation and key performance indicators. - ERP and BPR, ERP in modeling business processes, workflow management systems in BPR, steps of BPR, five-stage model of as-is/to-be analysis, process centric organizations, business process maturity model, business process performance measurement.

Laguna, Business Process Modeling, Simulation and Design, 2005, Pearson.
Chan Meng Khoong, Re-engineering in action, 1st Edition, 2009, Cambridge.
Charles Poirier, Business Process Management Applied, 2005, Cengage.
Varun Grover, M. Lynne Markus, Business Process Transformation, 2010, PHI.
Daniel Minoli, Business Process Re-engineering, 2010, Routledge

MBA8G2 Contemporary Issues in Management (3-0-0) 3

Understanding emerging environment - emergence of vertical environment, understanding hyper-turbulence, networks and business eco-systems, role of information technology , understanding networked, knowledge-based economy - organisations as networks, self-organizing systems, organisational designs for change and innovation – team working, high performance work systems, managing empowerment and accountability, roles and systems in flat, networked organisations, developing competencies for new organizational forms - changing models of people technology and ethical behavior, business success through social responsibilities, cost effective business models – changing business cycles – emerging trends - triple bottom-line concept, ethical leadership , empowerment, teamwork & communication, lean business, customer driven marketing, sustainable competitive advantages , balanced scorecards .

Claude George Jr, The History of Management Thought, Prentice Hall.
Subhash Sharma, Management in New Age: Western Windows Eastern Doors, New Age International Publishers, New Delhi.

Siddharth Shastri (ed.), Indian Management for Nation Building, WISDOM, Banasthali Vidyapith, Banasthali.

MBA8G3 Economic Environment & Policy (3-0-0) 3

Economic and non-economic environment. Interaction between economic and non-economic environment. Analysis of contemporary macro-economic and micro-economic problems and issues, related governmental policies and their impact on the business firm including unemployment, inflation, fiscal and monetary policy. Government regulation of business. Business concentration and anti-trust policy; income distribution and international economic relations.

Welch, Patrick J. and Welch, Gerry F., Economics: Theory and Practice, John Wiley & Sons, 2000.
Mankiw N. Gregory, Macroeconomics, Worth Publishers, 2008.
Bimal Jalan, India's Economic Policy, Viking, 1996.

MBA8G4 International Business Management (3-0-0) 3

Introduction. Globalization of world economy, world trade & foreign investment trends. Technological changes. Types of international business. The cultural dimensions of international business. The global trade and investment environment. Trading practices. World financial environment. Tariff and non-tariff barriers. WTO and regional blocks. Global financial environment. Determinants of exchange rates. International banks. Non-banking financial institutions. Global competitiveness: export and import financing. Licensing and joint ventures. Research and development in global market. Globalization with social responsibility. World economic growth and environment. Negotiations in international business and multilateral settlements.

Hill Charles W. L., International Business: Competing in the Global Marketplace, 5/E, McGraw Hill/Irwin, 2005.
Hill Charles W. L., Global Business Today,4/E, McGraw Hill/Irwin, 2006.
Bhalla V. K. and Shivaramu S., International Business: Environment and Management, Anmol, 2003.

MBA8G5 Enterprise Risk Management (ERM) (3-0-0) 3

Introduction – benefits of risk management , environment of business, know business, establishment checks and balances, set limits and boundaries ,concepts : risk concepts, risk process, risk awareness, risk measurement, risk control, enterprise risk management frame work, enterprise risk management : benefits of enterprise risk management, chief risk officer,

components of ERM. Corporate governance, line management, portfolio management, risk transfer, risk analysis, data and technology, stake holder management , risk management application : credit risk management , market risk management , operations risk management ,business applications , financial institutions , energy firms, non financial corporation's look up to future : predictions

James Lam, Enterprise risk management (ERM): from incentives to control, Publisher : Wiley finance

MBA8G6 Entrepreneurship Lab (3-0-0) 3

Nature and importance of entrepreneurship, entrepreneurial decision making process, role of entrepreneurship in economic development , National knowledge commission report, entrepreneurship- characteristics, motivation, role models and support systems, entrepreneurial entry into international business, MSME's in India , intrepreneurship, entrepreneurial process - identifying and evaluating opportunities, developing business plan, assessment of resources, project appraisal and feasibility plan , creating and starting venture- legal requirements, marketing strategies, financial plans and human resources management, managing growth, concept of family business, conceptual models of family business, challenges facing entrepreneurs -individuals ,family ,groups, society , provisions for nursing sick units.

