2. Branches of Study

Branch :

1. Aerospace Engineering
2. Bio-Technology
3. Chemical Engineering
4. Civil Engineering
5. Computer Science and Engineering
6. Electrical Engineering
7. Engineering Physics
8. Mechanical Engineering
9. Metallurgical and Materials Engineering
10. Naval Architecture and Ocean Engineering

Duration : 4 years (8 semesters)

3.1 SEMESTER WISE CREDIT REQUIREMENTS ABSTRACT

Dept.	I	II	III	IV	V	VI	VII	VIII	Total
AE	20	20	21	22	20	24	21	17	165
BT	20	23	20	20	20	22	26	14	165
CH	20	24	21	21	22	25	20	12	165
CE	20	22	21	23	21	23	21	14	165
CS	20	19	23	21	23	24	23	12	165
EE	20	20	23	21	20	24	20	17	165
ME	20	19	21	26	23	22	21	13	165
MM	20	22	23	20	21	21	22	16	165
OE	21	23	24	16	22	22	20	17	165
EP	20	20	22	21	25	21	21	15	165

3.2 CATEGORY-WISE & BRANCH-WISE CREDIT REQUIREMENTS

CATEGORY	CODE	CAT CR	AE	BT	CE	CH	CS	EE	EP	ME	MM	OE
1. HUMANITIES	HSS	9	9	9	9	9	9	9	9	9	9	9
	HPF	2	2	2	2	2	2	2	2	2	2	2
2. BASIC SCIENCES:		29										
PHYSICS	SPH		8	8	8	8	8	8	8	8	8	8
CHEMISTRY	SCY		7	7	7	7	7	7	7	7	7	7
MATHS	SMA		12	12	12	12	12	12	12	12	12	12
LIFE SCIENCE	SLS		2	0	2	2	2	2	2	2	2	2
3. BASIC ENGG												
THEORY	BET	14-17	17	17	17	17	17	14	17	17	17	17
SKILLS	BES	5	5	5	5	5	5	5	5	5	5	5
4. PROFESSIONAL												
MAJOR		60-67										
THEORY COURSES	PMT		55	64	67	67	61	65	66	67	64	60
LABORATORY	PML	5-12	12	10	6	6	9	8	8	5	7	10
SELF STUDY	PSS	3-4	3	3	3	4	4	3	3	3	3	3
PASS/FAIL	PPF	3-6	6	-	-	-	-	-	-	-	-	-
PROJECT	PMP	8-12	9	10	9	8	11	12	8	10	11	12
INDUSTRIAL TRAINING	PIT	2	2	2	2	2	2	2	2	2	2	2
INDUSTRIAL LECTURE	PIL	1	1	1	1	1	1	1	1	1	1	1
5. MINOR ELECTIVES	MNS	9	9	9	9	9	9	9	9	9	9	9
6. FREE ELECTIVES			6	6	6	6	6	6	6	6	6	6
TOTAL		**165-180**	**165**	**165**	**165**	**165**	**165**	**165**	**165**	**165**	**165**	**165**

4. B. Tech Curriculum

4.1 Semesters I & II
(Common for all Branches)

SEMESTER I

No.	Subject	L	T	P	Credit	Cat.
MA101	ELEMENTS OF CALCULAS	3	0	0	3	SMA
PH101	PHYSICS I	3	0	0	3	SPH
CY101	CHEMISTRY I	3	0	0	3	SCY
ID110	CONCEPTS IN ENGINEERING DESIGN	2	0	0	2	BET
CS110/ ME110	COMPUTATIONAL ENGG. / THERMODYNAMICS	3	0	0	3	BET
*	INTRODUCTION TO ……PROFESSION	2	0	0	2	PMT
WS101	WORKSHOP I	0	0	6	2	BES
PH103	PHYSICS LAB. I	0	0	3	1	SPH
CY103	CHEMISTRY LAB I	0	0	3	1	SCY
	Total	14	0	12	20	

*** Professional Major Theory (PMT) Courses :**

Branch	Course	Title	Cr.
AE	AS101	Introduction to Aerospace Engg	2
BT	BT101	Life Sciences	2
CH	CH101	Introduction to Chemical Engg	2
CE	CE101	Introduction to Civil Engg.	2
CS	CS130	Introduction to Cs And E	2
EE	EC100	Introduction to Electrical Engg	2
ME	ME111	Introduction to Mechanical Engg	2
MM	MM101	Introduction to Materials Engg	2
NA	OE101	Introduction to Ocean Engg and Oceanography	2
EP	EP101	Introduction to Engg. Physics	2

SEMESTER II

No.	Subject	L	T	P	Credit	Cat.
MA102	VECTORS, MATRICES AND DIFFERENTIAL EQUATION	3	0	0	3	SMA
PH102	PHYSICS II	3	0	0	3	SPH
CY102	CHEMISTRY II	3	0	0	3	SCY
CS110/ ME110	COMPUTATIONAL ENGG./ THERMODYNAMICS	3	0	0	3	BET
AM110/ EE110	ENGINEERING MECHANICS / BASIC ELECTRICAL ENGINEERING	3/ 3	1 0	0 0	4/ 3	BET
*	ONLY FOR BT, CH, CE, EE, MM & NA	2/4	0	0	2/4	PMT
ME112	ENGG. DRAWING1	0	3	2	BES	
WS102	WORKSHOP II	0	0	3	1	BES
PH104	PHYSICS LAB. II	0	0	3	1	SPH
	Total	18/20	1	9	19/24	

*** Professional Major Theory (PMT) Courses :**

Branch	Course No.	Title	Cr.
BT	CH102	Process Calculations	4
CH	CH102	Process Calcualtions	4
CE	CE102	Functional Design Of Buildings	2
EE & EP	EC101/ EC104	Electrical And Magnetic Circuits / Digital Systems	4
MM	MM102	Science And Engg. Materials	3
NA	OE102	Materials And Production Process	4

\+ AM110 to be offered to AE, CE, ME & NA branch students in the II semester & BT, CH, CS, EE, EP & MM in III Semester.
EE110 dropped for EE students
EE 110 to be offered to BT, CH, CS & MM in II Semester, to AE, CE, ME & NA in III Semester & to EP in IV Semester.

4.2 B. Tech Curriculum (Semesters III to VIII)

4.2.1 AEROSPACE ENGINEERING :

AE

SEMESTER III

No.	Subject	L	T	P	C	Cat.
ID120	ECOLOGY AND ENVIRONMENT	2	0	0	2	BET
BT101	LIFE SCIENCES 2	0	0	2	SLS	
HS	Humanities Elective I	3	0	0	3	HSS
MA	Mathematics Elective III	3	0	0	3	SMA
EE110/	BASIC ELEC. ENGG.	3	0	0	3	BET
AS102	FLUID MECHANICS	3	1	0	4	PMT
AS201	BASIC STRENGTH OF MATERIALS	3	1	0	4	PMT
	Total	19	2	0	21	

SEMESTER IV

No.	Subject	L	T	P	C	Cat.
HS	Humanities Elective II	3	0	0	3	HSS
MA	Mathematics Elective IV	3	0	0	3	SMA
AS202	STRUCTURES	3	1	0	4	PMT
AS203	GAS DYNAMICS	3	1	0	4	PMT
AS205	AERODYNAMICS	3	1	0	4	PMT
AS226	PROPULSION I	3	0	0	3	PMT
AS251	LOW SPEED LAB	0	0	3	1	PML
	Total	18	3	3	22	

AE

SEMESTER V

No.	Subject	L	T	P	C	Cat.
	Minor Elective I (Core)	3	0	0	3	MNS
AS204	FLIGHT DYNAMICS I	3	0	0	3	PMT
AS206	EXPERIMENTAL AERODYNAMICS	3	0	0	3	PMT
AS327	PROPULSION II 3	0	0	3	PMT	
AS301	INTRODUCTION TO SPACE TECHNOLOGY	3	0	0	3	PMT
AS303	Vibrations	0	0	0	3	PMT
AS252	PROPULSION LAB	0	0	3	1	PML
AS351	AERO LAB 1	0	0	3	1	PML
	Total	15	0	6	20	

SEMESTER VI

No.	Subject	L	T	P	C	Cat.
	Minor Elective II (Core)	3	0	0	3	MNS
AS305	FLIGHT DYNAMICS II	3	0	0	3	PMT
AS306	EXPERIMENTAL STRESS ANALYSIS - Self Study	3	0	0	3	PSS
	Elective I	3	0	0	3	PMT
	Elective II	3	0	0	3	PMT
	Elective III	3	0	0	3	PMT
AS521	AERODYNAMIC DESIGN	1	0	5	3	PML
AS352	AERO LAB II	0	0	3	1	PML
	Total	19	0	8	22	
AS350	INDUSTRIAL TRAINING (Summer)	0	0	2	2	PIT

SEMESTER VII

No.	Subject	L	T	P	C	Cat.
	HS Professional Ethics (P/F)/ HS Elective III	2/3	0	0	2/3	HPF/ HSS
	Minor Elective III	3	0	0	3	MNS
	Free Elective I	3	0	0	3	*
	Elective IV	3	0	0	3	PMT
	Elective V	3	0	0	3	PMT
	Elective VI	3	0	0	3	PMT
AS522	STRUCTURAL DESIGN	1	0	5	3	PML
AS451	EXPERIMENTAL STRESS ANALYSIS LABORATORY	0	0	3	1	PML
AS459	PROJECT I	-	-	-	0	PMP
	Total	18/19	0	8	21/22	

SEMESTER VIII

No.	Subject	L	T	P	C	Cat.
HS	Professional Ethics (P/F)/ HS Elective III	2/3	0	0	2/3	HPF/ HSS
	Free Elective II	3	0	0	3	*
AS452	FLIGHT TEST LAB	0	0	3	1	PML
AS402	INDUSTRIAL LECTURE (Pass/Fail)	0	0	0	1	PIL
AS460	PROJECT II	0	0	9	9	PMP
	Total	5/6	0	12	16/17	

Note :

1. Electives I to VI from enclosed Aero Electives List or their equivalents from other Departments with the consent of the Faculty Adviser.
2. If required by subject area of B.Tech. project, a maximum of two electives relevant to the project area may be taken for PMT credit even though they are not in Aero Electives list or equivalence thereof.
3. Students may choose to take up two of electives I through VI on P/F basis.

* Free elective I & II : Category will be indicated in the grade cared according to the course chosen by the student from his own department or from other departments such as MA, HS & PH.

AE

AE

ELECTIVE LIST

No.	Title	L	T	P	C
AS212	Matrix methods in Structural Analysis	3	0	0	3
AS214	Advanced Aerodynamics	3	0	0	3
AS216	Combustion in Aerospace Propulsion	3	0	0	3
AS594	Advanced Strength of Materials	3	0	0	3
AS313	Introduction to Composite Structures	3	0	0	3
AS542	Introduction to CFD3	0	0	3	
AS317	Flight Testing	3	0	0	3
AS319	Design of Gas Turbines	3	0	0	3
AS567	Transport Process in Reacting Flows	3	0	0	3

4.2.2 Bio-Technology

BT

SEMESTER III

No.	Subject	L	T	P	C	Cat.
ID120	ECOLOGY AND ENVIRONMENT	2	0	0	2	BET
HS	Humanities I (Elective)	3	0	0	3	HSS
MA	Mathematics III (Elective)	3	0	0	3	SMA
AM110	ENGG MECHANICS/	3	0	0	3	BET
BT 201	MICROBIOLOGY	3	0	0	3	PMT
BT 203	BIOCHEMICAL THERMODYNAMICS	3	0	0	3	PMT
BT 211	MICROBIOLOGY LABORATORY	0	0	6	2	PML
	Total	17	0	6	19	

SEMESTER IV

No.	Subject	L	T	P	C	Cat.
HS	Humanities II (Elective)	3	0	0	3	HSS
MA	Mathematics IV (Elective)	3	0	0	3	SMA
BT 202	BIOCHEMISTRY	3	0	0	3	PMT
BT 204	GENETICS AND MOLECULAR BIOLOGY	3	0	0	3	PMT
BT 206	REACTION ENGINEERING FUNDAMENTALS	3	0	0	3	PMT
BT 208	TRANSPORT PROCESSES AND UNIT OPERATIONS	3	0	0	3	PMT
BT 212	BIOCHEMISTRY LABORATORY	0	0	6	2	PML
	Total	18	0	6	20	

BT

SEMESTER V

No.	Subject	L	T	P	C	Cat.
	Minor Elective I (Core)	3	0	0	3	MNS
BT 301	CELL BIOLOGY	3	0	0	3	PMT
BT 303	ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY	3	0	0	3	PMT
BT 305	GENETIC ENGINEERING	3	0	0	3	PMT
BT 307	BIOCHEMICAL ENGINEERING	3	0	0	3	PMT
BT 3xx	Professional Elective I	3	0	0	3	PMT
BT 311	MOLECULAR BIOLOGY AND GENETIC ENGG. LABORATORY	0	0	6	2	PML
	Total	18	0	6	20	

SEMESTER VI

No.	Subject	L	T	P	C	Cat.
	Minor Elective II (Core)	3	0	0	3	MNS
	Free Elective I	3	0	0	3	*
BT 302	STRUCTURAL BIOLOGY	3	0	0	3	PMT
BT 304	IMMUNOLOGY	3	0	0	3	PMT
BT 306	DOWNSTREAM PROCESSING IN BIOTECHNOLOGY	3	0	0	3	PMT
BT 3xx	Professional Elective II	3	0	0	3	PMT
BT 312	BIOREACTION ENGINEERING LAB.	0	0	6	2	PML
	Total	18	0	6	20	
BT362	INDUSTRIAL TRAINING (Summer)	0	0	6	2	PIT

SEMESTER VII

No.	Subject	L	T	P	C	Cat.
HS	Professional Ethics (PF) / Humanities III (elective)	2/3	0	0	2/3	HPF/ HSS
	Minor III (Elective)	3	0	0	3	MNS
	Free Elective II	3	0	0	3	*
BT 401	BIOINFORMATICS	2	1	3	4	PMT
BT 403	PLANT BIOTECHNOLOGY	3	0	0	3	PMT
BT 4xx	Professional Elective III	3	0	0	3	PMT
BT 4xx	Self-Study (Elective)	3	0	0	3	PSS
BT 411	DOWNSTREAM PROCESSING LABORATORY	0	0	6	2	PML
BT 455	PROJECT I	0	0	0	2	PMP
	Total	19/20	1	9	25/26	

SEMESTER VIII

No.	Subject	L	T	P	C	Cat.
HS	Humanities III (Elective) / Professional Ethics (P/F)	3/2	0	0	3/2	HPF/ HSS
	Industrial Lecture (Pass/Fail)	1	0	0	1	PIL
BT 4xx	Professional Elective IV	3	0	0	3	PMT
BT 456	PROJECT II	0	0	24	8	PMP
	Total	7/6	0	24	15/14	

* Free elective I & II : Category will be indicated in the grade cared according to the course chosen by the student from his own department or from other departments such as MA, HS & PH.

BT

ELECTIVES

No.	Title	L	T	P	C
CH 306	Transport Phenomena	3	0	0	3
CH 304	Instrumentation and Process Control	3	0	0	3
CH 319	Introduction to Industrial Biotechnology	3	0	0	3
BT 313	Food Biotechnology	3	0	0	3
BT 314	Bacterial Genetics	3	0	0	3
BT 315	Biotechnology for Health-Care	3	0	0	3
BT 316	Medicinal Chemistry and Drug Design	3	0	0	3
BT 317	Enzyme, Structure & Mechanisms	3	0	0	3
BT 319	Metabolic Regulation	3	0	0	3
CH 403	Environmental Engineering	3	0	0	3
CH 412	Molecular Thermodynamics	3	0	0	3
CH 419	Protein Engineering	3	0	0	3
BT 412	Biocatalysis and Bio transtromations	3	0	0	3
BT 413	Spectroscopic Applications in Biotechnology	3	0	0	3
BT 414	Bioprocess Modelling and simulation	3	0	0	3
BT 416	Biomaterials Engineering	3	0	0	3
BT 417	Molecular Basis of Diseases	3	0	0	3
BT 418	Animal Biotechnology	3	0	0	3
BT 421	Regulatory Issues IPR Biotechnology (SS)	3	0	0	3
BT 422	IPR Issues in Biotechnology (SS)	3	0	0	3
BT 423	Bio-Ethnics (SS)	3	0	0	3
BT 424	Process Equipment Design in Biotechnology (SS)	3	0	0	3
BT 425	Biosensors	3	0	0	3

4.2.3 CHEMICAL ENGINEERING :

SEMESTER III

No.	Subject	L	T	P	C	Cat.
ID120	ECOLOGY AND ENVIRONMENT	2	0	0	2	BET
BT101	LIFE SCIENCES 2	0	0	2	SLS	
HS	Humanities I (Elective)	3	0	0	3	HSS
MA	Mathematics III (Elective)	3	0	0	3	SMA
AM110	ENGINEERING MECHANICS	3	1	0	4	BET
CH201	CHEMICAL ENGG. THERMODYNAMICS	3	1	0	4	PMT
CH203	MOMENTUM TRANSFER	3	1	0	4	PMT
	Total	19	3	0	22	

SEMESTER IV

No.	Subject	L	T	P	C	Cat.
HS	Humanities II (Elective)	3	0	0	3	HSS
MA/PH/ CY	Mathematics IV (Elective)/ PH202 /CY202	3	0	0	3	SMA/ SPH/ SCY
CH202	EQUILIBRIUM STAGED OPERATIONS	3	1	0	4	PMT
CH204	MECHANICAL OPERATIONS	3	1	0	4	PMT
CH206	PROCESS HEAT TRANSFER	3	1	0	4	PMT
CH210	CHEMICAL TECHNOLOGY	3	0	0	3	PMT
	Total	18	3	0	21	

CH

SEMESTER V

No.	Subject	L	T	P	C	Cat.
	Minor Elective I (Core)	3	0	0	3	MNS
	Free Elective I	3	0	3	3	*
CH	Elective I	3	0	0	3	PMT
CH301	CHEMICAL REACTION ENGINEERING I	2	1	0	3	PMT
CH303	MASS TRANSFER	3	1	0	4	PMT
CH305	COMPUTATIONAL TECHNIQUES	3	1	0	4	PMT
CH351	MOMENTUM TRANSFER & MO LAB	0	0	6	2	PML
	Total	17	3	9	22	

SEMESTER VI

No.	Subject	L	T	P	C	Cat.
	Minor II (Core)	3	0	0	3	MNS
CH	Elective II	3	0	0	3	PMT
CH302	CHEMICAL REACTION ENGG II	3	1	0	4	PMT
CH304	INSTRUMENTATION & PROCESS CONTROL	3	1	0	4	PMT
CH306	TRANSPORT PHENOMENA	3	0	0	3	PMT
CH308	Process Equipment Design (Self Study)	3	0	3	4	PSS
CH352	HEAT & MASS TRANSFER LAB	0	0	6	2	PML
	Total	18	2	9	23	
CH350	INDUSTRIAL TRAINING (SUMMER)	0	0	6	2	PIT

SEMESTER VII

No.	Subject	L	T	P	C	Cat.
HS	Professional Ethics (P/F)/HS Elective III	2/3	0	0	2/3	HPF/ HSS
	Minor Elective III3	0	0	3	MNS	
	Free Elective II	3	0	0	3	*
CH	Elective III	3	0	0	3	PMT
CH401	PROCESS DESIGN & ECONOMICS	3	1	0	4	PMT
CH451	CRE & TDC LAB	0	0	6	2	PML
CH45543	PROJECT I	0	0	6	2	PMP
	Total	14/15	1	12	19/20	

SEMESTER VIII

No.	Subject	L	T	P	C	Cat.
HS	Professional Ethics (P/F)/HS Elective III	2/3	0	0	2/3	HPF/ HSS
CH	Elective IV	3	0	0	3	PMT
CH462	INDUSTRIAL LECTURE (Pass/Fail)	1	0	0	1	PIL
CH456	PROJECT II	0	0	18	6	PMP
	Total	6/7	0	18	12/13	

* Free elective I & II : Category will be indicated in the grade cared according to the course chosen by the student from his own department or from other departments such as MA, HS & PH.

4.2.4 CIVIL ENGINEERING :

SEMESTER III

No.	Subject	L	T	P	C	Cat.
HS	Humanities I (Elective)	3	0	0	3	HSS
MA	Mathematics III (Elective)	3	0	0	3	SMA
EE110	BASIC ELEC. ENGG.	3	0	0	3	BET
ID120	ECOLOGY AND ENVIRONMENT	2	0	0	2	BET
BT101	LIFE SCIENCES 2	0	0	2	SLS	
CE231	MECHANICS OF MATERIALS	3	1	0	4	PMT
CE233	BUILDING MATERIALS AND CONSTRUCTION	3	0	0	3	PMT
CE205	BUILDING DRAWING	0	0	3	1	PML
	Total	19	1	3	21	

SEMESTER IV

No.	Subject	L	T	P	C	Cat.
HS	Humanities II (Elective)	3	0	0	3	HSS
MA	Mathematics IV (Elective)	3	0	0	3	SMA
CE202	STRUCTURAL ANALYSIS	3	1	0	4	PMT
CE204	HYDRAULIC ENGINEERING	3	1	0	4	PMT
CE206	GEOLOGY & SOIL MECHANICS	3	1	0	4	PMT
CE208	SURVEYING	3	1	0	4	PMT
CE210	SURVEYING PRACTICAL	0	0	3	1	PML
	Total	18	4	3	23	

SEMESTER V

No.	Subject	L	T	P	C	Cat.
	Minor Elective I (Core)	3	0	0	3	MNS
CE	Elective I	3	0	0	3	PMT
CE301	TRANSPORTATION ENGG I	3	0	0	3	PMT
CE303	WATER RESOURCES ENGINEERING	3	1	0	4	PMT
CE305	BASIC STRUCTURAL STEEL DESIGN	3	0	0	3	PMT
CE335	GEOTECHNICAL ENGINEERING	3	1	0	4	PMT
CE341	CONSTRUCTION MATERIALS LAB	0	0	3	1	PML
	Total	18	2	3	21	

SEMESTER VI

No.	Subject	L	T	P	C	Cat.
	Minor Elective II (Core)	3	0	0	3	MNS
	Free Elective I	3	0	0	3	*
CE	ELECTIVE II	3	0	0	3	PMT
CE302	TRANSPORTATION ENGG II	3	0	0	3	PMT
CE304	ENVIRONMENTAL ENGG	3	1	0	4	PMT
CE306	BASIC REINFORCED CONCRETE DESIGN	3	0	0	3	PMT
CE310	STRUCTURAL ENGINEERING LAB	0	0	3	1	PML
CE312	STRUCTURAL DESIGN DRAWING	0	0	3	1	PML
	Total	18	1	6	21	
CE328	INDUSTRIAL TRAINING (Summer)	0	0	6	2	PIT

SEMESTER VII

No.	Subject	L	T	P	C	Cat.
HS	Professional Ethics (P/F)/ HS Elective III	2/ 3	0 0	0 0	2/ 3	HPF/ HSS
	Minor Elective III3	0	0	3	MNS	
	Free Elective II	3	0	0	3	*
CE	Elective III	3	0	0	3	PMT
CE	Self study Elective	3	0	0	3	PSS
CE401	ESTIMATION & CONSTN. MGMT.	3	1	0	4	PMT
CE403	HYDRAULIC & ENVRN.ENGG. LAB	0	0	3	1	PML
CE405	PROJECT I	-	-	-	2	PMP
	Total	17/18	1	3	21/22	

CE

SEMESTER VIII

No.	Subject	L	T	P	C	Cat.
HS	Professional Ethics (P/F) / HS Elective III	2/ 3	0 0	0 0	2/ 3	HPF/ HSS
CE	Elective IV	3	0	0	3	PMT
IL402	INDUSTRIAL LECTURE (Pass/Fail)	0	0	3	1	PIL
CE406	PROJECT II	-	-	-	7	PMP
	Total	5/6	0	3	13/14	

* Free elective I & II : Category will be indicated in the grade cared according to the course chosen by the student from his own department or from other departments such as MA, HS & PH.

ELECTIVE LIST

No.	Title	L	T	P	C
CE331	Advanced Structural Analysis	3	0	0	3
CE332	Design of Steel Structural System	3	0	0	3
CE333	Computer Methods in Civil Engineering	3	0	0	3
CE341	Planning & Design of Building Services	3	0	0	3
CE342	Concrete Technology	3	0	0	3
CE351	Ground Improvement	3	0	0	3
CE352	Foundation Engineering	3	0	0	3
CE353	Introductory Rock Mechanics	3	0	0	3
CE361	Flow Measurements	3	0	0	3
CE362	Ground Water Engineering	3	0	0	3
CE431	Design of Concrete Structural Systems	3	0	0	3
CE432	Analysis & Design for Wind and Earthquake Effects	3	0	0	3
CE441	Structural Masonry	3	0	0	3
CE442	Remote Sensing	3	0	0	3
CE451	Dynamics of Foundations	3	0	0	3
CE452	Principles of Reinforced Soil Structures	3	0	0	3
CE461	Water Management	3	0	0	3
CE462	Watershed Management	3	0	0	3
CE471	Transport Project Planning & Evaluation	3	0	0	3
CE472	Computer Application in Highway & Traffic Engg.	3	0	0	3
CE481	Air Pollution Control and Solid Waste Management	3	0	0	3
CE482	Advanced Environmental Engineering	3	0	0	3
CE483	Computational Methods in Water Resources & Environmental Engineering	3	0	0	3

CE

4.2.5 COMPUTER SCIENCE & ENGINEERING :

SEMESTER III

No.	Subject	L	T	P	C	Cat.
ID120	ECOLOGY AND ENVIRONMENT	2	0	0	2	BET
BT101	LIFE SCIENCES 2	0	0	2	SLS	
HS	Humanities I (Elective)	3	0	0	3	HSS
MA	Mathematics III (Elective)	3	0	0	3	SMA
AM110	ENGINEERING MECHANICS /	3	1	0	4	BET
CS210	FOUNDATIONS OF COMPUTER SCIENCE	3	1	0	4	PMT
CS230	SWITCHING THEORY AND DIGITAL DESIGN	3	0	0	3	PMT
CS211	COMPUTER PROGRAMMING LAB	0	0	3	1	PML
CS231	DIGITAL LOGIC AND DESIGN LAB	0	0	3	1	PML
	Total	19	2	6	23	

SEMESTER IV

CS

No.	Subject	L	T	P	C	Cat.
HS	Humanities II (Elective)	3	0	0	3	HSS
MA/PH/ CY	Mathematics IV (Elective)/ PH/CY	3	0	0	3	SMA/ SPH/ SCY
CS220	LANGUAGE MACHINES AND COMPUTATIONS	3	0	0	3	PMT
CS240	PRINCIPLES OF COMMUNICATION	3	0	0	3	PMT
CS260	COMPUTER ORGANISATION	3	0	0	3	PMT
CS280	DATA STRUCTURES AND ALGORITHMS	3	1	0	4	PMT
CS261	ASSEMBLER LANGUAGE PROGRAMMING LAB	0	0	3	1	PML
CS281	ADVANCED PROGRAMMING LAB	0	0	3	1	PML
	Total	18	1	6	21	

SEMESTER V

No.	Subject	L	T	P	C	Cat.
	Minor Elective I (Core)	3	0	0	3	MNS
CS	Elective I	3	1	0	4	PMT
CS310	PARADIGMS OF PROGRAMMING	3	1	0	4	PMT
CS330	LANGUAGE TRANSLATORS	3	0	0	3	PMT
CS350	OPERATING SYSTEMS	3	0	0	3	PMT
CS370	INTRODUCTION TO DATABASE SYSTEMS	3	1	0	4	PMT
CS331	LANGUAGE TRANSLATORS LAB	0	0	3	1	PML
CS351	OPERATING SYSTEMS LAB	0	0	3	1	PML
	Total	18	3	6	23	

SEMESTER VI

CS

No.	Subject	L	T	P	C	Cat.
	Minor Elective II (Core)	3	0	0	3	MNS
	Free Elective I	3	0	0	3	*
CS	Elective II	3	1	0	4	PMT
CS	Elective III (Self Study)	3	1	0	4	PSS
CS320	COMPUTER NETWORKS	3	0	0	3	PMT
CS340	PRINCIPLES OF SOFTWARE ENGG	3	0	0	3	PMT
CS321	COMPUTER NETWORKS LAB	0	0	3	1	PML
CS341	SOFTWARE ENGG LAB	0	0	3	1	PML
	Total	18	2	6	22	
CS366	INDUSTRIAL TRAINING (SUMMER)	0	0	6	2	PIT

SEMESTER VII

No.	Subject	L	T	P	C	Cat.
HS	Professional Ethics (P/F)/HS Elective III	2/3	0	0	2/3	HPF/ HSS
	Minor Elective III	3	0	0	3	MNS
	Free Elective II	3	0	0	3	*
CS	Elective IV	3	1	0	4	PMT
CS	Elective V	3	1	0	4	PMT
CS410	COMPUTER SYSTEM DESIGN	3	0	0	3	PMT
CS411	COMPUTER SYSTEM DESIGN LAB	0	0	3	1	PML
CS479	PROJECT I	-	-	-	3	PMP
	Total	17/18	2	3	23/24	

SEMESTER VIII

No.	Subject	L	T	P	C	Cat.
HS	Professional Ethics (P/F)/HS Elective III	2/3	0	0	2/3	HPF/ HSS
CS488	INDSUTRIAL LECTURE (P/F)	1	0	0	1	PIL
CS480	PROJECT II	-	-	-	8	PMP
	Total	3/4	0	0	11/12	

* Free elective I & II : Category will be indicated in the grade cared according to the course chosen by the student from his own department or from other departments such as MA, HS & PH.

ELECTIVES

No.	Title	L	T	P	C
CS580	Advanced Data Structures & Algorithms	3	1	0	4
CS606	Computer Architecture Lab	0	0	3	1
CE607	Object-Oriented Software Development Lab	0	0	3	1
CS609	Technical Enhanced Learning & Teaching Theory & Practice [SS]	3	0	0	3
CS610	Topics in Design and Analysis of Algorithms	3	1	0	4
CS611	Computational Geometry	3	1	0	4
CS614	Advanced Programming Language Lab	0	0	3	1
CS617	Parallel and Randomized Algorithms	3	1	0	4
CS618	Advanced Topics in Formal Languages and Automata	3	1	0	4
CS619	Recent Developments in Theoretical Computer Science	3	1	0	4
CS620	Advanced Computer Architecture	3	1	0	4
CS621	Performance Evaluation of Computer Sys & Networks	3	1	0	4
CS622	Multimedia Systems	3	1	0	4
CS623	CAD for VLSI Systems	3	1	0	4
CS625	Memory Based Reasoning in Artificial Intelligence	3	1	0	4
CS630	Speech Technology	3	1	0	4
CS631	Artificial Neural Networks	3	1	0	4
CS632	Signals and Systems	3	1	0	4
CS633	Digital System Testing & Testable Design	3	1	0	4

CS

CS634	Soft Computing	3	1	0	4
CS635	Computer Vision	3	1	0	4
CS636	Computer Graphics	3	1	0	4
CS637	Natural Language Processing	3	1	0	4
CS638	Computational Intelligence	3	1	0	4
CS639	Model Based and Qualitative Reasoning in AI	3	1	0	4
CS640	High Performance Computing	3	1	0	4
CS641	Real-time Computing and Communications	3	1	0	4
CS642	Dependable Computing and Communications	3	1	0	4
CS643	Optical Networks	3	1	0	4
CS644	Distributed Computing	3	1	0	4
CS645	Object Oriented Software Development	3	1	0	4
CS646	Protocol Software Engineering	3	1	0	4
CS647	Network Management Systems	3	1	0	4
CS648	E-Commerce	3	1	0	4
CS650	Cryptography and Network Security	3	1	0	4
CS651	Advances in Database Technology	3	1	0	4
CS652	Software Architecture – Theory and Practice	3	1	0	4
CS654	Distributed Systems Lab	0	0	3	1
CS655	Database Management System	3	1	0	4
CS660	Computer Architecture	3	1	0	4
CS664	Mobile Computing	3	1	0	4
CS665	Software Project Management	3	1	0	4

CS

4.2.6 ELECTRICAL ENGINEERING :

SEMESTER III

No.	Subject	L	T	P	C	Cat.
ID120	ECOLOGY AND ENVIRONMENT	2	0	0	2	BET
BT101	LIFE SCIENCES 2	0	0	2	SLS	
HS	Humanities Elective I	3	0	0	3	HSS
MA	Mathematics Elective III	3	0	0	3	SMA
AM110	ENGINEERING MECHANICS	3	1	0	4	BET
EC104/ EC101	DIGITAL SYSTEMS / ELECTRICAL AND MAGNETIC CIRCUITS	3	1	0	4	PMT
EC204/ EC209	NETWORKS AND SYSTEMS/ COMPUTER ORGANISATION AND MICROPROCESSORS	3	1	0	4	PMT
EC205/ EC211	CAD LABORATORY / DIGITAL CIRCUITS LABORATORY	0	0	3	1	PML
	Total	19	3	3	23	

SEMESTER IV

No.	Subject	L	T	P	C	Cat.
	Mathematics/Science/ BET Elective	3	0	0	3	SMA
HS	Humanities Elective II	3	0	0	3	HSS
EC209/ EC204	COMPUTER ORGANISATION AND MICROPROCESSORS/ NETWORKS AND SYSTEMS	3	1	0	4	PMT
EC220/ EC201	ANALOG AND DSP/ ANALOG CIRCUITS	3	1	0	4	PMT
EC210/ EC207	SOLID STATE DEVICES/ ELECTRO MECH. ENERGY CONVERSION	3	1	0	4	PMT
EC211/ EC205	DIGITAL CIRCUIT LAB/ CAD LAB	0	0	3	1	PML
EC225	PRINCIPLES OF MEASUREMENT LAB	1	0	3	2	PML
	Total	16	3	6	21	

EE

SEMESTER V

No.	Subject	L	T	P	C	Cat.
	Minor Elective I (Core)	3	0	0	3	MNS
EC207/ EC210	ELECTRO MECH. ENERGY CONVERSION/ SOLID STATE DEVICES	3	1	0	4	PMT
EC201/ EC220	ANALOG CIRCUITS/ ANALOG AND DIGITAL SIGNAL PROCESSING	3	1	0	4	PMT
EC301/ EC321	ELECTROMAGNETIC FIELDS / CONTROL ENGINEERING	3	1	0	4	PMT
EC305/ EC303	COMMUNCIATION SYSTEMS/ POWER SYSTEM PRACTICE	3	1	0	4	PMT
EC312	MICROPROCESSOR LAB	0	0	3	1	PML
	Total	15	4	3	20	

SEMESTER VI

No.	Subject	L	T	P	C	Cat.
	Minor Elective II (Core)	3	0	0	3	MNS
EE	Elective I	3	0	0	3	PMT
EE	Elective II	3	0	0	3	PMT
EE	Elective III	3	0	0	3	PMT
EC321/ EC301	CONTROL ENGINEERING/ ELECTROMAGNETIC FIELDS	3	1	0	4	PMT
EC303/ EC305	POWER SYSTEM PRACTICE/ COMMUNCIATION SYSTEMS	3	1	0	4	PMT
EC309	ELECTRO MECH. ENERGY CONVERSION LAB	0	0	3	1	PML
EC330	ANALOG CIRCUITS LAB	0	0	3	1	PML
	Total	18	2	6	22	
EE350	INDUSTRIAL TRAINING	0	0	6	2	PIT

SEMESTER VII

No.	Subject	L	T	P	C	Cat.
HS	Professional Ethics (P/F)	2	0	0	2	HPF
	Minor Elective III	3	0	0	3	MNS
	Free Elective I	3	0	0	3	*
EE	Elective IV (Self Study)	3	0	0	3	PSS
EE	Elective V	3	0	0	3	PMT
EE	Elective VI	3	0	0	3	PMT
EC400	ADVANCED EE LAB	0	0	3	1	PML
EE489	PROJECT I	0	0	6	2	PMP
	Total	17	0	9	20	

SEMESTER VIII

No.	Subject	L	T	P	C	Cat.
HS	Humanities Elective III	3	0	0	3	HSS
	Free Elective II	3	0	0	3	*
IL402	INDUSTRIAL LECTURE (Pass/Fail)	1	0	0	1	PIL
EC490	PROJECT II	0	0	30	10	PMP
	Total	7	0	30	17	

*Free elective I & II : Category will be indicated in the grade cared according to the course chosen by the student from his own department or from other departments such as MA, HS & PH.