Robert D. Hisrich and Michael P. Peters, Entrepreneurship, Mc Graw – Hill, 2006

Donald Roratko & Richard Hodgetts , Entrepreneurship – A contemporary approach , PHI, 2007
David holt , New venture Creation - , Prentice hall India, 5TH ED, 2008

MBA8G7 E-Business (3-0-0)3

Introduction to e-commerce – business models in e-commerce – environment – economic and social impact of e-business. Structure and organization of e-business – internet architecture – web technology – structure, sub systems, communications. Salient features of web programming – multimedia production, file conversions – principles of animation – concepts of java, applets and CGI scripts. Building interactivity – component technologies and writing interfaces. Servers, server sw, security aspects of server, tools for preparing web pages. Internet marketing – advertising – attracting traffic to the site – CRM – mobile commerce – cyber laws. marketing an e-business, search engines and directories, consumer communication, news groups & forums, exchanging links, web rings, e-business back end systems, business record maintenance, back up procedures and disaster recovery plans - e-business security/payment services - knowledge management - ERP, e-business backbone - e-business strategy into action, challenges, and e-transition

Andrew S. Tanenbaum, Distributed Operating Systems, Prentice Hall of India.

Bharat Bhasker, Electronic Commerce -Framework, technologies and Applications - TMH Publications
Napier, Judd, Rivers, Creating a winning E-Business, Wagner-Course Technology- Thomson Learning, 2001

MBA8G8 Management Control System (3-0-0) 3

Introduction to MCS - purpose- types- approaches to MCS- cybernetic and contingency approach- business strategy and management control system- hierarchy of control process- industrial dynamics and management control- design of MCS- steps- factors influencing design of MCS- it and design of MCS- key success variables as control indicators- environment and MCS- goals strategy and organization for adaptive control- divisional autonomy and responsibilities- management control tools and - processes – strategic planning and programming process- budgeting and budgetary control- standard costing system and variance analysis for control- transfer pricing- reward system- management control of operations- strategic cost management- auditing as a tool- MCS in organizations-MCS in non-profit organizations- current issues in MCS- corporate governance and management control.

Subhash Chandra Das- Management Control System- Prentice-Hall India- 2011
Kenneth Merchant and Wim Van Der Stede - Pearson Publication- 2011

MBA8G9 Merger and Acquisitions (3-0-0)3

Mergers, Acquisitions, Amalgamations – Strategic Perspective, SWOT Analysis, BCG Matrix, Porter's Five Forces Model – Corporate Restructuring, Methods – Valuation Approaches, Methods Of Financing Mergers, Accounting For Amalgamation, Methods Of Payment, Share Repurchase And Exchanges – Takeovers, Types, Defenses – Legal And Regulatory Framework, Company's Act, Income Tax Act, SEBI Guidelines, Provisions Of Competition Act – International Mergers And Acquisitions.

Weston, F., Chung, K.S., Hoag, S.E. Mergers, Restructuring and Corporate Control, Pearson Education.
Vadapalli., R.,Mergers acquisitions and Business valuation, Excel books, 1/e 2007
Damodaran,A., Corporate Finance-Theory And Practice, John Wiley & Sons

MBA8G10 Services Management (3-0-0) 3

Introduction to service operations - nature of services, strategy and positioning - designing service operations - technology and its impact on services - design and development of services and service delivery systems - work measurement, locating facilities, designing their layout - managing service operations - capacity planning and waiting line management (queuing) - managing capacity and demand - improving service processes – use of tools for process improvement - project presentations

James A. Fitzsimmons, Mona J.Fitzsimmon , Service Management , Tata McGraw Hill

MBA8G11 Supply Chain Management (3-0-0) 3

Supply chain – objectives – importance – decision phases – process view – competitive and supply chain strategies – achieving strategic fit – supply chain drivers – factors influencing distribution – distribution networks in practice – network design in the supply chain –supplier scoring and assessment– procurement process-sourcing planning and analysis– CRM – internal supply chain management – supplier relationship management – Bullwhip effect – obstacle to coordination – building partnerships and trust – collaborative planning, forecasting and replenishment - logistics interfaces with other areas – approaches to analyzing logistics systems. – channels of distribution, cases in supply chain management.

Sunil Chopra and Peter Meindl, Supply Chain Management: Strategy, Planning and Operation, Pearson/PHI, 3rd Edition 2007.
Donald J. Bowersox, D J Closs, M B Coluper, Supply Chain Logistics Management, TMH, Second Edition, 2008.
Wisner, K Leong and Keah – C Tan- Principles of Supply Chain Management: A Balanced Approach, Thomson Press, 2005.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

CS901 WIRELESS NETWORKS & SYSTEMS 4

Introduction to network resilience problems & solutions, Wireless beyond 3G, Performance modeling of (Wireless)networks & Formal Methods, Network design algorithms and Network design using Network Processors, Wireless Ad-hoc Networks, Security Issues in control, Management, routing and other areas of networks, Distributed control in(Wireless) network and Middleware, Distributed Mobile Computing, Embedded Systems in Mobile/ Wireless/Network Systems – Hardware & Software Design/ Development issues, Standardization in Wireless / Mobile Network Systems.

Theodore. S Rappaport, Wireless Communications – Principles & Practices, Pearson Education, 2nd Edition, 2002.

Boucher. N, Cellular Radio Handbook, Quantum Publishing, 1991.

Feng & Leonidas, Wireless Sensor Networks, Elsevier India, 2005.

CS902 NETWORK MANAGEMENT 4

Network management Overview, Network Management, SNMP and Network Management, TMN, Network Management Applications, Management of Heterogeneous Network with Intelligent Agents, Network Security Management, Internet Management(IEEE Communication May, Oct /03), QoS in IP Network, Basic Methods & Theory for Survivable Network Design & Operation, Network Planning, Network Management Standards.

Subramanian M., Network Management: Principles and Practice, Addson – Wesly, 2000

James F. Kurose and Keith W. Rose, Computer Networking, Pearson Education, LPE, 2003

Burke J., Network Management Concepts and Practice, A Hands- On Approach, Pearson Education

John Strassner, Policy based Network Management, Elsevier India, 2004.

CS903 EVOLUTIONARY COMPUTING 4

Introduction to Evolutionary Computation, Search Operators , Selection Schemes, Search Operators and Representations , Evolutionary Combinatorial Optimisation , Co-evolution, Niching and Speciation, Constraint Handling , Genetic Programming , Multi objective Evolutionary Optimisation, Learning Classifier Systems ,Theoretical Analysis of Evolutionary Algorithms.

Baeck T., D. B. Fogel, and Z. Michalewicz (eds.), Handbook on Evolutionary Computation, IOP Press.

Z Michalewicz, Genetic Algorithms + Data Structures = Evolution Programs (3rd edition) Springer-Verlag,1996.

Goldberg D E, Genetic Algorithms in Search, Optimisation & Machine Learning, Addison-Wesley, 1989.

CS904 SOFTWARE & IT SYSTEMS – ARCHITECTURE, MEASUREMENT AND TESTING 4

Architecture, Measurement, Testing, Tools.

Len Bass, Software Architecture in practice, Paul elements & Rick Addison – Wesley

Edward Kit, Software Testing in the Real world, Pearson Education

Craig R. D. &. Jaskiel S. P, Systematic Software Testing, Artech House, Bosten.

CS905 BIOINFORMATICS 4

Introduction to Bioinformatics, Biological Databanks, Sequence Analysis, Structure Prediction, Protein Folding, Proteomics, Emerging Areas in Bioinformatics.

Krane D.E. & Raymer M.L, Fundamental Concepts of Bioinformatics, Pearson, 2003

Attwood & Parrysmith: Introduction to Bioinformatics, Pearson Ed, 2003

Zoe.L & Terenee. C, Bioinformatics, Elseiver, 2004.

CS906 VLSI SYSTEMS-DESIGN & TESTING: PERSPECTIVES FROM COMPUTER ENGINEERING 4

State machine model design of VLSI system, Computational aspects of VLSI and algorithm, Genetic algorithms for VLSI Design partitioning cell routing.

S. Sjoholm & L. Lindth, VHDL for Designers, Prentice Hall.

J. D. Ullman, Computational aspects of VLSI, Computer Science Press

Genetic Algorithm for VLSI Design, Layout & Test Automation, Pinaki Mazumder, Elizabeth M. Rudrick PH PTR

CS907 PROTOCOLENGINEERING 4

Protocol Design & Implementation, Protocol Verification and Validation, Protocol Testing, Formal Methods (FDTs)

Web sites, IEEE, ISO and ITU-T sites.

P. Venkatram & S. S., Manavi, Communication Protocol Engineering, PHI, 2004.

CS908 SOFTWARE RELIABILITY & FAULT TOLERANCE 4

Introduction to fault tolerant computing, Software Safety, Software Fault Injection and fault analysis.

Les Hatton, Software Faults & Failures, Addison Wesley, 2000.

Neil Storey, Safety critical computer systems, Addison Wesley, 1996.

CS909 SIMULATION & MODELING 4

System models, System Simulation, Exponential growth models, exponential decay models, Discrete system simulation, Web based simulation and Distributed Simulation.