ELECTIVES

No.	Title	PRE-Requisite	L	T	P	C
EE356	Analog Communication Systems	EC 220	3	1	0	4
EE358	Analog and Digital IC's		3	0	0	3
EE360	Advanced Analog Circuits	EC 201	3	1	0	4
EE362	Device Modelling	EC 210	3	0	0	3
EE401	Instrumentation Systems	EC225	3	0	0	3
EE403	High Voltage Engineering		3	0	0	3
EE419	Digital Communication Systems	EE 356	3	0	0	3
EE421	Microwave Engineering	EC 301	3	0	0	3
EE422	EM Waves and Antennas	EC 301	3	0	0	3
EE424	Image Signal Processing		3	0	0	3
EE425	Fibre Optic Communication		3	0	0	3
EE426	Quantum Electronics and Lazers		3	0	0	3
EE428	VLSI Design	EC 210	3	0	0	3
EE429	Power Semiconductor Devices & Power IC's	EC 210	3	0	0	3
EE431	Digital System Design		3	0	0	3
EE432	Digital Electronics	COT	3	0	0	3
EE433	Design of Control Systems	EC 321	3	0	0	3
EE434	Modern Control Theory	EC 321	3	0	0	3
EE435	Guidance and Control	EC 321	3	0	0	3
EE436	Introduction to Robotics	EC 321	3	0	0	3
EE437	Network Synthesis	EC 204	3	0	0	3
EE438	Analog and Digital Filters		3	0	0	3
EE439	Applications of Graph Theory to Networks	EC 204	3	0	0	3
EE442	Design and Layout of Power Apparatus & Sys.	EC 207	3	0	0	3
EE443	Power System Operation and Control		3	0	0	3
EE444	Power System Analysis		3	0	0	3
EE446	EHV AC and DC Power Transmission		3	0	0	3
EE447	Computer Methods in Electrical Engineering		3	0	0	3
EE448	Solid State Drives	EC 207	3	0	0	3
EE452	Electromechanical Energy Conversion II	EC 207	3	0	0	3
EE454	Power System Protection and Switchgear		3	0	0	3

EE

4.2.7 ENGINEERING PHYSICS

SEMESTER III

No.	Subject	L	T	P	C	Cat.
HS	Humanities I (Elective)	3	0	0	3	HSS
MA	Mathematics III (Elective)	3	0	0	3	SMA
ID120	ECOLOGY AND ENVIRONMENT	3	0	0	2	BET
BT110	LIFE SCIENCES	2	0	0	2	SLS
AM110	ENGINEERING MECHANICS	3	1	0	4	BET
EC 101 / EC103	ELECTRICAL AND MAGNETIC CIRCUITS / DIGITAL CIRCUITS	3	1	0	4	PMT
PH 201	PHYSICS III	3	0	0	3	PMT
EC 260	DIGITAL CIRCUITS LAB	0	0	3	1	PML
	Total	22	2	3	22	

SEMESTER IV

No.	Subject	L	T	P	C	Cat.
HS	Humanities II (Elective)	3	0	0	3	HSS
MA	Mathematics IV (Elective)	3	0	0	3	SMA
EE110	BASIC ELEC. ENGG.	3	0	0	3	BET
EP 211	INTRODUCTION TO MATHEMATICAL PHYSICS	3	0	0	3	PMT
EP 214	HIGH VACUUM SCIENCE AND TECHNOLOGY	3	0	0	3	PMT
EC 204	NETWORKS AND SYSTEMS	3	1	0	4	PMT
EC 212	PRINCIPLES OF MEASUREMENTS Lab	2	0	0	2	PML
	Total	20	1	0	21	

SEMESTER V

No.	Subject	L	T	P	C	Cat.
	Minor I (Core)	3	0	0	3	MNS
EP 221	PRINCIPLES OF QUANTUM MECHANICS	3	0	0	3	PMT
EC 201	ANALOG CIRCUITS	3	1	0	4	PMT
EP 311	ELECTROMAGNETICS AND APPLICATIONS	3	0	0	3	PMT
EP 312	STATISTICAL PHYSICS AND APPLICATIONS	3	0	0	3	PMT
EP 319	ENGINEERING PHYSICS LAB-I	0	0	3	1	PML
EC 220	ANALOG AND DIG.SIGNAL PROCESSING	3	1	0	4	PMT
EC 210	SOLID STATE DEVICES	3	1	0	4	PMT
	Total	21	3	3	25	

SEMESTER VI

No.	Subject	L	T	P	C	Cat.
	Minor II (Core)	3	0	0	3	MNS
	Free Elective - I	3	0	0	3	*
**	ELECTIVE – I	3	0	0	3	PMT
**	ELECTIVE - II	3	0	0	3	PMT
EP 201	PHYSICS AND TECHNOLOGY OF MATERIALS	3	0	0	3	PMT
EP310	ATOMIC AND MOLECULAR SPECTROSCOPY	3	0	0	3	PMT
EP 329	ENGINEERING PHYSICS LAB-II	0	0	3	1	PML
	Total	18	0	3	19	
EP361	INDSUTRIAL TRAINING (SUMMER)	0	0	6	2	PIT

SEMESTER VII

No.	Subject	L	T	P	C	Cat.
HS	Professional Ethics (P/F)/ HS Elective III	2 3	0 0	0 0	2/ 3	HPF/ HSS
	Minor III (Elective)	3	0	0	3	MNS
	Free Elective II	3	0	0	3	*
**	ELECTIVE-III	3	0	0	3	PMT
**	ELECTIVE-IV	3	0	0	3	PMT
**	ELECTIVE –V (Self Study)	3	0	0	3	PSS
EC 411	ANALOG CIRCUITS LAB	0	0	3	1	PML
EP 419	ENGINEERING PHYSICS LAB-III	0	0	6	2	PML
EP 414	PROJECT-I	-	-	-	1	PMP
	Total	17/18	0	9	21/22	

SEMESTER VIII

No.	Subject	L	T	P	C	Cat.
HS	Professional Ethics (P/F)/ HS Elective III	2 3	0 0	0 0	2/ 3	HPF/ HSS
IL402	INDUSTRIAL LECTURE (P/F)	0	0	3	1	PIL
**	ELECTIVE –VI	3	0	0	3	PMT
EP 416	PROJECT –II	-	-	-	7	PMP
EP404	SEMINAR	0	0	3	1	PMT
	Total	5/6	0	6	14/15	

* Free elective I & II : Category will be indicated in the grade cared according to the course chosen by the student from his own department or from other departments such as MA, HS & PH.

**Note: Electives to be registered from PH/EE courses with the approval of Faculty Advisor/HoD, Physics.

ELECTIVES

No.	Title	L	T	P	C
EE356	Analog Communication Systems	3	0	0	3
EE358	Analog and Digital IC's	3	0	0	3
EE360	Advanced Analog Circuits	3	0	0	3
EE401	Instrumentation Systems	3	0	0	3
EE419	Digital Communication Systems	3	0	0	3
EE424	Image Signal Processing	3	0	0	3
EE425	Fibre Optic Communication	3	0	0	3
EE428	VLSI Design	3	0	0	3
EE429	Power Semiconductor Devices & Power IC's	3	0	0	3
EE432	Digital Electronics	3	0	0	3
EE437	Network Synthesis	3	0	0	3
EE438	Analog Filters	3	0	0	3
EE439	Applications of Graph Theory to Networks	3	0	0	3

4.2.8 MECHANICAL ENGINEERING :

SEMESTER III

No.	Subject	L	T	P	C	Cat.
ID120	ECOLOGY AND ENVIRONMENT	2	0	0	2	BET
BT101	LIFE SCIENCES 2	0	0	2	SLS	
HS	Humanities Elective I	3	0	0	3	HSS
MA	Mathematics III (Elective)	3	0	0	3	SMA
EE110/	BASIC ELEC. ENGG./	3	0	0	3	BET
ME205	MACHINE DRAWING PRACTICE	1	0	6	3	PMT
AM220	STRENGTH OF MATERIALS	3	1	0	4	PMT
	Total	17	1	6	20	

SEMESTER IV

No.	Subject	L	T	P	C	Cat.
MA	Mathematics IV (Elective)	3	0	0	3	SMA
AM253	FOUNDATION OF FLUID MECHANICS	3	1	0	4	PMT
AM271	DYNAMICS OF MACHINERY	3	1	0	4	PMT
ME224	INSTRUMENTATION AND CONTROL	4	0	0	4	PMT
ME226	MATERIALS AND DESIGN	3	1	0	4	PMT
ME228	MANUFACTURING TECHNOLOGY	4	0	0	4	PMT
AM254	APP. MECH. LAB./ FLUID MECH. LAB	0	0	3	1	PML
EN210	Electrical Sciences	1	0	3	2	PMT
	Total	21	3	6	26	

SEMESTER V

No.	Subject	L	T	P	C	Cat.
	Minor Elective I (Core)	3	0	0	3	MNS
ME317	HEAT TRANSFER	3	1	0	4	PMT
ME319	MACHINING AND METROLOGY	4	0	0	4	PMT
ME331	TURBOMACHINES	3	0	0	3	PMT
ME333	INTERNAL COMBUSTION ENGINES	3	0	0	3	PMT
ME335	DESIGN OF MACHINE ELEMENTS	3	1	0	4	PMT
ME327	MECHANICAL ENGG. LAB I	0	0	3	1	PML
ME329	MACHINE TOOLS AND METROLOGY LAB	0	0	3	1	PML
	Total	19	2	6	23	

SEMESTER VI

No.	Subject	L	T	P	C	Cat.
	Minor Elective II (Core)	3	0	0	3	MNS
HS	Humanities Elective II	3	0	0	3	HSS
	Free Elective I	3	0	0	3	*
ME	Elective I	3	0	0	3	PMT
ME325	REFRIGERATION AND AIR CONDITIONING	3	0	0	3	PMT
ME326	THERMAL POWER ENGINEERING	3	0	0	3	PMT
ME328	MECHANICAL ENGG. LABORATORY II	0	0	3	1	PML
ME330	CONTROL AND MANUFACTURING LAB	0	0	3	1	PML
	Total	18		6	20	
ME350	INDUSTRIAL TRAINING (SUMMER)	0	0	0	2	PIT

SEMESTER VII

No.	Subject	L	T	P	C	Cat.
HS	Professional Ethics (P/F) / HS Elective III	2/3	0	0	2/3	HPF/ HSS
	Minor Elective III3	0	0	3	MNS	
	Free Elective II	3	0	0	3	*
ME	Self Study Elective	3	0	0	3	PSS
ME	Elective II	3	0	0	3	PMT
ME	Elective III	3	0	0	3	PMT
IL402	Industrial Lecture (Pass/Fail)	0	0	3	1	PIL
ME455	Project I	0	0	6	2	PMP
	Total	17/18	0	9	20/21	

SEMESTER VIII

No.	Subject	L	T	P	C	Cat.
HS	Professional Ethics (P/F)/HS Elective III	2/3	0	0	2/3	HPF/ HSS
ME	Elective IV	3	0	0	3	PMT
ME456	Project II	0	0	24	8	PMP
	Total	5/6	0	24	13/14	

* Free elective I & II : Category will be indicated in the grade cared according to the course chosen by the student from his own department or from other departments such as MA, HS & PH.

ELECTIVES

No.	Title	L	T	P	C
ME334	Selected Topics in I.C Engines	3	0	0	3
ME338	Trends in Manufacturing	3	0	0	3
ME344	I.C Engine Processes (Self-study)	3	0	0	3
ME348	CNC Machining (Self-study)	3	0	0	3
ME402	Combustion	3	0	0	3
ME408	Modelling of Heat Transfer Process	3	0	0	3
ME410	Quality Control	3	0	0	3
ME412	Hydroturbomachines Appln. Engg.	3	0	0	3
ME413	Combustion and Propulsion	3	0	0	3
ME414	Axial Flow Hydroturbomachines	3	0	0	3
ME415	Utilisation of Solar Energy	3	0	0	3
ME416	Design of Pumps	3	0	0	3
ME418	Automobile Engineering	3	0	0	3
ME419	Industrial Heat Transfer Equipment	3	0	0	3
ME423	Design Practice	1	3	0	3
ME424	Vehicle Mechanisms & Dynamics	3	0	0	3
ME425	Advanced Ref. And Air conditioning	3	0	0	3
ME426	Cryogenic Systems	3	0	0	3
ME427	Solar Heating & Cooling	3	0	0	3
ME429	Fans, Blowers & Compressors	3	0	0	3
ME431	Mechanisms and Transmissions	3	0	0	3
ME432	Gas Turbine Engineering	3	0	0	3
ME434	Steam Turbines and Accessories	3	0	0	3
ME436	Failure Analysis and Design	3	0	0	3
ME439	Metal Cutting & Cutting Tool Design	3	0	0	3
ME440	Manufacturing Planning	3	0	0	3

No.	Title	L	T	P	C
ME441	Tooling for Production	3	0	0	3
ME442	Unconventional Mfg. Techniques	3	0	0	3
ME443	Oil Hydraulic & Pneumatics Sys. & Circuits	3	0	0	3
ME444	Gear Manufacture and Inspection	3	0	0	3
ME445	Fluid Mechanics of Turbo machines	3	0	0	3
ME446	Control of Production Systems	3	0	0	3
ME447	Automated Manufacturing	3	0	0	3
ME448	Advances in Machine Tools	3	0	0	3
ME451	Systems Design & Optimization in Thermal Engg.	3	0	0	3

4.2.9 METALLURGICAL & MATERIALS ENGINEERING :

SEMESTER III

No.	Subject	L	T	P	C	Cat.
HS	Humanities Elective I	3	0	0	3	HSS
MA	Mathematics Elective III	3	0	0	3	SMA
ID120	ECOLOGY AND ENVIRONMENT	2	0	0	2	BET
BT101	LIFE SCIENCES	2	0	0	2	SLS
AM110	ENGINEERING MECHANICS	3	1	0	4	
MM201	PRINCIPLES OF PHYSICAL METALLURGY	4	0	0	4	PMT
MM203	METALLURGICAL THERMODYNAMICS	3	1	0	4	PMT
MM211	PHYSICAL METALLURGY LAB	0	0	3	1	PML
	Total	20	2	3	23	

SEMESTER IV

No.	Subject	L	T	P	C	Cat.
HS	Humanities Elective II	3	0	0	3	HSS
MA	Mathematics Elective IV	3	0	0	3	SMA
MM202	MECHANICAL METALLURGY	3	0	0	3	PMT
MM204	INTRODUCTION TO TRANSPORT PHENOMENA	3	0	0	3	PMT
MM206	PHASE TRANSFORMATIONS	3	0	0	3	PMT
MM208	PRINCIPLES OF EXTRACTIVE METALLURGY	3	0	0	3	PMT
MM212	MECHANICAL METALLURGY LAB	0	0	3	1	PML
MM214	CHEMICAL METALLURGY LAB	0	0	3	1	PML
	Total	18	0	6	20	

SEMESTER V

No.	Subject	L	T	P	C	Cat.
	Minor Elective I (Core)	3	0	0	3	MNS
MM301	PHYSICS OF MATERIALS	3	0	0	3	PMT
MM303	MATERIALS CHARATERISATION	4	0	0	4	PMT
MM305	CREEP, FATIGUE AND FRACTURE MECHANICS	3	0	0	3	PMT
MM307	SOLIDIFICATION PROCESSING	3	0	0	3	PMT
MM309	ENVIRONMENTAL DEGRADATION OF MATERIALS	3	0	0	3	PMT
MM311	METAL CASTING LABORATORY	0	0	3	1	PML
MM313	MATERIALS CHARACTERISATION LAB	0	0	3	1	PML
	Total	19	0	6	21	

SEMESTER VI

No.	Subject	L	T	P	C	Cat.
	Minor Elective II (Core)	3	0	0	3	MNS
	Free Elective I	3	0	0	3	*
MM	Elective I	3	0	0	3	PMT
MM302	IRON MAKING AND STEEL MAKING	4	0	0	4	PMT
MM304	METAL FORMING TECHNOLOGY	3	0	0	3	PMT
MM306	METAL JOINING TECHNOLOGY	3	0	0	3	PMT
MM312	METAL FORMING LAB	0	0	3	1	PML
MM314	METAL JOINING LAB	0	0	3	1	PML
	Total	19	0	6	21	

SEMESTER VII

No.	Subject	L	T	P	C	Cat.
HS	Professional Ethics (P/F) / HS Elective III	2/3	0	0	2/3	HPF/ HSS
	Minor Elective III3	0	0	3	MNS	
	Free Elective II	3	0	0	3	*
MM	Elective II (Self Study)	3	0	0	3	PSS
MM	ELECTIVE III	3	0	0	3	PMT
MM401	P/M, REFRACTORIES AND CERAMICS	4	0	0	4	PMT
MM411	PROJECT I	-	-	-	2	PMP
	Total	18/19	0	0	20/21	
MM402	INDUSTRIAL TRAINING	0	0	6	2	PIT

SEMESTER VIII

No.	Subject	L	T	P	C	Cat.
HS	Professional Ethics (P/F) / HS Elective III	2/3	0	0	2/3	HPF/ HSS
IL402	INDUSTRIAL LECTURE (P/F)	0	0	3	1	PIL
MM	Elective IV	3	0	0	3	PMT
MM412	PROJECT II	-	-	-	9	PMP
	Total	5/6	0	3	15/16	

* Free elective I & II : Category will be indicated in the grade cared according to the course chosen by the student from his own department or from other departments such as MA, HS & PH.