Geoffrey Gordon, System simulation, Prentice Hall, 1987

Maryanski. F., Digital Computer Simulation, CBS Distributors.

Banks and Carson, Discrete Event System simulation. Prentice Hall 2004.

Bernard, Herbert & Tag, Theory of modeling and simulation, 2/e, Elsevier India, 2004.

CS910 WEB ENGINEERING 4

Requirements specification and analysis, Web-based systems development methodologies and techniques ,Migration of legacy systems to Web environments ,Web-based real-time applications development, Testing , verification and validation ,Quality assessment, control and assurance, Configuration and project management, "Web metrics" – generating metrics for estimation of development efforts, Performance specification and evaluation ,Update and maintenance, Development models, teams, staffing, Integration with legacy systems, Human and cultural aspects, User-centric development, user modeling and user involvement and feedback, End-user application development.

Journal of Web Engineering, Rinton Press & IEEE and ACM publications on these areas.

Cato & John, User centered Web design, Pearson Education, 2001.

Zimmermann Olaj, Tomlinson Mark R, Peuser, Stefan, Perspectives on Web Services, Allied Publishers, 2004.

CS911 ADVANCED PARALLEL COMPUTATION 4

Survey of leading high-end computing systems and their programming environments. Advanced models of parallel computation. Mapping of parallel algorithms to architectures. Performance programming and tools for performance optimization on parallel systems. Execution environments and system software for large-scale parallel computing. Multiprocessor Programming, Case studies of parallel applications, Expression of parallelism: CUDA, SSE and OpenMP

Ananth Grama, George Karypis, Vipin Kumar, and Anshul Gupta: "Introduction to Parallel Computing, Addison-Wesley, 2003.

Michael J. Quinn: "Parallel Programming in C with MPI and OpenMP". McGraw Hill Higher Education, 2004.

Ian Foster, Designing and Building Parallel Programs.

CS 912 ADVANCED OPTIMIZING COMPILERS 4

Introduction and Motivation, Effectiveness of parallelizing compilers, Basic Transformations, Program Analysis, Advanced Loop Optimizations, Program Analysis, Performance of Compiler Techniques, optimizations for Accelerators, Class Presentations.

Michale Wolfe, High Performance Compilers for Parallel Computing, Addison-Wesley

Utpal Banerjee, Ken Kennedy and John R. Allen, Optimizing Compilers for Modern Architectures: A Dependence-based Approach, Morgan Kaufmann Publishers.

Cooper and Torczon, Engineering a Compiler, Morgan Kaufmann, 2004

CS913 INTELLIGENT INFORMATION RETRIEVAL 4

Overview of IR Systems, Historical Perspectives, Basic Evaluation, Document Representation: Statistical Characteristics of Text, Basic Query Processing, Data Structure and File Organization for IR, Automatic Indexing and Indexing Models, Retrieval Models: Similarity Measures and Ranking, Boolean Matching, Vector Space Models, Probabilistic Models, Search and Filtering Techniques: Relevance Feedback, User Profiles, Collaborative Filtering, Document and Term Clustering, Document Categorization, IR Systems and the WWW, Heterogeneous Information Sources, Intelligent Web Agents, Web Mining and Its Applications.

D. Grossman and O. Frieder. Information Retrieval: Algorithms and Heuristics, Kluwer Academic Press, Richard K. Belew, Finding Out About: A Cognitive Perspective on Search Engine Technology and the WWW, Cambridge University Press, 2001.

C. J. van Rijsbergen , Information Retrieval(online book).

CS914 AUTONOMIC COMPUTING 4

Key concepts and techniques underlying the design and engineering of autonomic computing and networking (AC) systems, characteristics of AC, foundational AC principles based on control theory, artificial intelligence and systems concepts. Architectures and technologies for AC, Machine learning in AC systems, Agent-based systems, Algorithms and optimization methods for AC, Autonomic networking and communications , Advanced topics, Case studies and technologies used to implement AC systems.

Joseph L. Hellerstein, Yixin Diao, Sujay Parekh, Feedback Control of Computing Systems, John Wiley & Sons, Inc, 2004

CS915 NETWORK ALGORITHMS 4

Algorithms for data aggregation in networks and distributed systems, algorithms for distributed search, algorithms for distributed configuration management, and algorithms for distributed trust and reputation schemes, overlay networks.

Ravindra K. Ahuja, Thomas L. Magnanti, James B. Orlin. Network flows. Theory, Algorithms, and Applications. Prentice-Haal, Englewood Cliffs, New Jersey, 1993

Alexander Schrijver, Combinatorial Optimization. Polyhedra and Efficiency. Springer-Verlag, 2003.

Christos H. Papadimitriou, Kenneth Steiglitz , Combinatorial optimization : Algorithms and complexity .

COURSE CONTENTS - 900 Level Courses

DEPARTMENT OF METALLURGICAL & MATERIALS ENGINEERING

MT900 Metallurgical Process Design 3

Design and its significance. Modern trends, fluid flow and heat transfer principles applicable to design. Furnaces, classifications, Glinkove theory. Burners. Principles of chimney design. Fuel economy. Design features of electric arc furnaces, induction furnaces, reheating furnaces and soaking pits. Refractories for furnaces.

A. Glinkove, A Ggeneral Theory of Furnaces, Mir Publishers Moscow, 1980
G. E. Dieter, Engineering Design, 2nd Edition, McGraw Hill, 1990

MT901 Mass Transfer and Chemical Kinetics 3

Review of various rate theories, Gibbs and Langmiuir isotherms, diffusion in solids, liquids and gases. Mass Transfer: interfacial phenomenon-significance, interfacial turbulence, electrocapillary effects, enhanced vaporization electro-chemical theory of smelting and refining. Process analysis, impinging jets and submerged jets. Continuous flow systems. Analysis of single particle reactions - correlation with packed beds and fluidised beds.

N. J. Thumelis, Transport and Chemical Rate Phenomena, Gordon Breach, New York, 1995

MT902 Thermodynamics of Solids 3

First law of thermodynamics, second law of thermodynamics, some relations between thermodynamics quantities, thermodynamics of phase transformation and chemical reactions. Partial molar and excess quantities. Thermodynamic properties of alloy system - equilibrium between phases of variable composition. Free energy of binary system. Thermodynamics of surfaces and interfaces. Classification of defects in the crystal, defects in the metals, defects in elemental semiconductors, defects in nearly stoichiometric compound, defects in non - stoichiometric compound.

R. A. Swalin, Thermodynamics of solids, John Wiley, 1962

MT903 Solidification of Metals 3

Heat flow in solidification, plane front solidification of single phase alloy, cellular solidification, plane front solidification of polyfront alloy, solidification of castings and ingots, solidification of polyphase alloy. Fluid flow, thermodynamics of solidification, nucleation and interface kinetics growth. Processing and properties: homogenization, mechanical properties of equiaxed cast structure, properties of columnar structure, aligned composites, effect of working.

M.C. Flemings, Solidification Processing, McGraw Hill, 1974
W. Kurz, D. J. Fischer, Fundamentals of Solidification, Trans Tech, 1984.

MT904 Materials Science & Engineering 3

Introduction, atomic structure and bonding, crystal structure and crystal geometry, solidification, crystal imperfections and diffusion in solids, electrical properties of materials, mechanical properties of metals, polymeric materials, phase diagrams, engineering alloys, ceramic materials, silicate structure, processing of ceramics, electrical, mechanical, thermal properties of ceramics. Magnetic materials, corrosion, composite materials, optical properties, superconducting materials.

E. Reed Hill, Introduction to Physical Metallurgy, Van Nostrand, East west Press, New Delhi, 1973.

MT905 **Plastic Deformation** 3

Interatomic forces, metallic crystals and their elastic properties, elementary theory of structural imperfections in crystals, plastic deformation of single crystals, plastic deformation of polycrystals. Deformation textures, characteristics and driving forces of softening process in deformed crystals. Fracture, resistance of metal to plastic deformation, ductility and deformability of metals and alloys, thermo-mechanical treatment, superplasticity and its applications.

G. E. Dieter, Mechanical Metallurgy, McGraw Hill, 1988.

MT906 **Structure & Properties of Alloys** 3

Structure of pure metal, properties of pure metal, solidification solid solution, working and annealing, two phase alloy, Aluminum alloys and age hardening, magnesium and berylium, theory of heat treatment of steels, steels for structural applications, carbon and alloy tool steels, stainless steels, cast iron, reactive and refractory metals for high temperature applications, failure of materials, non-destructive testing.

MT907 **Heat Transfer** 3

Modes of heat transfer, one dimensional, steady state conduction, transient conduction, external flow (convection), internal flow (convection), free (natural, buoyant) convection, boiling and condensation, radiation, radiation exchange between surfaces.