ELECTIVES

No.	Title	L	T	P	C
MM210	Non Destructive Examination	3	0	0	3
MM212	Modern Experimental Techniques	3	0	0	3
MM316	Electronic Materials	3	0	0	3
MM318	Advanced Materials & Processes	3	0	0	3
MM320	Surface Modifications	3	0	0	3
MM405	Materials Selection and Design	3	0	0	3
MM407	Modern Materials	3	0	0	3
MM411	Computational Techniques in Materials Engineering	3	0	0	3
MM413	Sintering Technology	3	0	0	3
MM415	Defects and Failures in Manufacturing and Service	3	0	0	3
MM417	Magnetic Materials	1	3	0	3
MM419	Metallurgical Plant Design	3	0	0	3
MM 559	Mathematical Methods in Materials Engg	3	0	0	3

4.2.10 NAVAL ARCHITECTURE & OCEAN ENGINEERING :

SEMESTER III

No.	Subject	L	T	P	C	Cat.
BT101	LIFE SCIENCES 2	0	0	2	SLS	
ID120	ECOLOGY AND ENVIRONMENT	2	0	0	2	BET
HS	Humanities Elective I	3	0	0	3	HSS
MA	Mathematics III (Elective)	3	0	0	3	SMA
EE110	Basic Elec. Engineering	3	0	0	3/	BET
OE 201	Ship Theory	3	0	0	3	PMT
AM220	STRENGTH OF MATERIALS	3	1	0	4	PMT
AM253	Foundation of Fluid Mechanics	3	0	0	4	PMT
	Total	22	2	0	24	

SEMESTER IV

No.	Subject	L	T	P	C	Cat.
HS	Humanities Elective II	3	0	0	3	HSS
MA	Mathematics IV (Elective)	3	0	0	3	SMA
OE202	ANALYSIS OF STRUCTURES	3	0	0	3	PMT
OE206	SHIP RESISTANCE AND PROPULSION	3	0	0	3	PMT
OE210	CASDD 1	1	0	6	3	PML
AM254	APPLIED MECHANICS LAB	0	0	3	1	PML
	Total	13	0	9	16	

SEMESTER V

No.	Subject	L	T	P	C	Cat.
	Minor Elective I (Core)	3	0	0	3	MNS
OE	Self Study Elective	3	0	0	3	PSS
OE301	SHIP HYDRODYNAMICS	3	0	0	3	PMT
OE303	MARINE ENGINEERING	3	0	0	3	PMT
OE305	OCEAN WAVE HYDRODYNAMICS	3	0	0	3	PMT
OE307	SHIP STRUCTURES	3	0	0	3	PMT
OE309	CASDD II	0	0	6	2	PML
OE311	LAB I	0	0	6	2	PML
	Total	18	0	12	22	

SEMESTER VI

No.	Subject	L	T	P	C	Cat.
	Minor Elective II (Core)	3	0	0	3	MNS
	Free Elective I	3	0	0	3	*
OE	Elective II	3	0	0	3	PMT
OE	Elective III	3	0	0	3	PMT
OE302	SHIP DESIGN	3	0	0	3	PMT
OE304	VIBRATION OF MARINE STRUCTURES AND ACOUSTICS	3	0	0	3	PMT
OE314	LAB II	0	0	6	2	PML
	Total	18	0	6	20	
OE316	INDUSTRIAL TRAINING (SUMMER)	0	0	6	2	PIT

SEMESTER VII

No.	Subject	L	T	P	C	Cat.
HS	Professional Ethics (P/F)/HS Elective III	2/3	0	0	2/3	HPF/ HSS
	Minor Elective III3	0	0	3	MNS	
	Free Elective II	3	0	0	3	*
OE	Elective IV	3	0	0	3	PMT
OE401	OFFSHORE STRUCTURAL DESIGN	3	0	0	3	PMT
OE403	DYNAMICS OF FLOATING SYSTEMS AND MANOEUVRING OF MARINE VEHICLES	4	0	0	4	PMT
OE405	PROJECT I	0	0	6	2	PMP
	Total	18/19	0	6	20/21	

SEMESTER VIII

No.	Subject	L	T	P	C	Cat.
HS	Professional Ethics (P/F)/ HS Elective III	2/3	0	0	2/3	HPF/ HSS
OE402	Industrial Lecture (Pass/Fail)	0	0	3	1	PIL
OE	Elective V	3	0	0	3	PMT
OE406	PROJECT II	0	0	30	10	PMP
	Total	5/6	0	33	16/17	

* Free elective I & II : Category will be indicated in the grade cared according to the course chosen by the student from his own department or from other departments such as MA, HS & PH.

ELECTIVES

No.	Course	Title	L	T	P	C
1	OE313	Physical Modelling and Instrumentation	3	0	0	3
2	OE430	Ocean Energy	3	0	0	3
3	OE440	Drilling Vessels and Support Crafts	3	0	0	3
4	OE460	Advanced Ship Hydrodynamics	3	0	0	3
5	OE531	Guidance and Control of Marine Vehicles	3	0	0	3
6	OE532	Nonlinear Problems in Ocean Engineering	3	0	0	3
7	OE533	Advanced Marine Structures	3	0	0	3
8	OE534	Ocean Environment Policy and Coastal Zone Management	3	0	0	3
9	OE540	Port and Harbour Structures	3	0	0	3
10	OE545	Numerical Techniques in Ocean Hydrodynamics	3	0	0	3
11	OE550	FEM Applied to Ocean Engineering	3	0	0	3
12	OE580	Coastal Engineering	3	0	0	3
13	OE610	Ocean Mining and Dredging	3	0	0	3
14	OE640	Marine Foundations	3	0	0	3
15	OE698	Computer Aided Surface Development of Marine Vehicles	3	0	0	3
16	OE699	Advanced Marine Vehicles	3	0	0	3
17	AM657	Flow Induced Vibration	3	0	0	3
18	AM666	Signal Processing	3	0	0	3
19	AM670	Acoustics and Noise Control	3	0	0	3
20	AM682	Random Vibration	3	0	0	3
21	CH713	Computational Fluid Dynamics	3	0	0	3
22	CT720	Composite Product Design	3	0	0	3
23	ID502	Multi-body Dynamics and Applications	3	0	0	3

5. Course Contents

5.1 Course Contents for I and II Semesters (Common for all branches)

Semester I

MA101 Elements of Calculus **3 0 0 3**

Integral Calculus: Definite integral as the limit of a sum, Properties of definite integrals; Mean Value theorem; Fundamental theorem; Applications.

Sequences and Series: Sequences; Infinite series; Tests for convergence; Alternating series; Functional series; Uniform convergence; Power series and Fourier series.

Functions of Several Variables: Geometric representation; Partial and total increments; Partial derivatives and approximations; Derivatives of composite functions; Directional derivatives, Gradient, Divergence, curl; Taylor's formula; LaGrange multipliers; Optimization problems.

References:

1. *Thomas G.B., Jr., Calculus and Analytic Geometry, Addison- Wesley, 1968.*
2. *RSL Srivastava (IIT, Kanpur), Engineering Mathematics, Vol. I, Tata-McGraw Hill, 1980.*
3. *Piskunov N., Differential and Integral Calculus, Volumes I and II, MIR Publishers, MOSCOW, 1981.*
4. *Kreyszig E., Advanced Engineering Mathematics, Wiley Eastern Private Ltd., New Delhi, 1985.*

PH101 Physics **3 0 0 3**

Use of vectors in practical mechanics. Unit vectors in spherical and cylindrical polar coordinates. Conservative vector fields and their potential functions -gravitational and electrostatic examples. Gradient of a scalar field. Equipotentials, states of equilibrium. Work and energy, conservation of energy. Motion in a central force and conservation of angular momentum.

Physics concepts in vector fields, Continuity equations and conservation principles for matter, energy and electrical charge. Flux, divergence of a vector. Gauss' theorem, physical applications in gravitation and electrostatics. Irrotational versus rotational vector fields. . Physical significance of circulation, curl of a vector field. Stokes' theorem, physical applications.

IITM July '06

Oscillatory motion, Wave motion in one dimension. Wave equation and travelling wave solutions. Wave velocity, group velocity and dispersion. Shallow water waves. Wave equation in three dimensions, spherical waves.

References:

1. *Kittel C., Knight W.O. and Ruderman M.A., Mechanics - Berkeley Physics Course, Vol. 1, Tata McGraw-Hill*
2. *Purcell E.M. Electricity and Magnetism - Berkeley Physics Course, Vol.2, Tata McGraw-Hill*
3. *Crawford F.S. - Waves and Oscillations, Berkeley Physics Course, Vol. 3, McGraw-Hill*
4. *Feyman R.P., Leighton R.B. and Sands M. (Narosa) The Feyman Lectures on Physics, Vol. 1*
5. *Feyman R.P., Leighton R.B. and Sands M. (Narosa) The Feyman Lectures on Physics, Vol. 2*
6. *Davis D. (Academic) - Classical Mechanics*

CY101 Chemistry I **3 0 0 3**

Structure and Reactivity

Elementary systems: The Schrodinger equation, postulates of quantum mechanics, model problems, harmonic oscillator, hydrogen atom; separation of variables, generation of quantum numbers, orbitals, electron density and probabilities; many electron systems.

Molecules: Hydrogen molecule ion; linear combination of atomic orbitals, secular equation; chemical bonding in H_2 and H_2, Overlap , bonding and antibonding orbitals; homonuclear and heteronuclear diatomic molecules, M.O. diagrams, bond order, charge density and properties, hybridization, Huckel M.O. theory of π systems, (4n + 2); reactivity related to electron charge densities, frontier orbitals, Woodward – Hoffmann rules, elementary model of band formation in a chain of atomic orbitals, hydrogen bonding.

Spectroscopy : General features of spectroscopy ; interaction of radiation with matter, Beer-Lambert's Law, line broadening effects; vibrations of diatomic molecules; harmonic and Morse oscillators, energy levels and intensities, selection rules; electronics absorption and emission spectroscopy, magnetic resonance: FT NMR.

Equilibrium and Dynamics of Chemical Systems

Equilibrium Thermodynamics: Basic concepts, the second law of thermodynamics, entropy; clausius inequality, calculation of entropy changes for reversible and

irreversible processes, third law of thermodynamics and absolute entropy, definition of free energy and spontancity; Maxwell relations, free energy and chemical equilibria; Gibbs-Helmholtz and van't Hoff equations, thermodynamic properties from EMF measurements, Nernst equation, phase equilibria, Clausius-Clapeyron equation, phase rule, phase diagrams ; one component systems, two component eutectic systems.

Dynamics of Chemical Processes: Basic concepts, composite reactions, opposing , parallel, and consecutive reactions, reaction mechanisms, chain reactions (stationary and non- stationary); enzyme kinetics (Michaelis – Menten equation); theories of reaction rates (collision theory and classical transition state theory); unimolecular reactions.

Special Topics: Phase transitions in multi- component systems; elementary concept of irreversible thermodynamics, fuel cells, kinetics of fast reactions – relaxation techniques, surface characterization techniques.

References:

1. *Atkins P.W., Physical Chemistry, Sixth Edition, Oxford University Press, 1998.*
2. *C N Banwell and E M McCash "Fundamentals of Molecular Spectroscopy ", McGraw Hill, 1994.*
3. *D.A.McQuarrie and J D Simon "Physical Chemistry: A Molecular Approach", Fist South Asian Edition, Viva Books, 1998.*
4. *G W Castellarn, Physicsl Chemistry , 3rd Edition, Narosa 1995.*
5. *J C Kuriacose and J Rajaram, Chemistry in Engg & Technology, Volume I, Tata McGraw-Hill 1984.*
6. *R McWeeny and C A Coulson, "Coulson's Valence', Oxford University Press 1980.*
7. *F A Cotton, Chemical Applications of Group Theor' Wiley, 1994.*
8. *R J Silbey and R A Alberty, Physical Chemistry, 3rd Edition, Wiley 2000.*

ID110 Concepts in Engineering Design. 2 0 0 2

The purpose of this course is to introduce to the undergraduate student the fundamental principles of Engineering Design which is very important and relevant in the context of to-day's engineering professionals. The course will be generic to all engineering disciplines and will not require specialized preparation or pre-requisites in any of the individual engineering disciplines.

The first eight lectures will introduce the students to the following aspects of design.

1. Philosophy of Engineering Design.
2. Engineering Design Process.
3. Identification and Analysis of needs.
4. Organization of Design Concept.
5. Design Methods.
6. Considerations in Engineering Design.
7. Design decisions.
8. Development of design.

Case studies from field situations and real products will be used to illustrate these principles. Software support will be provided for self-learning by students.

References:

1. Dandy G. C. and Warner, R.F., "Planning and Design of Engineering Systems" Unwin Hyman, 1989.
2. *Eric Laithevaite, (1989), "Invitation to Engineering", Basil Blackwell Inc., Oxford, U.K., 1984.*
3. *Florman, S.C., "Existential Pleasures of Engineering", St. Martin's Press, New York, 1976.*
4. *George E.Dieter, "Engineering Design, A Materials and Processing Approach", McGraw Hill International Book Co., (62:744 DIE (148 532), 1983.*
5. *Henry Petroski, "To Engineer is Human -The Role of Failure in Successful Design", St. Martin Press (62.744.004.6 Pet, 167795), 1985.*
6. *IITO, "Design Thinking Visual Fundamental+ Human Features", (62:744 ING 106961).*
7. *Lawrence, P. Grayson, Joseph M. Biedenbac (Eds.), "Engineering Education for 215 century" ASEE, 1980, 62:744 DIE (148532), 1980.*
8. *Morris Asinow, "Introduction to Design", Prentice Hall, (62:744 ASI 23501), 1962.*
9. *Nicholas Jequier, (Ed.) "Appropriate Technology, Problems and Promises", (62:330.19 (.ORG) 1976 133727) 1976.*
10. *Shoup, "Introduction to Engineering Design with Graphics and Design Projects", (62.744.8150)*
11. *Vijay Gupta and Murthy., P.N., "An Introduction to Engineering Design Method", Tata McGraw Hill Book Co., 62:744 Gup 1980.*
12. Wallence, P.J., "Technique of Design, Isaac Pitman & Sons Inc. (62:744 Wal, 9284), Hill, Percy, H., "The Science of Engineering Design", Holt, Reinhart & Winston Inc., (62:744 Hill) 1970

CS 110 Computational Engineering **3 0 0 3**

Computer Organization - Personal Computing - Distributed Computing -Client/server Computing - Higher Level languages - C environment – C Standard Library - Structured programming - Selection and repetition structure - Break, exit and continue statements - program control -

functions - arrays - printers - structures - Formatted I/O.

Numerical Methods -round off and truncation errors - Approximations - Order of Convergence - non Linear equations - regula falsi; bisection, Newton - Raphson methods - matrices - Gauss eliminations – LU Decomposition - iterative methods for linear systems - interpolation - case studies illustrating the applicability of these techniques in general engineering, chemical, Civil, Mechanical and Electrical Engineering problems Computer Modeling and simulation - Discrete & Continuous approaches - Systems approach to problem solving - Models from various Engineering disciplines - Limitations of simulation.

References:

1. *C: How to program, H. M. Deitel, P. J. Deitel, Prentice Hall, 1997.*
2. *Numerical Methods, Software and Analysis, J. R. Rice, Mc-Graw Hill, 1993.*
3. *Numerical Methods for Engineers, S. C. Chapra, R. P. Canale, Mc-Graw Hill, 1989.*
4. *Computer simulation and Modeling - Francis Neelamuavil, John Wiley & Sons, 1987*
5. *Numerical Recipes in C - William H. Press, Saul A. Teukolsky William T. Vellerling, Brain P. Flannery, Manas Saikia for Foundation Books, 1993.*
6. *Engineering problem solving with ANSI C - Delores M. Etter, Prentice Hall*

ME110 Thermodynamics **3 0 0 3**

Fundamentals - System & Control volume, Property, State & Process, Exact & Inexact differentials; Work - Thermodynamic definition of work; examples, Displacement work, Path dependence of displacement work and illustrations for simple processes, Fully resisted, partially resisted and unresisted process, Other forms of work - gravitational, electrical, magnetic, spring and shaft; Temperature - Definition of thermal equilibrium, Zeroth law, Definition of temperature and temperature scales, Various Thermometers; Heat - Definition; examples of heat/work interaction in systems.

First Law - Cyclic & Non-cyclic processes, Concept of total energy E, Demonstration that E is a property, Various modes of energy; Pure substance - Two property rule, Enthalpy and internal energy; Ideal Gases and Mixtures of Ideal Gases; Properties of water-steam system - Const. temperature and Const. pressure heating, Definitions of saturated states, P-v-T surface, Use of steam tables-Saturation tables, Superheated tables, Identification of states & determination of properties; First Law for Flow Processes - Derivation of general energy equation for a control volume, Steady state steady flow processes, Examples of steady flow devices, Unsteady processes; Second law - Definitions of direct and reverse heat engines - Definitions of thermal efficiency and COP, Kelvin-Planck and Clausius statements, Definition of reversible process, Internal and external irreversibilities, Carnot cycle, Absolute temperature scale; Entropy - Clausius inequality, Definition of entropy S, Demonstration that entropy S is a property, Evaluation of ?S for solids, liquids, and ideal gases undergoing various processes, Determination of s from steam tables, Examples - Turbine, compressor, pump, nozzle, diffuser, Definition of Isentropic efficiency , Available and Unavailable energy, Concept of Irreversibility and Lost work; Thermodynamic cycles - Basic Rankine cycle, Basic Brayton cycle, Basic vapor compression cycle.