J. P. Holman, Heat Transfer, 9th Edition, McGraw Hill, 2002.

MT908 **Corrosion Engineering** 3

Definition of corrosion, corrosion damage, standard expressions for corrosion rate, classification of corrosion, electrochemical aspects, electrochemical reactions, Pourbaix diagrams, mixed potential theory, polarization, Evan's diagrams, passivity, effects of environment - oxygen and oxidizers, temperature, corrosive concentration, cathode/anode area ratio, galvanic coupling using mixed potential theory. Forms of corrosion - uniform, galvanic, crevice, intergranular, pitting, selective leaching, erosion, stress corrosion, corrosion fatigue, fretting. Corrosion rate measurements - Tafel and linear polarization, AC impedance, small - amplitude cyclic voltammetry. Corrosion testing. Interpretation of results, Corrosion protection: materials selection, alternative environment, design, cathodic and anodic protection, coatings, High - temperature corrosion: mechanisms and kinetics, high - temperature materials.

Mars G. Fontana, Corrosion, McGraw - Hill Book Company 1986.

David Talbot and James Talbot, Corrosion Science and Technology, CRC Press, NewYork, 1998 Denny A. Jones, Principles and Prevention of Corrosion, Maxwell Macmillan 1992 Metals Handbook, Vol.13, Corrosion, ASM Metals Book, Ohio, 1987.

MT909 **Surface Engineering** 3

Surface Cleaning: Classification and Selection of Cleaning Processes Finishing Methods: Classification and Selection of Finishing Processes; Topography of Surfaces; Microstructural Analysis of Finished Surfaces Plating and Electroplating: Electrodeposition Processes: Copper Plating; Nickel Plating; Zinc Plating; Zinc Alloy Plating; Selective (Brush) Plating; Electroforming. Nonelectrolytic Deposition Processes: Eletroless Nickel Plating; Electroless Alloy Deposition Dip, Barrier and Chemical Conversion Coatings: Batch Hot Dip Galvanized Coatings; Phosphate Coatings; Chromate Conversion Coatings; Rust Preventive Compounds; Painting; Ceramic Coatings and Linings; Anodizing. Vacuum and Controlled - Atmosphere Coating and Surface Modification Processes: Thermal Spray Coatings; Chemical Vapor Deposition of Nonsemiconductor Materials; Chemical Vapor Deposition of Semiconductor Materials; Plasma - Enhanced Chemical Vapor Deposition; Growth and Growth - related Properties of Films Formed by Physical Vapor Deposition; Vacuum Deposition, Reactive Evaporation, and Gas Evaporation; Sputter

Deposition; Ion Plating; Ion-Beam-Assisted Deposition; Arc Deposition; Ion Implantation; Diffusion Coatings; Pulsed - Laser Deposition. Testing and Characterization of Coatings and Thin Films: Film Thickness Measurements Using Optical Techniques; Corrosion Testing; Evaluation of Mechanical Properties of Thin Films.

P. K. Dutta & I. S. Gray, Surface Engineering, Vol. I - III, Royal Society of Chemistry, 1993.
ASM Hand Book, Vol.5, ASM International, Metals Park, Ohio, 1999.
Kenneth G. Budinsk, Surface Engineering for wear resistance, Prentice Hall, NJ 1988.

MT910 Instrumental Methods of Analysis 3

Spectroanalytical Methods: Introduction and fundamentals, Beer-Lambert's law, Selection rules; Fundamental principles, instrumentation and applications of IT spectroscopy, UV-visible spectroscopy, Raman spectroscopy, Atomic absorption spectroscopy; Thermal Analysis: Fundamental principles, instrumentation and application of Thermogravimetry, Differential thermal analysis, Differential scanning calorimetry, Dynamic mechanical thermal analysis, Hyphenated techniques; Surface characterization by spectroscopy, Fundamental principles, instrumentation and applications of X-ray photoelectron spectroscopy, TOF-SIMS; Surface analysis by microscopy, Fundamental principles, instrumentation and application of Scanning probe microscopy, Scanning tunneling microscopy, sample preparation techniques for electron microscopy.

J. W. Robinson, E. M. S. Frame and G. M. Frame II, Undergraduate Instrumental Analysis, 6th Ed., Marcel Dekker, 2005.
D. A. Skoog, F. J. Holler and T. A. Nieman, Principles of Instrumental Analysis, 4th Ed., Harcourt, 2001.
C. R. Brundle, C. A. Evants, Jr., and S. Wilson, Encyclopaedia of Materials Charaterization, Butterworth-Heinemann, 1992
J. D. Menczel, R. B. Prime, Thermal Analysis of Polymers, Wiley, 2009.
http://www.cem.msu.edu/~reusch/VirtualText/Spectrphy/spectro.htm#intro

DEPARTMENT OF HUMANITIES, SOCIAL SCIENCES & MANAGEMENT

HU800 Introduction to Research (1-1-0) 2

Mandatory Learning Course for I/IISem PhD/ MTech (Research).

Course Description: The course is offered at the introductory level, is intended to create awareness in the learner to get insight into various aspects of scientific research and challenges ahead. Every Researcher today needs certain minimum knowledge of how to conduct good and effective research, which is also the mandate of UGC *(Gazette Notification July 11, 2009, Section 1)*. Research concepts are discussed with case studies wherever applicable. The course provides the learner knowledge of various research approaches and applications in different areas of science, engineering and management. It also imparts knowledge of importance of theoretical and conceptual frame work adopted for research, conducting literature review, literature map, identifying research gaps, writing research questions and objectives, various research methods, sampling design and data analysis, findings and inferences, data presentation, referencing and report writing.

Course Objectives:

1. To appreciate role of scientific research in teaching and learning
2. To understand the relevance of theoretical and conceptual framework.
3. To identify the various methods, tools and sampling designs used in research.
4. To acquaint with the methods of data analysis and interpretation of results.
5. To be conversant in writing a research report.

Course Contents: Nature of science, Human Inquiry and Science , Learning and creativity , Innovation and creativity, Nature of Research, Research Ideas and problems, Critically Reviewing the Literature and Literature Map, Identifying research gaps , Framing research questions, Research objectives, Ethics in Research, Research approaches and strategies, Research Design: Conceptualization, Operationalization and Measurement, Sampling: Probability and Non - Probability, Using Primary and Secondary Data, Quantitative and Qualitative Methods and Procedures, Data Analysis: Presentation, Exploring and Examining; Communicating research findings: Written, oral, visual; Referencing .

Pedagogy: The instructional tools consist of lectures, journal articles reviews, case studies, simulation packages, group discussions.

William M.K. Trochim, "Research Methods", Biztantra publications II Editions

John W. Creswell, "Research Design, Qualitative, Quantitative and Mixed Approaches", Sage Publication, 2003.

Earl Babbie, "The Basic of Social Research", Wadsworth- Thomson Learning, 2nd Edition, 2002.

E. M. Phillips and D. S. Pugh, "How to Get A PhD -A Handbook for PhD Students and their Supervisors", Viva Books Pvt Ltd, 2006

Antony Wilson, Jane Gregory, Steve Miller, Shirley Earl, "Handbook of Science Communication, Overseas Press India Pvt. Ltd, New Delhi, 2005

Donald R. Cooper and Pamela S. Schindler, "Business Research Methods", TMH, New Delhi, 9th Edition, 2006.

Annexure - XXX

DEPARTMENT OF CHEMICAL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL.

Proceedings of the DUGC:

The Department Undergraduate Committee met on 28th May, 2012 to look into the need for any change that may be required in the apportioning of credits for the undergraduate program.

The faculty of the Department of Chemical Engineering, are of the view that, there has been a disproportionate emphasis on electives in comparison with foundation and program core courses. It is felt that electives should carry a lesser weightage than what has been proposed as requirement for award of degree.

The department proposes the following weightages:

Foundation Courses: 45-55 Credits
Program Core: ≥60 Credits
Electives: ≥40 Credits

This would give departments the leverage to judiciously apportion core and elective subjects and still meet the credit limits of 170-180.

This may be placed before the BOS for consideration and necessary action.

Members Present

D V R Murthy

M B Saidutta

G Srinikethan

I Regupathi

P E Jagadeesh Babu

Annexure - XXXI

Proceedings of DUGC Meeting held on 25-05-2012

Subject: Relaxation on minimum credit requirement for the Elective Courses (EC) to be offered in the proposed B. Tech. Curriculum for the academic year 2012-13 onwards.

Facts:

In the proposed B. Tech. Curriculum. for the academic year 2012-13 onwards, it was suggested to adopt following structure;

Foundation Courses (FC)	: 45-55	Programme Core Courses(PC)	: ≥ 60
Electives Courses (EC)	: ≥ 50	Programme Major Project:	: 8-12
Manadatory Learning Courses	: 5		

Total Credits :170-180

As a consequence, the credits for some of the important PC courses need to be reduced to 3 credits from the existing 4 credits. In addition, many of the Core Courses have to be offered as Elective courses because of the constraint of offering minimum of 50 credits for the elective courses. This may lead to a situation where students may pass out without studying some important courses. It was also noted that the credits for the Electives (PSE+OE) in the earlier curriculum was just 31 as against ≥ 50 in the proposed new curriculum.