References :

i. *Spalding, D. B. and Cole, E. H.,* Engineering Thermodynamics*, Edward Arnold, 1976.*
ii. *Nag, P.K,* Engineering Thermodynamics*, Tata McGraw-Hill, 1995.*
iii. *Jones, J. B. and Dugan, R. E.,* Engineering Thermodynamics*, Prentice-Hall India, 1996.*
iv. *Moran, M.J. and Shapiro, H.N.,* Fundamentals of Engineering Thermodynamics*, John Wiley, 1999.*
v. *Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., Sixth Edition,* Fundamentals of Thermodynamics*, John Wiley, 2003.*

WS101 Workshop I **0 0 6 2**

Introduction to Engineering Drawing, Line work and lettering, Construction of plane curves. Projection of points, straight lines and planes.

Concepts of Orthographic projections and systems. Dimensioning principles and conventions. Isometric views of simple objects, and missing views.

References:

1. *French & Vierk, Fundamentals of Engineering Drawing, McGraw Hill, Book Co. New York, 1980.*
2. *Luzadder W.J., Fundamentals of Engineering Drawing -Prentice Hall Book Co., 1988.*
3. *Gopalakrishna, K.R., Engineering Drawing, Subash Stores, Bangalore, 1988.*
4. *Natarajan, K.V. -Engineering Drawing -Classic Prints, Madras, 1989.*

PH103 Physics Laboratory I **0 0 3 1**

Experiments in Mechanics Properties Materials, Heat, Electromagnetism and Optics.

References:

1. *Smith E. V. -Manual of Experiments in Applied Physic$, London,'» Butterworth, 1970.*
2. *Workshop B.L., and Flint H.P. -Advanced Practical Physics for Students, Methuen and Co. Ltd. London.*
3. *Jerrad H.G. and Mc Neil D.B. -Theoretical and Experimental Physics.*
4. *Fretter W.B. -Introduction to Experimental Physics, Blackiee 5. M. Nelkon and J.rlJl. Ogborn -Advanced Level Practical Physics, English Language Book Society, 1955.*

CY103 Chemistry Laboratory **0 0 3 1**

Volumetric analysis involving acid-base, redox, precipitation and complexometric titrations. Analysis of ores and alloys. Preparation of simple inorganic compounds.

Determinations of molecular weight, distribution coefficient, equilibrium constant, rate constant. Experiments in phase rule. Preparation and properties of simple organic compounds, determination of phenol and formalin.

References:

1. *A.I. Vogel, A Text of Quantitative Inorganic Analysis, ELBS, London.*
2. *Shoemaker D.P. and Garland C.W., Experiments in Physical Chemistry, McGraw Hill, London.*
3. *Dey B.B. and Seetharaman M.V., Laboratory Manual of Organic Chemistry,.*

AS101 Introduction to Aerospace Engineering **2 0 0 2**

History of aviation and space flight; Classification of aircraft and space vehicles; Functions of major components of airplane and space vehicles; subdivisions of aerospace engineering; elements of aerodynamics, propulsion, structures, systems, flight mechanics and controls. Indian aerospace activities.

Text Books:

1. *Benkert J W "Introduction to aviation sciences"*
2. *Above and beyond – Encyclopedia of Aviation Science*
3. *"Encyclopedia of Space Science & Technology" Wiley Interscience 20 0 3*
4. *Janes all world's aircraft".*

BT 101 Introduction to Bio-Technology **2 0 0 2**

Course Overview- Evolution & Origin of Life, Theories for origin of life –Darwinian selection, Diversity of Life; Cell structure- Prokaryotic and Eukaryotic Cell Structures, Functions of Organelles, Mitosis and Meiosis; Classical Genetics - Mendel's laws and Patterns of Inheritance.

Structures of Bio-molecules - DNA, RNA, Protein, Carbohydrates and Lipids; Molecular Genetics - Overview of Information Flow in Biological Systems; Techniques in Cell & Molecular biology

Structure and Regulation of Cellular Metabolism; Energy Flow - Photosynthesis, Cell Respiration, Cellular Oxidation of Glucose; Membrane biology - Cellular Transport and Signal Processing

Overview of Developmental Biology, Human physiology, Behavioral biology.

Text Books:

1. *Life: the Science of Biology - William K. Purves, David Sadava, Gordon H. Orians, H. Craig Heller. 6th edition, W. H. Freeman & Company (2000)*
2. *Biology - Neil A Campbell & Jane B. Reece, 6th edition Pearson Higher Education (2001)*

CH101 Introduction to Chemical Engineering 20 0 2

Definition, Origins and Development of the Chemical Process Industry. The Present Day Chemical Industry, The systematic Analysis of Chemical, Processes, Representation of a Chemical Process in terms of Flow sheet. Scale of Chemical Processes.

Definition, Origin and History of Chemical Engineering. Functions of a Chemical Engineer. Professional and General Aspects of Chemical Engineering . Difference in Chemical Engineering Science & Technology.

Brief description of important Chemical Industries in terms of Unit Operations and Unit Processes. Analysis of Flow Charts in terms of Chemical Engineering subjects. Measuring Techniques, Devices and Control in Process Industries. Pollution and its Abatement.

Conceptual Developments in Chemical Engineering and the associated persons. The use of Mathematics and Computers in Chemical Engineering. Future challenges in Chemical Engineering.

CE 101 Introduction to Civil Engineering **2 0 0 2**

Role of Civil Engineers in Society; Outstanding accomplishments of the profession; Future trends.

Types of projects; Stages of projects; Participants in projects and their role; Techno-economic considerations; Project failures and their causes. All these would be illustrated through case studies and talks by professionals.

References:

1. *Engineers and Engineering, Oxford University Press, 1970.*
2. *Engineering Cases, American Society for Engineering Education, 1982.*
3. *Florman, S.C., The Existential Pleasures of Engineering, St. Martin's Press, New York, 1976.*
4. *The Institution of Civil Engineers, Whither Civil Engineering, Thomas Telford, London, 1996.*
5. *Laithwaite, E., Invitation to Engineering, Basil Blackwell Inc., Oxford, U.K., 1984.*
6. *Skyscraper, six-part video on design and construction of Worldwide Plaza, New York.*
7. *Thirng, M.W. Editor, Engineering -an Outline for the Intending Student, Routledge & Kegan Paul, London 1972.*

CS 130 Introduction to Computer Science and Engineering **2 0 0 2**

Evolution of Computer Hardware and Moore's law, Problem solving using computers Computer Languages, Operating systems, System software Large-scale software system design issues and seminal case studies and history, Next generation computing applications, Grand challenge problems in Computer Science and Engineering.

References:

1. *G. Polya, "How to Solve It", 2nd ed., Princeton University Press, 1957, ISBN: 0-691-08097-6.*
2. *Jon Bentley, "Programming Pearls", Addison-Wesley, Inc., 2000, ISBN: 0-201-65788-0.*
3. *Roger Penrose, "The Emperor's New Mind", Oxford University Press, 1990. ISBN: 0-192-86198-0.*

EC100 – Introduction to Electrical Engineering **2 0 0 2**

1. Electrical Power and Energy – dc and ac power – polyphase systems, Electrical Machines.
2. Semiconductor devices and their applications - Analog and digital systems – Methods of electrical communication – telephony – radio – television – computers and communications.
3. Working Principles of some simple electrical gadgets such as radio – television, computer, mixie, mobile phone, etc.

Text Books:

1. *Vicent Del Toro, Electrical Engineering fundamentals, Prentice Hall India.*
2. *Zbar, Paul B Malvin, Albert Paul and Miller Michael. Basic electronics, Tata McGraw Hill.*

References:

1. *Paul Horowitz, The art of electronics, Cambridge University Press*

ME111 Introduction to Mechanical Engineering **2 0 0 2**

Role of mechanical engineering in industry and society An historical overview of evolution of mechanical systems with examples - Role of materials, engineering analysis and manufacturing with case studies

Basics of conventional design and modern manufacturing processes like micro and nano machining – MEMS

Role of engineering measurements and quality standards

Basics of novel mechanisms – Principles of working of revolutionary machines – Traditional methods of design and analysis – Modern methods – case studies in mechanical design Principles of working of important thermal systems with examples – the role of basic thermal sciences in the design and analysis of mechanical systems Interface between mechanical and other systems – eg: Mechatronics Future challenges.

1. References :

i. *J.L.Adams, Flying Buttresses, Entropy and O–Rings, Harvard University Press, 1993.*

ii. *S.P. Timeshenko, History of strength of materials, Dover Publications, 1993.*

iii. *M.P.Groover, Fundamentals of Modern manufacturing, Prentice Hall, 1996.*

iv. *L.A.Bloomfield, How things work, John Wiley, 2001.*

v. *M.J.Moran, H.N.Shapiro, B.R.Munson and D.P.Dewitt, Introduction to thermal systems engineering, John Wiley, 2002.*

MM101 Introduction to Materials Engineering **2 0 0 2**

Historical perspective, scope of materials science and of materials engineering, Properties of materials – mechanical, electrical , thermal , magnetic, optical, deteriorative, Classification of materials, Illustrative examples of practical uses of materials.

Economic, environmental and societal issues in Materials science and engineering.

Reference Books:

1. *Materials Science & Engineering, an introduction , by William D Callister, Jr. (John Wiley & Sons, Inc,) Singapore 2003.*
2. *Materials Science and Engineering – A First Course, by V Raghavan, 4th edition, Prentice Hall of India Pvt Ltd. New Delhi 1998.*
3. *Mereier, J P Zambelli, G Kurz, W, "Introduction to Materials Science, 1st Edition , ——Elsevier, Paris 2002.*

OE 101 Introduction to Ocean Engineering and Oceanography **3 0 0 3**

I Offshore Structures for oil and gas: Fixed offshore platforms (jackets, gravity platforms, articulated towers); superstructure & foundation, floating platforms (semi-submersibles, jack-ups, TLPS, FPSOs, pipe laying barges); Mooring, station keeping, berthing systems for floating platforms; towing launching & installation of platforms, Nearshore structures.

II Marine Vehicles: Oceangoing, ship types, types of small crafts, high speed crafts, vehicles for Inland water transport, special ship types, e.g. warships, icebreakers, types of propulsion systems, marine safety regulation, underwater vehicles and submersibles.

III Physical Oceanography: Different types of ocean waves and their importance, ocean currents, ocean circulation, measurement of physical properties of ocean basin oscillations, Tsunamis, storm surge, ties, Air-sea interaction.

IV Geological Oceanography: Features of ocean boundaries, geomorphology and structures of ocean floor, continental slope and shelf; marine sediments & formation, types, distribution, distribution of marine minerals in the Indian coast; geophysical prospecting for oil bearing state, placer deposits and polymetallic modules.

EP 101 Introduction to Engineering Physics **2 0 0 2**

Definition and scope of Engineering Physics – Relationship fo Engineering Physics with Engineering Technologies and Physics (with special reference to electrical engineering) – Examples of Application of Engineering Physics – Interdisciplinary areas and emerging technologies – Overview of B.Tech (Engineering Physics) curriculum

Reference:

1. *Eilliots E Elements of Electromagnetics, Oxford University Press – Reprinted from Mc Graw Hill 2003*
2. *Raymond Serway, Physics for Scientists and Engineers, Sander's Publishers (2001)*
3. *Rudolf Dejerls, Surprises in Physics, Oxford University Press (1977)*

Semester II

MA102 Vector Matrices and Differential Equations II **3 0 0 3**

Multiple Integrals: Line Integrals and Surface Integrals; Multiple integrals and their evaluation as iterated integrals; Evaluation of line integrals; Green's theorem; Evaluation of furface integrals; Stokes' and Gauss' theorems.

Matrices: Review of matrix algebra; Rank of matrix; Eigen-values and Eigen-vectors; Diagonalization; Systems of linear equations; Quadric surfaces.

Ordinary Differential Equations: First order equations; Linear equations and systems of linear equations with constant coefficients; Linear differential equations of higher order with constant coefficients; Applications.

References:

1. *Thomas G.B., Jr., Calculus and Analytic Geometry, Addison-Wesley, 1968.*
2. *RSL Srivastava (IIT, Kanpur), Engineering Mathematics, Vol. I, Tata- McGraw Hill, 1980.*
3. *Piskunov N., Differential and Integral Calculus, Volumes I and II, MIR Publishers, MOSCOW, 1981.*
4. *Kreyszig E., Advanced Engineering Mathematics, Wiley Eastern Private Ltd., New Delhi, 1985.*

PH102 Physics II **3 0 0 3**

Electrostatic potential and field due to discrete and continuous charge distributions. Dipole and quadrupole moments. Energy density in an electric field. Dielectric polarization. Conductors and capacitors. Electric displacement vector, dielectric susceptibility.

Biot-Savart's law and Ampere's law in magnetostatics. Magnetic induction due to configurations of current-carrying conductors. Magnetization and surface currents.

Energy density in a magnetic field. Magnetic permeability and susceptibility. Force on a charged particle in electric and magnetic fields.

Time-varying fields. Faradays' law of electromagnetic induction. Self and mutual inductance. Resonance and oscillations in electrical circuits. Displacement current. Maxwell's equations in free space and in linear media. Scalar and vector potentials, gauges. Plane electromagnetic waves. Electromagnetic energy density, Pointing vector. Wave guides.

References:

1. *E.M. Purcell - Electricity and Magnetism - (Berkeley Physics Course, Vol. 20 (Tata McGraw-Hill)*
2. *Feyman R.P., Leighton R.B. and Sands M. (Narosa), The Feyman Lectures of Physics, Vol.2.*
3. *Griffith D.JH., Introduction to Electrodynamics - (Prentice Hall, India)*
4. *Reitz J.R. et al (Narosa), Foundations of Electromagnetic Theory.*
5. *Wangsness R.K., Electromagnetic Fields - (Wiley)*

CY102 Chemistry II **3 0 0 3**

Inorganic Chemistry

Transition Metal Chemistry : Bonding in transition metal complexes: coordination compounds, crystal field theory, octahedral, tetrahedral and square planar complexes, crystal field stabilization energies, Jahn-Teller theorem, spectral and magnetic properties.

Organometallics: 16 & 18 rule, oxidative addition reation, insertion and deinsertion reactions, examples of reaction types in catalystic cycles like homogeneous hydrogenation and hydroformylation reactions, types of bonding in organometallic compounds, ionic, 2 center – 2 electron, 3 centre – 2 electron and Main Group Chemistry: Classification of boranes, simple examples: borazine, participation of d orbitals in nonmetal complexes: disilanes.

Bio-Inorganic: Trace elements in biology, heme and non-heme oxygen carriers, haemoglobin and myoglobin-cooperativity; Bohr effect, Hill coefficient, oxy and deoxy haemoglobin, reversible binding of oxygen, Perutz model, chlorophyll and photosynthesis.

Solid State Chemistry: X-ray and neutron diffraction, Bragg equation, Miller Indices; conduction in solids, Arrhenius equation and conductivity expressions; magnetic ordring, soft & hard magnets, B-H loop, spinels and inverse spinels, ferrites, rare earth transition metal compounds, dielectric, ferroelectric and piezo electric materials; basics & examples.

Special topics: Superconductivity, nano materials , preparation , properties and applications; colossal magneto resistance, dilute magnetic semiconductors.

Organic Chemistry

Aromaticity: Electron delocalization, resonance and aromaticity; molecular orbital description of aromaticity and anti-aromaticity, annulenes; ring current, NMR as a tool, diamagnetic anisotropy; aromatic electrophilic substitutions, aromatic nucleophilic substitutions, benzyne; reaction mechanisms, reactivity and orientation.

Pericyclic rections : Definition, classification, electrocyclic, cycloaddition, sigmatropic reactions, electrocyclic reactions, examples of ring closing and ring opening reactions of butadiene and hexatriene only; cycloaddition reactions – $\{2\pi + 2\pi]$ and $[4\pi + 2\pi]$ cycloadditions; Woodward Hoffmann rules, FMO approach, stereochemical aspects and synthetic utility of the above reactions, sigmatropic rearrangement limited to Cope and Claisen rearrangements: examples and synthetic utility.

Polar reactions: Generation and reactions of carbocations, 1,2 shifts; generation and rections of carbanions – alkylationa nd acylation of enolates, aldol and Michael reactions, Claisen and Dieckman condensation reactions.

Multistep organic synthesis. Functional group introduction and interconversion retrosynthesis, synthons and synthetic equivalents, C-X and C-C disconnections, syntheis of selected targets utilizing the reactions described above.

References:

1. *James E. Huheey, Ellen A Keiter, Richard L Keiter: "Inorganic Chemistry, Principles of Structure and Reactivity' Addison Wesley, 1997.*
2. *F A Cotton & G Wilkinson, "Advanced Inorganic Chemistry" 5th Edition, Wiley Interscience, 1988.*
3. *Anthony R West, "Solid State Chemistry and Applciations" John Wiley 1984.*
4. *Leonid V Azaroff, "Introduction to Solids, Krieger Publishing 1960*
5. *J D Lee "Concise Inorganic Chemistry" Chapman & Hall, London, 1996*
6. *William L Jolly, Modern Inorganic Chemistry" McGraw-Hill International, 2nd Edition, 1991*
7. *R T Morrison & R N Boyn "Organic Chemistry, " Prentice Hall, New Delhi , 6th Edition, 1999*
8. *P Bruice, "Organic Chemistry" Prentice Hall New Delhi , 3rd Edition, 2001*
9. *F Carey "Organic Chemistry", McGraw Hill Publishers, 5th Edition, 2003*
10. *J McMurray, "Organic Chemistry", Brooks/ Cole Publishing Co, 5th Edition, 2000*
11. *K P C Vollhardt & N E Schore, Organic Chemistry, Structure & Function', Freeman Press, 4th Edition, 2003.*

AM110 Engineering Mechanics **4 0 0 4**

Equilibrium of rigid bodies, free body diagram, Analysis of beams and trusses, Equilibrium of continuous systems -derivation of relation between load, shear force and bending moment. Energy conservation in rigid bodies -potential energy and elastic energy. Virtual work in multibody assemblies.