Recommendations of the DUGC:

In the light of the above facts, the DUGC of the Department of Metallurgical and Materials Engineering opines that the minimum credit requirement for the Elective courses to be offered in the proposed new curriculum be modified to 30 credits in place of 50 credits; and recommends that the matter may be placed in the forth coming Board of Studies (BoS) Meeting to be held on 8th June 2012 for discussion and decision.

Members of DUGC:

1. Dr. Udaya Bhat (Secretary)
2. Prof. K Rajendra Udupa 25/05/12
3. Prof. Jagannath Nayak
4. Dr. P L N Reddy
5. Dr. Ravishankar K S
6. Mr. Shashibhushan Arya
7. Prof. K Narayan Prabhu (Chairman) For 25.5.12

Annexure - XXXII

Department of Electrical and Electronics Engineering

National Institute of Technology Karnataka Surathkal

Mangalore -575025

PROCEEDINGS OF THE DUGC MEETING HELD ON 13TH April, 2012

Date13 -04-2012

AGEND A: The need for a suitable and tenable policy to aid/direct the mechanism of administration of the 'MakeUp'(EndSemester) Test and also to decide upon the eligibility of a student to appear thereat.

PREAMBLE: Over the past two/three years, there have been an increasing number of requests from the UG Students (belonging to different branches) for taking the 'MakeUp' (EndSemester) Test, pertaining especially to the course EE100 (with a few requests for other courses as well).In most such cases, the students concerned (applicants for the MakeUp Test) are not regular registrants of the course (for which the MakeUp Test is being requested) during the concurrent (running) academic session. It then becomes a very tedious (and sometimes impossible) task to locate the insemester performance records of the applicants more so when the applicant asks for a 'MakeUp' (EndSemester) Test, TWO or THREE (or even more) years after he had been a regular registrant for thesaid course and had obtained an FF grade therein. Moreover, it is sometimes difficult to verify whether the applicant has been awarded an FF grade or an FA grade. The traceability of this detail becomes even more complicated when the Teaching Department (of the said course) is other than the applicant's Parent Department. This Department has experienced considerable trouble in addressing the above aspects and therefore feels the need for a suitable and tenable policy in respect of the administration of the 'MakeUp" (EndSemester) Test.

The DUGC (EE) deliberated upon the above matter and concurred to draw the following resolution.

RESOLUTION: It is hereby resolved to approve the following recommendations:

1. *Only regular registrants of a given course* (e.g. EE100) *during a given academic session* (e.g. EVEN Semester 2012), *who have obtained an FF grade* in the said course be granted permission to appear for a 'MakeUp' (EndSemester) Test scheduled after the regular EndSemester Test *of that very academic session*.
2. Students obtaining FF grade even after appearing for the 'MakeUp' (EndSemester)Test (or who do not appear/apply for the 'MakeUp' (EndSemester)Test are to be required to reregister for the said course, whenever the course is subsequently offered. (This is similar to the case of the FA graders)
3. Having agreed upon the above two points; there is a need to provide clarity on the admissibility of a claim for Summer Term registration.

Approved for forwarding to the BOS (NITK) for necessary deliberation and onward transmission, if required.

Secretary, DUGC (EE)

Chairman, DUGC (EE) Professor and Head
Dept. of Electrical & Electronics
NATIONAL INSTITUTE OF TECHNO
KARNATAKA, SURATHKAL
Mangalore - 575 025, (D.K.)

Members, DUGC (EE)

(1) (Dr. Udaya kumar R. Y)

(2) (K. MANJUNATHA SHARMA) K. Manjunatha Sharma

(3) Debashisha Jena

(4) Dr. P. Parthiban (P. Parthiban 13/04/12)

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EED/232/2012

BOS 14
XXXIII

Department of Electrical and Electronics Engineering

National Institute of Technology Karnataka Surathkal
Mangalore -575025

PROCEEDINGS OF THE DUGC MEETING HELD ON 28TH MAY, 2012

Date 28-05-2012

AGENDA: Evaluate the need for Sumer course and its registration process in the curriculum

RESOLUTION: The DUGC (EE) deliberate on the need for sumer course and its registration process in the curriculum and resolved to request the BOS (NITK) to abolish the summer course and its registration process as there is a make up exam option available at the end each semester.

Secretary DUGC

Chairman DUGC
Professor and Head
Dept. of Electrical & Electronics Engg.
NATIONAL INSTITUTE OF TECHNOLOGY
KARNATAKA, SURATHKAL
Mangalore - 575 025. INDIA

Members of DUGC

Name	Signatures
1. K. MANJUNATHA SHARMA	K. Manjunatha Sharma
2. Dr. Debashisha Jena	
3. Dr. P. Parthiban	P. Parthiban

BoS Agenda
28.05.2012