Lumped mass models in Dynamics -Particle motion in cylindrical c0ordinates, engineering applications of central force motion. Kinetics of rigid bodies -translation and rotation motion of a rigid body, relative motion with translating and rotating axes and Coriolis acceleration. Kinematics of rigid bodies -3-D properties of sections, angular momentum of rigid bodies and energy relations for rigid bodies. Mechanical vibrations of single degree of freedom systems -free vibration of rigid bodies, general equations of motion and response to forced sinusoidal loading.

References:

1. *Beer F.P. and Johnston E.R., Vector Mechanics for Engineers - Volume I - Statics, Volume II - Dynamics, McGraw Hill, New York.*
2. *Merlam J.L and Kraige L.G., Engineering Mechanics, Volume I - statics, Volume 11- dynamics, John Wiley & Sons, New York.*
3. *Shames L.H., Engineering Mechanics, Prentice HaII, New Delhi*

EE110 Basic Electrical Engineering **3 0 0 3**

DC circuits -AC circuits -True and reactive power in AC circuits.

Electro -Mechanical Energy Conversion -Power Systems.

Opams and their Applications -Basic digital systems - Microprocessors –Computer networking fundamentals.

Principles of communication -Basics of Signal Processing.

References:

1. *Vincent Del Toro : Electrical Engineering Fundamentals, Prentice Hall India, 1989.*
2. *Paul Horowitz & Winfield Hill, The Art of Electronics, Cambridge University Press, 1992.*
3. *Taub & Schilling, Digital Integrated Electronics, McGraw-Hill, 4. Ralph J Smith, "Circuits Devices and Systems, John Willey & Sons, 1989.*

ME112 Engineering Drawing **1 0 3 2**

Manual drawing:

Introduction to Engineering drawing and graphics. Construction of plane curves. Coordinate system – projection of lines and planes. Projection of right regular solids. Section and intersection of solids and development of surfaces.

Computer Aided Drafting:

Systems of projections - principles, conventions and applications of orthographic and isometric projections. Dimensioning principles and conventional representations.

1. References :

i. *Luzadder. W.J., Fundamentals of Engineering Drawing, Prentice Hall India, 1990.*
ii. *French and Vierk., Fundamentals of Engineering Drawing, McGraw Hill, 1996.*
iii. *Narayana.K.L., & Kannaiah.P.,Engineering Drawing, Charotar Publishing House, 1998.*
iv. *Venugopal.K., Engineering Drawing, New Age International, 2000.*
v. *Natarajan.K.V., A text book on Engineering Drawing, Classic Prints, 2000.*
vi. *Gopalakrishna.K.R., Engineering Drawing. Subash Stores, 2000.*
vii. *Bhatt.N.D., Engineering Drawing, New Age International. 2000.*

WS102 Workshop II **0 0 3 1**

Introduction to the usage of tools, instruments and machinery in turning, welding, carpentry and pneumatics and hydraulics.

Turning: Types of lathes and operations. Exercises covering - facing and centering, plain turning, step turning, taper turning.

Welding: Weld joint preparations, exercises in arc and gas welding, soldering and brazing.

Carpentry: Wood sizing, exercises in planing, marking, sawing, chiselling, grooving and fitting.

Pneumatics and Hydraulics: Pneumatics and hydraulic components and circuits, experimental covering -calibration, pneumatics, control valves, cylinders, pumps and motors, hydraulic circuits.

Processing of Plastics: Hand injection moulding, semi-automatic injection moulding, welding of plastics. Fabrication of FRP components.

PH104 Physics Laboratory II **0 0 3 1**

Experiments in Electricity, Magnetism, Optics and Atomic.

References:

1. *Smith E.V. - Manual of Experiments in Applied Physics, London, Butterworth, 1970.*
2. *Workshop B.L., and Flint H.P. -Advanced Practical Physics for Students, Methuen and Co. Ltd. London.*
3. *Jerrad H.G. and Mc Neil D.B. -Theoretical and Experimental Physics.*
4. *Fretter W.B. - Introduction to Experimental Physics, Blackiee, 5. M. Nelkon and J.M. Ogborn -Advanced Level Practical Physics,English Language Book Society, 1955.*

CH102 Process Calculations **4 0 0 4**

Basic Concepts, Units and Dimensions, Steady state and dynamic processes, Lumped and distributed processes, Single and multiphase systems.

Types of Variables, Intensive and extensive variables, Specific properties, State Variables.

Types of Equation: Mass and energy conservation, equilibrium relations, Rate, laws Constitutive equations for material behaviour , Correlations for physical and transport properties.

Material Balances for Steady State Processes: Properties of gases, liquids and solids, equations of state, phase equilibria for ideal mixtures, Reactions and stoichmometry, Non-Reaching single phase systems; Single and multiple units without recycle, Systems with recycle, bypass and purge, Non-Reacting multiphase systems; Processes involving vaporization and condensation, reacting systems.

Energy Balances for Steady State Processes: Specific heat capacity, Enthalphy, Heat of reaction, Thermochemistry, Isothermal systems, Adiabatic Systems, Simultaneous material and energy balances.

Unsteady State Material and Balances; Reaction rate laws, Transport laws.

Introduction to Computer Aided Process Calculations: Degrees of Freedom and Specifications, Use of Spreadsheets, Tearing and IIterative Techniques in Flowsheeting.

References:

1. *Himmelblau D M "Basic Principles and Calculations in Chemical Engineering" 6th Edition Prentice Hall of India 1997.*

CE102 Functional Design of Buildings **2 0 0 2**

Considerations of functional characteristics in planning and design of buildings. Influence of climate on the design of buildings, Principles involved in the design of buildings for thermal comfort, natural ventilation, lighting, acoustics. Principles of energy efficient buildings. Discussion on specific case studies.

EC 101 - Electrical and Magnetic Circuits **3 1 0 4**

DC Circuits – Independent and dependent sources – resistors – linear – non-linear – Node and Mesh methods of analysis of linear resistive networks containing independent and dependent sources – Network theorems – super position - reciprocity – Thevenin - Norton and Maximum power transfer. Sinusoidal AC sources – steady state analysis – self and mutual inductances - capacitance – phasor representation – impedance – admittance – Mesh and Node methods for ac circuits – power and reactive power – power factor – series and parallel resonance – three phase circuits – star – delta – balanced – unbalanced – power in three phase circuits – star – delta transformation – symmetrical components.

Magnetic circuit – dc excitation – hysterisis – loop – B – H – curve – reluctance – airgap – iterative design – ac excitation – eddy current losses – dynamic B-H curve – simple design.

Text Book

1. *William Hayt and Kemmerly JE, Engineering circuit analysis Tata Mcgraw Hill.*
2. *Murthy KVV and Kamath M.S., Basic current analysis, Tata Mcgraw Hill.*

Reference Books:

1. *Vincent Del Toro, Electrical Engineering Fundamentals, Prentice Hall, India*

EC104 Digital Systems **3 1 0 4**

Number systems and codes - Logic gates - Truth tables - minterms, maxterms - sum of products and product of sums - simplification of logic functions using Boolean algebra and Karnaugh maps - design of combinational circuits - flip-flops – counters - shift registers - design of sequential circuits - state graphs and state tables - MSI and LSI implementation of digital circuits - programmable logic devices - Top down approach to digital system design - simple design examples.

Text Book:

1. *M. Mano, "Digital Design", 3rd Ed., Prentice Hall, India.*
2. *D.D. Givone, "Digital Principles and Design", Tata McGraw Hill.*

MM102 Science and Engineering of Materials 3 0 0 3

Atomic structure and interatomic bonding. Lattices, basic ideas of symmentry, unit cells, crystal systems, Bravais lattices. Structure of crystalline solids. Indexing of directions and planes, notations, co-ordination number. Single crystals, polycrystalline materials, nano-crystalline materials, non crystalline materials. Imperfections in solids: point defects, 1D, 2D, and 3D defects. Solid solutions, phases, phase diagrams. Diffusion phenomenon, Phase transformations. Properties and applications of metals, alloys. Strengthening mechanisms. Structure, properties, and applications of ceramics, polymers, composites.

Reference Books :

1. *Materials Science and Engineering, an introduction, by William D. Callister, Jr.(John Wiley & Sons, Inc.) Singapore (2003).*
2. *Materials Science and Engineering—A First Course, by V. Raghavan, 4th edition, Prentice Hall of India Pvt. Ltd., New Delhi, (1998) .*
3. *Physical Metallurgy Principles, by R.E. Reed - Hill and R. Abbaschian - (Van Nostrand)*
4. *Mercier, J.P., Zambelli, G., Kurz, W., "Introduction to Materials Science", 1st edition, Elsevier, Paris, (2002).*

OE 102 Materials and Production Processes

Steel plates and sections for ships and offshore structures – different grade and their applications – Materials for propellers, shafts etc. – Titanium and aluminium for underwater application – Introduction to Marine Corrosion and Control – painting.

FRP materials; their application in ship building; design data – Ferro cement and concrete – wood in ship building industry – design data – Fatigue and fracture behaviour of materials

Introduction to ship production processes – shipyard lay out – material flow – material handling equipments – Cutting processes – edge preparation – metal joining processes – welding methods; welding procedure and welder qualification test; weld defects; weld inspection – Hull fabrication and assembly – hull erection – Launching of ships and offshore structures – Outfitting – Tests and trials

Text Books

1. *Crane FAA and Charles, J.A., Selection and use of Engineering materials, Butterworth and Co., Ltd. (1984).*
2. *Robert Taggart (Ed.), Ship design and construction, published by society of Naval Architecture and Marine Engineers, One World Trade Centre, New York (1980)*
3. *Dexter S.C., Handbook of oceanographic engineering materials, John Wiley and Sons, New York (1979)*
4. *Soheneck Jr.H. (Ed.), Introduction to Ocean Engineering, John Wiley & Sons, New York (1975)*
5. *Robert Taggart, Ship Design and Construction, SNAME, One World Trade Centre, Suite 1369, New York 10048 (1980)*
6. *Eyres, D.J., Ship construction, Heinman, London (1972)*
7. *Pursey, H.J., Merchant Ship Construction, Especially written for Merchant Navy, Edn.6, Glasgow, Brown, Ferguson (1975)*
8. *Stokoe, E.A., Embleton William, Reed's ship construction for marine students, Ed.2, Sunderland, Thomas Reed (1968)*
9. *Benford, Harry (Ed.), Half century of Marine Technology, Butterworths, London (1983)*

vector fields. . Physical significance of circulation, curl of a vector field. Stokes' theorem, physical applications.

Oscillatory motion, Wave motion in one dimension. Wave equation and travelling wave solutions. Wave velocity, group velocity and dispersion. Shallow water waves. Wave equation in three dimensions, spherical waves.

References:

1. *Kittel C., Knight W.O. and Ruderman M.A., Mechanics - Berkeley Physics Course, Vol. 1, Tata McGraw-Hill*
2. *Purcell E.M. Electricity and Magnetism - Berkeley Physics Course, Vol.2, Tata McGraw-Hill*
3. *Crawford F.S. - Waves and Oscillations, Berkeley Physics Course, Vol. 3, McGraw-Hill*
4. *Feyman R.P., Leighton R.B. and Sands M. (Narosa) The Feyman Lectures on Physics, Vol. 1*
5. *Feyman R.P., Leighton R.B. and Sands M. (Narosa) The Feyman Lectures on Physics, Vol. 2*
6. *Davis D. (Academic) - Classical Mechanics*

5.2 Branch Courses Contents – Semester III to VIII

5.2.1 B.Tech. Aerospace Engineering

SEMESTER III

AS102 Fluid Mechanics **3 1 0 4**

Brief history of fluid mechanics, Fluids and their properties, Concepts of viscosity, thermal conductivity, mass diffusivity, compressibility and surface tension. Molecular considerations of the same.

AE

Hydrostatic – center of pressure, center of buoyancy and meta centre, ISA .

Tensor calculaus (Cartesian Tensors).

Eulerian and Lagragian methods of describing fluid motion, streamlines , strick lines and path line. Kinmatics of fluids - translation , rotation and deformation , circulation , Green's Stokes theorems.

Derivation of governing equations for mass, momentum, energy in the differential and integral forms and their specialization for inciscid and potential flow. Equations in non-inertial frames. Bernoulli's equation. One-dimensional flow.

Illustrative examples in various cases.

Laminar flows like Couette flow and Hagen-Poiseulle flow, flow in bearings and boundary layers.

Dimensional analysis.

Viscous flow over a flat plate and in pipes –transition, turbulent flow, skin friction and losses in pipes.

References:

1 Granger Holt R A, Fluid Mechanics – Rinehart and Winstan, 1985.
2. Yuan Printice S N Foundation of Fluid Mechanics, Hall of India 1976.

AS201 Basic Strength of Materials **3 1 0 4**

Introduction to stress and strain - Hooke's law, stress and strain transformations, principal stresses and strains - Torsion of circular sections - Thin-walled pressure vessels - Bending and shearing stresses in beams of symmetric cross-sections - Deflection of statically determinate beams by various methods - Stresses due to combined loading, theories of failure.

Introduction to theory of elasticity, field equations, Airy's stress - function, two-dimensional problems in Cartesian coordinates, Lame's solution for thick cylinders.

Semester IV

AS202 Structures **3 1 0 4**

Unsymmetrical bending; bending and shearing stresses/shear flows in beams of solid and thin-walled open sections, shear centre, lumped area-Strain energy, Castigliano's theorems, application to beams, trusses and in-determinate structures-Torsion of single and multicell tubes, Neuber tubes, open sections, restrained warping-Combined bending and torsion, multicell structures - elastic and inelastic buckling of columns with solid, hollow and thin-walled sections-Buckling of flat sheets in compression, shear, bending and under combined loading-Beam-columns.

AE

AS203 Gas Dynamics **3 1 0 4**

Introductory concepts of compressible flow, Isentropic one-dimensional flow, Normal shocks - stationary and moving, applications, applications to supersonic wind tunnels, Shock tubes, Supersonic Pitot' probes, oblique shock, reflection, Prandtl - Meyer expansion flow. Fanno flow & Rayleigh flow. Under and over expanded nozzles, Shock expansion method for flow over airfoils.

Brief introduction to the methods of characteristics. Prandtl-Glauert and Goethert rules. Ackeret's supersonic airfoil theory. Small perturbation equations for subsonic, transonic, supersonic and Hypersonic flow. Experimental characteristics of airfoils in compressible flow.

AS205 Aerodynamics **3 1 0 4**

Vortex motion : Helmholtz laws and Kelvin's theorem, Point vortex, vortex sheet, Biot-Savart law.

Incompressible flow past airfoils. Airfoil nomenclature and characteristics. Kutta condition, starting vortex. Method of singularities and thin airfoil theory. Elements of panel method. Experimental characteristics of airfoils.

Momentum and blade elements of theory of propellers.

Incompressible flow past finite wings. Wing nomenclature. Prandtl's lifting line theory. Induced drag. Effect of geometrical parameter on lift and induced drag. Element of lifting surface theory. Flow past swept and delta wings.

Elements of flow past bodies in incompressible flow.

Lift, drag and moment characteristics of the entire airplane.

AS226 Propulsion – I **3 0 0 3**

Equilibrium Combustion Thermodynamics.

Basic Principles of boundary layer mechanics and heat transfer

Cycle analysis: Thermodynamics of aircraft jet engines Aerothermodynamics of non-rotating propulsion components: Inlets, combustors, and nozzles.

AS251 Low Speed Lab. **0 0 3 1**

Wind tunnels - Similarly considerations - Pressure and velocity measurements - Force and moment measurements - Hot-wire measurements - Experiments designed to cover the above.

SEMESTER V

AS204 Flight Dynamics I **3 0 0 3**

Forces and moments acting on a vehicle in flight.

Equations of motion of a rigid flight vehicle.

Various types of drags. Drag polar of vehicles from low speeds to hypersonic speeds.

Review of the variation of thrust / power and SFC with altitude and velocity, for various air breathing engines and rockets.

Performance of airplane in level flight, glide, climb, accelerated flight, turn, maneuvers, take-off and landing. Flight limitations.

Flight-testing: Altitude definitions, Speed definitions, Air Speed, altitude and temperature measurements. Errors and calibration. Measurement of engine power, charts and corrections. Flight determination of drag polar.

AS206 Experimental Aerodynamics **3 0 0 3**

Definition of accuracy, precision, resolution etc. Estimation of uncertainty analysis of data. Principles of model testing. Characteristic features, operation and

performance Low Speed, Transonic, Supersonic, Hypersonic and special tunnels. Shock tubes and shock tunnels. Shock tubes and shock tunnels.

Introduction to measurements of pressure, temperature, flow rate and velocity. Measurements of Mach number, pressure, temperature, velocity and flow rate in test facilities. Optical flow visualization, hot-wire anemometer, Laser diagnostics.

AS327 Propulsion - II **3 0 0 3**

Turbo machinery: Axial compressors and turbines; centrifugal pumps and compressors. Rocket propulsion elements; Complex chemical equilibrium calculations; Chemical rocket thrust chambers and associated systems; non-chemical rockets; combined cycle propulsion concepts.

AS301 Introduction to Space Technology **3 0 0 3**

Space mission types, Environment, Astrodynamics; fundamentals of orbital mechanics (two body motion, circular and escape velocity, motion in elliptic hyperbolic, and parabolic orbits); basic orbital maneuvers. Rocket propulsion fundamentals; ascent flight mechanics; launch vehicle selection. Atmospheric entry; entry flight mechanics; entry heating. Attitude determination and controls; basic concepts; review of rotational dynamics; rigid body dynamics; disturbance torques; passive attitude control; active control; attitude determination. Thermal control. Spacecraft power, Telecommunications.

AS303 Vibrations **3 0 0 3**

Systems with single and two degrees of freedom; free, forced vibrations with and without damping - Lagrange's equation - Equations of motion of systems with many degree of freedom - Exact analysis of longitudinal, torsional and lateral vibrations of continuous elastic systems - Approximate methods: Rayleigh, Ritz, Galerkin, etc.

References:

1. *'Mechanical Vibrations', F.S. Tse, I.E. Morse and R.T. Hinkle, Second Edition, CBS Publishers and distributors, Delhi 1983.*

AS252 Propulsion Laboratory **0 0 3 1**

Experiments in Aerothermodynamics of propulsion; Calorific value of fuel, propellant burning rate, static testing of rockets etc.

AS351 Aero Lab - I **0 0 3 1**

Experiments in structures; unsymmetrical bending of beams, shear centre of open section, composite beams, determination of material constants etc.

Flow through CD nozzle, performance of transonic and supersonic wind tunnels, experiments in transonic tunnel.

SEMESTER VI

AS305 Flight Dynamics II **3 0 0 3**

AE

Basic concepts of stability and control, Static longitudinal, directional, and lateral stability and control. Equations of equilibrium and stability - contribution of major components. Stick-fixed stability, control effectiveness, hinge moment, Tabs, aerodynamic balancing, effects of freeing the stick. Control forces and force gradients. Critical conditions for stability and control. Effect of Maneuvers. Longitudinal dynamic stability; Equations of motion of a disturbed aircraft, stability derivatives, characteristic equation for stick fixed case, modes and stability criterion, effect of freeing the stick. Brief description of lateral and directional dynamic stability - Spiral, divergence and dutch roll. Response, automatic control, autorotation and spin.

Determination of neutral points and maneuver point in flight tests.

AS306 Experimental Stress Analysis **3 0 0 3**

Different types of strain measuring devices such as electrical, mechanical, optical, pneumatic, acoustical strain gauges. Electrical resistance strain gauges and associated circuits. Application to load cells, torque wrenches etc. Stress gauge. Two-dimensional photo elasticity. Model materials, calibration, Compensating technique, Stress separation, Stress freezing.

Principles of NDT methods - brittle lacquer, X-ray diffraction, Ultrasonic etc.

AS352 Aero Lab - II **0 0 3 1**

Experiments in supersonic tunnel, flow visualization techniques in high speed flow, shock tube, hot wire and laser doppler anemometry.

Experiments such as Euler load by southwell plot, buckling of thin-walled open sections, influence lines, moment indicator, frame analysis etc.

AS350 Industrial Training (Summer) **0 0 2 2**

Semester VII

AS451 Experimental Stress Analysis Laboratory **0 0 3 1**

Selected experiments covering

a) Calibration of electrical strain gauge and photoelastic model material

b) Wiring electrical strain gauge rosettes to load cells etc.

c) Study of fringes, fringe orders etc., in two-dimensional photoelasticity.

AE

AS 459 Project I **0**

Semester VIII

AS452 Flight Test Lab **0 0 3 1**

AS 402 Industrial Lecture (Pass/Fail) **0 0 0 1**

AS 450 Project II **0 0 9 9**

Electives:

AS212 Matrix Methods in Structural Analysis **3 0 0 3**

Introduction to matrix methods of structural analysis, stiffness and flexibility approaches - Work and energy principles, reciprocal theorems of Betti and Maxwell - Assembly techniques - applications to trusses and frames - introduction to finite element method - Simple applications.

AS214 Advanced Aerodynamics **3 0 0 3**

Application of conformal transformations: Basics of complex variables, Joukowski transformation, Theodorsen's theory for thick airfoils. Wing theory: Vortex dynamics, extended lifting line theory, vortex lattice method. Simple Wave Solution of one dimensional unsteady compressible flow. Numerical Techniques: Solution of Laplace, Heat and Wave equations. Introduction to Transonic flow. Elements of hypersonic flow, Basics of Turbulent flows : Elements of hypersonic flow, Basics of Turbulent flows : Reynolds averaged equations, models of turbulence.

AS216 Combustion In Aerospace Propulsion **3 0 0 3**

Explosions, Schvab-Zeldvich formulation, Rankine-Hugoniot relations. Deflagration, detonation, and transition. Multiphase flows Combustion modeling in multiphase systems.

AS311 Advanced Strength of Materials **3 0 0 3**

Analysis of indeterminate beams; Clapeyron's equation for continuous beams - Analysis of frames and rings - Analysis of curved beams - Composite beams, wide beams - Torsion of noncircular solid and thin-walled cross-sections, Warping function - Rotating disks - Flexural - torsional buckling - Pure and semi-tension field beam theories - Load diffusion, shear lag - A brief introduction to impact loading, fatigue, creep, etc.

AS313 Introduction to Composite Structures. **3 0 0 3**

Composite materials: Classification of composites; Advantages of fibre-reinforced laminates; Methods of manufacture.

Macromechanics of a lamina : Anisotropic Elasticity; Stress - Strain relations in material coordinates; Transformation to geometric axes; Strength concepts; Biaxial Strength theories - maximum stress, maximum strain, Tsai-Wu. Introduction to micromechanics: Mechanics of materials approach to determine Young's modulus, shear modulus and Poisson's ratio; Brief mention of elasticity approach and Halpin-Tsai equations.

Laminate analysis : Introduction to classical plate theory; Classical lamination theory; Special cases of single-layer; symmetric, antisymmetric and unsymmetric configurations with cross-ply and angle-ply layups; Deflection analysis of laminated plates. Analysis of laminated beams and columns.

Shear deformation theories for composite laminates.

AS315 Introduction to CFD **3 0 0 3**

Introduction to numerical methods - machine epsilon, numerical differentiation and integration. Advection and diffusion by wave equation, heat equation and Laplace equation. Properties of the solutions. Discretization schemes for the one dimensional first order wave equation. Dissipation, Dispersion and stability of such schemes. Simple extension to Quasi-One-Dimensional Euler equations and Full Euler equations. Solution to heat equation. Time marching schemes-

ADI, LU approximate factorization schemes. Solution to Laplace equation-Point interactive technique. Properties of the solution. Introduction to grid generation-algebraic grids, elliptic grids. Applications to flow problems.

AS317 Flight Testing **3 0 0 3**

Basic definitions. Airspeed, altitude and temperature measuring systems, errors and calibration. Measurement of power of internal combustion engines thrust of Turbojet engines and thrust and s.h.p. of turboprop engines. Methods to obtain engine output under standard atmospheric conditions. Flight test techniques for evaluation of performance and stability of aircraft with piston and jet engines. Methods for obtaining performance under standard atmospheric conditions.

AS319 Design of Gas Turbines **3 0 0 3**

Detailed design calculation of gasturbine compressor and turbines: flow-matching, losses and heat transfer in various components. Construction details of blades, seals, shaft, etc. Off-design performance considerations. Diffuser, combustion chamber, after-burner and nozzle design.

AS321 Transport Processes in Reacting Flows **3 0 0 3**

Principles of heat transfer: conduction, convection, and radiation. Mass and momentum transfer: elements of mass diffusion and boundary layer theory. Chemical kinetics and equilibrium chemistry. Fundamentals of combustion and flame: premixed flame speed, Burke-Schumann analysis of diffusion flames, and droplet combustion**.**

5.2.2 B.Tech Bio-Technology

Semester III

BT201 Microbiology **3 0 0 3**

History and scope; Discovery of microorganisms, Spontaneous generation vs Biogenesis, Microorganisms and disease, Microbial world, Scope of microbiology.

Microbial cell structure and function: Prokaryotic cell structure and function, Eukaryotic cell structure and function, *Archaea*, Bacteria, Fungi, Algae, Protozoa and Viruses.

Microbial nutrition and growth: microbial nutrient requirements, nutritional types of microorganisms, growth factors, nutrient uptake mechanisms, growth curve, environmental factors affecting growth, growth in natural environments.

Microbial metabolism: Oxidation of glucose, Fermentations, Aerobic and anaerobic respirations, Oxidation of inorganic molecules, Bacterial photosynthesis, Assimilation of inorganic P, S & N,

Microbial taxonomy; Control of microbes; Pathogenecity; Antimicrobial resistance; Applied microbiology.

Reference Books:

1. *Prescott, L.M. Harley, J.P. and Klein, D.A., sixth edition, (2004), Microbiology, McGraw Hill.*
2. *Stanier, R.V. Adelberg E.A. and Ingraham J.L., fourth Edition, General Microbiology, Macmillan Press.*
3. *Pelczar Jr. M.J., Chan E.C.S. and Krieg, N.R., fifth edition Microbiology, McGraw Hill.*
4. *Westriech, G.A. and Lechfmann M.D., fifth edition Microbiology, Macmillan Press.*
5. *Atlas, R.M., Maxwell., second edition, (1989), Microbiology: Fundamentals and Applications, Macmillan.*

BT203 Biochemical Thermodynamics **3 0 0 3**

Course Contents:

BASIC CONCEPTS IN ENGINEERING THERMODYNAMICS

First and Second law of Thermodynamics; Calculation of work, energy and property changes in reversible processes, Thermodynamics of flow processes.

THERMODYNAMIC PROPERTIES OF FLUIDS

Volumetric properties of gases exhibiting non-ideal behaviour; Residual properties; Estimation of thermodynamic properties using equations of state; Partial molar properties and Excess properties; Solution Thermodynamics.

PHASE EQUILIBRIA

Ideal and Non-ideal behaviour of systems in phase equilibrium; vapour-liquid and liquid-liquid equilibria; Prediction of equilibrium compositions from equations of state.

CHEMICAL REACTION EQUILIBRIA

Equilibrium criteria for homogeneous chemical reactions; Evaluation of equilibrium constant and effect of pressure and temperature on equilibrium constant; Calculation of equilibrium conversions and yields for single and multiple chemical reactions.

BIOCHEMICAL THERMODYNAMICS

Bioenergetics, Energetics of Metabolic Pathways; Energy Coupling (ATP & NADH); Stoichiometry and energetic analysis of Cell Growth and Product Formation - elemental Balances, Degree of reduction concepts; available-electron balances; yield coefficients; Oxygen consumption and heat evolution in aerobic cultures; thermodynamic efficiency of growth; thermodynamics of oxidation-reduction reactions; Energetics of Protein folding, enzyme–ligand binding.

NON LINEAR THERMODYNAMICS

Fundamentals, energy conversion, coupling, examples.

Reference Books:

1. *Smith J.M., Van Ness H.C. and Abbott M.M.,fifth edition (1996), Introduction to Chemical Engineering Thermodynamics. McGraw Hill.*
2. *Roels J.A. (1983), Kinetics and Energetics in Biotechnology, Elsevier biomedical press.*
   Essig, A., and Caplan, S. R. (1999), Bioenergetics & Linear Non equilibrium Thermodynamics: The Steady State. Universe com.

BT 211 Microbiology Laboratory **0 0 6 2**

Introduction & culture media formulation: Nutrient broth and nutrient agar preparation, Sterilization and waste disposal; Pure cultures of microorganisms: Streak plate method, Pour plate method, Spread plate method, Aseptic transfer; Microorganisms

in the environment: Biodiversity (soil, water, air), Bacterial colony morphology; Light microscopy: Examination of prepared microscope slides , Motility, Size measurement, Yeast and fungus; Staining of microorganism: Preparing a bacterial Smear, Simple stain, Negative Stain, Gram stain, Acid-fast stain, Capsule stain, Spore stain, Flagella stain; Measurement of cell number: Microscopic counting, Serial dilution method. Minimum inhibitory concentration of antibiotic, Antibiotic sensitivity assays; Selective and differential media tests: Blood agar, Mannitol salt agar, Eosin methylene blue agar, Hektoen enteric agar, MacConkey agar, Fermentation tests, Triple sugar iron agar; Identification of extra-cellular enzyme producers: Casease test, Gelatin liquefaction, Lipase test, Starch hydrolysis test, Cellulose hydrolysis test; Identification of bacteria by biochemical test; Microbial growth kinetics: Cell mass measurement, Growth curve using flask culture, Kinetic parameters measurement; Microbial metabolism: Identification and measurement of metabolites, Microbial Production of Metabolites; Strain improvement by genetic engineering: Plasmid transfer into *E. coli*. Overproduction of Metabolites.

Reference Books:

1. *Cappuccino, J.G. and Sherman, N. (1999), Microbiology, A Laboratory Manual. Fourth edition, Addison Wesley Pub.*
2. *P.Gunasekaran (2002), Laboratory Manual in Microbiology, New Age Internal Pub.*

Semester IV

BT202 Biochemistry **3 0 0 3**

Chemistry of biomolecules- essentials of structure and classification of carbohydrates, lipids, amino acids and proteins and nucleic acids. Supramolecular assemblages and arrangement of cell organelles. Biocatalysis: Enzymes – structural aspects, cofactors, activation, catalytic mechanism-specific examples. Enzyme kinetics – Michaelis-Menton equation, classes of inhibition. Allosteric enzymes, isoenzymes and multienzyme complexes. Concepts in bioenergetics: Thermodynamics considerations, bioenergetic principles. Metabolism: Overview, important pathways related functions and inter-relationships -glycolysis, Citric acid cycle; hexose monophosphate shunt ; mitochondrial electron transport chain; oxidative phosphorylation process; ATP synthase; oxidation of fats and amino acids; urea cycle. Cellular processing of genetic information: Assemblages of DNA and RNA, nature of genetic code, replication of DNA, transcriptional aspects and translation process. Regulation of gene expression.

Reference Books:

1. *Voet, D. and Voet, G. (1999), Fundamentals of Biochemistry, Wiley Publication.*
2. *Voet, D., Judith and Voet, G. Third edition, (2004), Biochemistry, Wiley Publication.*
3. *Nelson, D.L., Lehninger, A.L. and Cox, M.M. Fourth edition, (2004) Principles of Biochemistry , Worth Publishers.*
4. *Berg, J., Tymoczko, J., Stryer, L. and Clarke, N.D. Fifth edition, (2000), W.H. Freeman Publication.*

BT204 Genetics and Molecular Biology **3 1 0 4**

Mendelian laws; transmission genetics; dominance relations and multiple alleles; gene interaction and lethality; sex linkage and mapping; gene mutation, epigenetic phenomena, maternal effects and cytoplasmic heredity; cytogenetics and quantitative inheritance, elements of population genetics.

Chromatin Assembly and gene structure, Replication mechanisms , DNA repair processes, Homologous Recombination, Site specific and meiotic recombination, Transposition, Operon and regulation of gene expression, Transcription and translation mechanisms.

Reference Books:

1. *Strickberger, M.W. Third edition,(1996) ,Genetics, Prentice Hall.*
2. *Griffith, A.J.F., Miller, J.H., Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2003), An Introduction to Genetic Analysis, W.H. Freeman publishers.*
3. *Hartl, D.L. and Jones, E.W. Third edition, (2002), Essential Genetics, Jones and Bartlett.*
4. *Lewin, B., First edition, (2003), Genes VIII, Prentice Hall.*

BT 206 Reaction Engineering Fundamentals **3 0 0 3**

Stoichiometry and rate laws: Definitions of rate constant, reaction order; Elementary and non-elementary reactions: mechanisms and kinetics; Reactions with constant volume and variable volume, conversion, yield. Introduction to Ideal reactors, Performance equations for ideal reactors and non-isothermal reactors. Rate data analysis, multiple reactors and multiple reactions. Polymerization reactions, enzymatic reactions, Microbial growth and Bioreactors. Non-ideality in reactors: RTD studies, dispersion effects, models for non-ideal reactors; Non-isothermal reactors, External diffusion effects on heterogeneous reactions, Diffusion and reaction in porous catalysts.

Reference Books:

1. *Levenspiel, O., Third edition, (1999), Chemical Reaction Engineering, Wiley, New York.*

2. *Fogler, S.H., Third edition, (2002), Elements of Chemical Reaction Engineering, Prentice Hall.*

3. *Lee, J.M., (1994), Biochemical Engineering, Prentice Hall, New York.*

4. *Cornish-Bowden., (1979), Fundamentals of Enzyme kinetics, Butterworths, London*

BT208 Transport Processes and Unit Operations **3 1 0 4**

Momentum transfer: fluid statistics and fluid flow phenomena, basic equations of fluid flow, flow of incompressible fluids, flow of compressible fluids, flow past immersed bodies, transport and metering of fluid, agitation and mixing of liquids. Heat transfer: heat transfer by conduction in solids, principles of heat flow in fluids, heat transfer to fluids with and without phase change, radiation heat transfer, heat exchanger and evaporator.

Mass transfer: Mass transfer by diffusion, interphase mass transfer, equilibrium stages operations: distillation, leaching, extraction, absorption, humidification, drying and adsorption. Unit operations involving particulate solids: properties and handling of particulate solids, size reduction, crystallization, mixing of solids and pastes, mechanical separations.

Reference Books

1. *McCabe, W.L., Smith, J.C. and Harriott, P., Sixth edition, (2000) Unit Operation of Chemical Engineering, McGraw Hill.*

2. *Treybal, R.E., Mass transfer operations, McGraw Hill.*

3. *Ozisic, M. (1985), Heat transfer-Basic approach, McGraw Hill.*

4. *Geankoplis, C.J., Fourth edition, (2002), Transport process & unit operations, Prentice Hall of India Ltd., New Delhi*

BT212 Biochemistry Laboratory **0 0 6 2**

Concepts of pH and buffers – application to enzyme reactions; Differential centrifugation and isolation of organelles and tests for organelle fractions; Estimation of carbohydrates – total and reducing; Estimation of proteins – Biuret, L*owry; Paper chromatographic and thin layer chromatographic separation of amino acids; Enzyme assays based on UV-VIS spectroscopy – â- galactosidase; Enzyme inhibition studies; Electrophoresis of protein; Separation of enzymes by electrophoresis – visualiz*ation of bands by staining; Isolation of DNA, amplification by PCR; Electrophoresis of nucleic acids and visualization of bands.

Semester V

BT301 Cell Biology **3 0 0 3**

Membrane structure and organization; Electrical properties of the membrane; Transport of molecules and mechanisms; Intracellular compartmentalization and protein sorting; Intracellular vesicular transport; Endocytosis and exocytosis phenomena; Intracellular organelle structure and function; Cell division, cell cycle and programmed cell death; Cytoskeleton and cell motility; Cell junctions, cell adhesion and extracellular matrix; Cell interaction in development and integration of cells into tissues.

Reference Books:

1. *Bruce Alberts et.al., Third edition, (1994), Molecular Biology of the Cell.*
2. *Cooper, G.M. and Hausman, R.E., Third edition, (2003), The Cell: A Molecular Approach.*

BT 303 Analytical Techniques in Biotechnology **3 0 0 3**

Microscopy - Phase contrast, Confocal; SEM & TEM Microscopic principles in biology Principles and applications of analytical instruments in biotechnology; Analytical techniques in biochemical systems – cell, cellular constituents and metabolites; Electrophoretic techniques - 1D, 2D gels, pulse field electrophoresis; Western blotting: Gel documentation; immunotechniques – immunofluorescence; immunohistocompatability; localization of cells in tissue immunoblotting; Fermentation processes – gas analysis for O_2 and CO_2: Flow injection analysis; Computational data acquisition of bioprocess; Online bioprocess instrumentation.

BT 305 Genetic Engineering **3 0 0 3**

Overview of recombinant DNA technology; Isolation, identification and characterization of DNA fragments; Plasmids- uses, restriction modifications, basic subcloning; Restriction endonucleases - type I, II and III; Chemical synthesis of DNA; DNA sequencing; Ligation of DNA fragments; E. coli vectors; Cloning in yeasts; Expression vectors in prokaryotes; Eukaryotic vectors; Genomic libraries; Directed mutagenesis.

Reference Books:

1. *Winnacker, E. L., (1987), From Genes to Clones: Introduction to Gene Technology, John Wiley & Sons.*
2. *Primrose, S.B., Twyman, R.M. and Old, R.W., Sixth edition, (2002), Principles of Gene Manipulation, Blackwell Science Ltd.*

BT307 Biochemical Engineering **3 0 0 3**

Growth kinetics*:*

Stoichiometry of cell growth and product formations: elemental balances, degree of reduction, electron balance, and calculation of yield coefficient. Biomass and product formation kinetics: Leudeking-Piret analysis, unstructured models, structured models, segregated models, cybernetic models. Growth in ideal bioreactors: substrate limited growth; oxygen limited growth, Inhibition models.

Types of reactor operation:

Modes of operation in stirred reactors: discontinuous batch operation, continuous operation, open and closed loops controlled reactors, semi-continuous reactors, periodic fed-batch cultivation.

Hydrodynamics of bioreactors:

Fluid flow and mixing: Mechanism of mixing, mixing patterns in Bioreactors, different types of impellers, mixing effectiveness, power requirement calculations, scale up of mixing systems, effect of rheological properties on mixing, role of shear in stirred fermenters.

Heat and mass transfer characteristics of bioreactors:

Sterilization, determination of area of heat exchanger, heating and cooling requirements, Role of diffusion in bio-processing, factors affecting cellular oxygen demand, measurement of DO concentrations estimations of $k_L a$ using different methods.

Introduction to analysis, design and control of bioreactors and economics

Text Books:

1. *Doran, P.M., (1995), Bioprocess Engineering Principles, Academic Press, London.*
2. *Bailey, J. E. and Ollis, D. F., Second edition, (1986), Biochemical Engineering Fundamental, McGraw Hill.*
3. *Blanch, H. W., Clark, D.S., (1996), Biochemical Engineering, Marcel Dekker.*

BT311 Molecular Biology and Genetic Engineering Laboratory **0 0 6 2**

Overview of recombinant DNA technology; Isolation, identification and characterization of DNA fragments; Plasmids- uses, restriction modifications, basic subcloning; Restriction endonucleases - type I, II and III; Chemical synthesis of DNA; DNA sequencing; Ligation of DNA fragments; E. coli vectors; Cloning in yeasts; Expression vectors in prokaryotes; Eukaryotic vectors; Genomic libraries; Directed mutagenesis.

1. Maniatis T. Second edition, (1989), Molecular Cloning, Cold Spring Harbor Laboratory.

Semester VI

BT 302 Structural Biology **3 0 0 3**

Basic principles of protein structures: three dimensional conformations, Ramachandran plot, properties of structures, motifs, folds, mechanism of protein folding, fibrous proteins, membrane proteins, spherical viruses

Protein structure, function and engineering: protein-protein interactions, DNA recognition, protein-carbohydrate interactions, enzyme catalysis, transcription factors, ribosome, molecules involved in signal transduction and immune system, prediction and engineering of protein structures

Nucleic acids: structures, function and properties

Methods of determination and analysis of biomolecular structures: Optical spectroscopy, NMR, mass spectrometry, X-ray crystallography, cryo-electron microscopy

Reference Books:

1) *Branden, C.I and Tooze, J. (1999). Introduction to protein structure. Garland Publishers, Second edition.*
2) *Lesk A. (2001). Introduction to protein architecture: The structural biology of proteins. Oxford University Press.*
3) *Creighton, T.E (1993). Proteins: Structure, function and properties. WH Freeman & Company Second edition.*
4) *Bloomfield, V, Crother, D.M, Tinoco, I. (2000). Nucleic acids: Structures, properties and functions. University Science Books, Sausalito, CA.*

BT304 Immunology **3 0 0 3**

Syllabus Immunology : Introduction; Immunity; Cells of the immune system and their origin; Primary and Secondary lymphoid organs; Mucosa associated lymphoid tissue(MALT); Gut associated lymphoid tissue (GALT); Antigens and their characterisitics.

Humoral Immunity: Development, differentiation and maturation of B cells; Immunoglobulins, their structure and functions; Idiotope and anti idiotypic antibodies; Hybridoma technology and application of monoclonal antibodies.

Cell Mediated Immunity: Development, differentiation and maturation of T cells; Antigen presenting Cells (APC); Phagocytosis; Antigen processing and presentation; Major Histocompatibility complex- MHC Class I and II molecules; T cell activation; cytokines; Immunological unresponsiveness; Hypersensitivity reactions; Mixed lymphocyte reaction.

Pathogenesis of infections and its therapy: Immunological mechanisms involved in the pathogenesis of tumor, AIDS, Tuberculosis and malaria; Laws of Transplantation; Graft vs Host reaction; Autoimmune disorders; Basic concepts of vaccine design and development.

Immunological Techniques: Double diffusion; Single Radial Immunodiffusion; Radioimmunoassay; ELISA; Lymphocyte Transformation Test.

Reference Books:

1. *Roitt, Brostoff and Male, Sixth edition, (2001), Immunology, Mosby.*
2. *Janeway, Travers, Walport and Shlomichik., Fifth edition, (2001), Immunobiology, Garland Publishing.*

BT306 Downstream Processing in Biotechnology **3 0 0 3**

Importance of downstream processing in biotechnology, problems, requirement of purification, characteristics of biological molecules, classes of bio-products, physicochemical basis of separation; Physical separation processes: solid and liquid system, flocculation, centrifugation, precipitation, filtration, settling, cell disruption: chemical, mechanical and enzymatic methods; extraction, absorption, adsorption, leaching, crystallization and drying. Membrane separation process, Separation of intracellular, extra-cellular, heat and photosensitive materials, case study with design aspect, chromatographic methods.

Reference Books

1. *Belter, P.A. and Cussler, E.L. Hu, W.S (1988), Bioseparation: Downstream processing for Biotechnology, Wiley, New York.*
2. *Ladisch, M.R., (2001), Bioseparation Engineering: Principles, Practice and Economics, Wiley, Interscience.*
3. *McCabe, W.L., Smith, J.C. and Harriott, P., Sixth edition, (2000), Unit Operation of Chemical Engineering, McGraw Hill.*
4. *Seader, J.D. and Henley, E.J., (1998), Separation Process Principles, Wiley.*

BT 312 Bioreaction Engineering Laboratory **0 0 6 2**

Enzyme Kinetics – activation and inhibition phenomena; mass transfer studies in immobilized enzymes; cell system using different reactors – OUR, k_La estimation, kinetic evaluation; Application of statistical optimization in bioprocesses.

Reference Books:

1. *Bailey, J. E. and Ollis, D. F. Second edition, (1986), Biochemical Engineering Fundamental, McGraw Hill.*
2. *Schügerl, K. and Bellgardt, H., Volume 4, (2000), Bio-reaction Engineering, Wiley, New York*

BT Industrial Training (Summer) **0 0 6 2**

Semester VII

BT401 Bioinformatics **2 1 3 4**

Scope of Bioinformatics-Elementary commands and Protocols, ftp, telnet, http. Primer on information theory.

SEQUENCE ALIGNMENT AND DYNAMIC PROGRAMMING

Introduction-Strings-Edit distance, two strings-string similarity local alignment gaps-parametric sequence alignments-suboptimal alignments-multiple alignment-common multiple alignment methods.

SEQUENCE DATABASE AND THEIR USE

Introduction to databases-database search-Algorithms issues in database search-sequence database search- FASTA-BLAST-Amino acid substitution matrices PAM and BLOSSUM.

EVOLUTIONARY TREES AND PHYLOGENY

Ultrasonic trees-parsimony-Ultrametric problem-perfect phylogeny-phylogenetic alignment-connection between multiple alignment and tree construction.

SPECIAL TOPICS IN BIOINFORMATICS

DNA Mapping and sequencing-Map alignment-Large scale sequencing and alignment-Shotgun-DNA sequencing-Sequence assembly-Gene predictions-Molecular predictions with DNA strings.

Text Books:

1. *Pevsner.J., (2003), Bioinformatics and Functional Genomics, John Wiley.*
2. *Richard, D. et. al., (1998), Biological Sequence Analysis, Cambridge University Press.*

BT411 Downstream Processing Laboratory **0 0 6 2**

Cell disruption, salt and solvent fractionation of proteins, centrifugation, aqueous two-phase systems, gel filtration, ion-exchange, affinity chromatography, electrophoresis of proteins, lyophilisation, crystallization and drying.

Reference Books:

1. *P.A. Belter and E.L. Cussler, W.S. Hu, (1988), Bioseparation: Downstream processing for Biotechnology, Wiley, new York,.*
2. *M.R. Ladisch, (2001), Bioseparation Engineering: Principles, Practice and Economics, wiley, Interscience*

BT 455 Project I **0 0 0 2**

Semester VIII

BT Industrial Lecture **1 0 0 1**

BT456 Project II **0 0 24 8**

Electives:

BT 313 Food Biotechnology **3 0 0 3**

INTRODUCTION TO FOOD PROCESSING

Biotechnology in relation to the food industry, nutritive value of food, types of microorganisms associated with food, its sources, types and behavior in foods.

FOOD PRESERVATION

Bio processing of meat, fisheries, vegetables, dairy products, enzymes and chemicals used in food processing, biochemical engineering for flavour and food production.

FERMENTED FOOD PRODUCTS

Dairy products, meat, fishery, non beverage plant products, beverages and related products of baking.

FOOD SPOILAGE

Utilization of micro organisms in food industry, genetic manipulations, food borne illness.

UNIT OPERATIONS & FOOD PROCESSING EQUIPMENTS

Process time calculation, equipments operation.

Text Books:

1. *Lindsay, W. (1988), Biotechnology: Challenges for the flavour and food industries.*
   Elsevier Applied Science.
2. *Roger, A., Gordan, B. and John T., (1989), Food Biotechnology.*
3. *James M.J., (1987), Modern Food Microbiology, CBS Publishers & Distributors.*

BT 315 Biotechnology for Health Care **3 0 0 3**

Introduction to biotechnology based tools and techniques to study health related problems; biotechnology/molecular biology based diagnostic methods; Therapeutics - Using natural products as therapeutics, Using biopolymers as medical devices, Replacing missing proteins (e.g., insulin), Using genes to treat diseases, Cell and tissue transplants, Stimulating/suppressing the immune system, Tissue engineering, Stem cells, Biotechnology vaccine production and delivery systems.

Reference Books:

1. *Benard, R., .Glick, B, R. and Pasternak, J, J. Third edition, (2003), Molecular Biotechnology: Principles and Applications of recombinant DNA, American Society for Microbiology.*

BT 316 Medicinal Chemistry and Drug Design **3 0 0 3**

Introduction: Drug discovery and Serendipity; Factors affecting Reactivity; Theories of Drug Activity; Receptor Concept and Characterisation; Mechanisms of Drug Action: Chemical similarity and Biological activity; Enzyme Stimulation; Enzyme Inhibition; Sulpha drugs; Membrane active drugs; Anti-cancer drugs and their mechanism of action; Anti-microbials – Cell wall biosynthesis inhibitors, Protein synthesis inhibitors, Anti-fungals, Anti-virals; Drugs for Cardiovascular diseases; Psychoactive drugs and their mode of action; Steroids; Recent Trends and Problems in Drug Design: Gene therapy; Antisense drugs; Drug resistance; Cytokines.

Reference Books:

1. *Patrick. A., Second edition, (2001), An Introduction to Medicinal Chemistry, Oxford University Press.*
2. *Silverman, R., Second edition, (2004), Organic Chemistry of Drug Design and Drug Action, Academic press.*

BT 317 Enzyme, Structure & Mechanisms **3 0 0 3**

Classification of enzymes (oxidoreductases, transferases, hydrolases, lyases, isomerases, ligases). Conformation and stereochemistry: Importance of shape in biological interactions, Chirality, diastereomers and prochiral molecules: Reprise Fisher projections. Nomenclature: d/l, D/L, R/S, proR/proS, E/Z. Quantifying enzyme activity- Michaelis-Menten theory and kinetics, Stereochemistry and Mechanisms of enzyme action; Basic catalytic principles; The catalytic triad of serine proteases (chymotrypsin), carbonic anhydrase, protein kinases; Enzyme Assays and Inhibition,

Effects of pH, Allostery; Immobilisation; Chemical modification and site-directed mutagenesis; Active site specificity. Active sites as targets for drug action; the ACE inhibitors; Roles and mechanisms of coenzymes in enzyme-catalysed reactions; Coenzymes in reduction and oxidation: NAD(P) - NAD(P)H; FAD – $FADH_2$;Thiamin, pyridoxal phosphate in transfer reactions, etc. Brief account of reactions involving biotin, folic acid and B_{12}**.** Protein design and its application in biotechnological application; Protein interactions with biomacromolecules: Enzyme and Protein Interaction with Specific Sequences of DNA; The chemistry and biology of protein-saccharide interactions and Protein-Protein interactions**.**

Reference Books

Voet and Voet, Third edition (2004), Biochemistry
Metzler, D.E. Second edition, (2001), Biochemistry - the chemical reactions of living cells. Harcourt.
Eliel, E. L., Wilen, S. H. and Doyle, M. P. (2001), Basic Organic Stereochemistry, J. Wiley.

BT 319 Metabolic Regulation **3 0 0 3**

Important concepts and mechanisms involved in metabolic regulation; Enzyme activity: the molecular basis for its regulation; Control structures in metabolism Signal Transduction Pathways – Control of cellular responses to external stimuli; Intra cellular signaling; Receptor tyrosine kinases, G-protein coupled receptors; Mechanism of hormone action with examples- hormone and neurotransmitter receptors; Protein phosphorylation- Role of phosphorylation/dephosphorylation in regulation of enzyme activity; Integration and regulation of carbohydrate, lipid and protein metabolism in humans; Gene - metabolic control analysis; regulatory networks (GRNs)-Operons, regulons, stimulons. Role of Free Radicals and signaling mechanisms; Oxidative Stress and disease conditions. Methods for studying metabolism and its regulation.

1. Voet and Voet, Third Edition, (2004), Biochemistry.
2. Matthews, Van Holde, Ahern, Third edition, (2000), Biochemistry.
3. Stryer, L., Fifth edition, (2001), Biochemistry.
4. Lehninger, A. (2001), Biochemistry, Nelson & Cox.
5. Fell, D. (1996), Understanding the Control of Metabolism, Portland Press.

BT 412 Biocatalysis and Bio transformations **3 0 0 3**

Overview: Current status of Biocatalysts, Advantages and disadvantages of biocatalysts, Characteristics of Biocatalytic Transformations, Biocatalysis as a technology, Green Chemistry; Screening of New Enzyme Activity; Industrial Products from Micro organisms, Rapid screening of micro organisms; Biocatalysis in non-Conventional Media; Enzymes in organic solvents, Advantages of Biocatalysis in organic media, Role of water in Enzyme reactions in Organic solvents, Substrate as solvent; Protein Engineering and Directed Evolution: Methods of Protein Engineering, Enhancement of Thermostability, Enhancement of stability of Proteases against Oxidation and thermal Deactivation, Change of Enantioselectivity with Site-Specific Mutagenesis, Stability of Proteins: The Protein folding Problem, Stabilisation of proteins, Correlation between stability and structure; Artificial Enzymes: Catalytic Antibodies, Ribozymes, Proteinaceous Enzyme Mimics, Synzymes-Design of Novel Enzyme Activity, Tandem Enzyme Organometallic Catalysts.

Applications of Enzymes as Catalysts: Enantiomerically pure amino acids, Hydroxy esters with carbonyl reductase, Alcohols with ADH, Penicillin G, Ephedrine, Chiral drugs, Anticholesterol drugs, Anti-infectives, Anti-AIDS drugs, Cardiovascular drugs, Applications of Lipases and Esterases in the Pharma industry; Comparison of Biological and Chemical Catalysts for Novel Processes: Criteria for Evaluation of Biocatalytic Processes, Pathway engineering for Chemicals

Reference Books

1. *Bommarius, A. S, and Riebel, B, R. (2004), Biocatalysis: Fundamentals & Applications, Vch.*
2. *Faber, K., Fifth edition, (2004), Biotransformations in Organic Chemistry, Springer Berlin.*
3. *Roberts, M. et al., (1989), Biotransformations in preparative organic chemistry-the use of isolated enzymes and whole cell systems in synthesis, California University Press.*

BT413 Spectroscopic Applications in Biotechnology **3 0 0 3**

Theory of spectroscopy – infrared spectroscopy, ultraviolet and visible; NMR; EPR; Applications to proteins, polysaccharide, lipids and liposomes, nucleic acid, PHA - structure and function relationship, ligand binding, ionisation, pH - kinetics, molecular motion.

BT 414 Bioprocess Modelling and Simulation **3 0 0 3**

Study of Structured and unstructured models for analysis of various bioprocess; non idealities; Model simulation using MATLAB-SIMULINK and ISIM software packages**;** Gas-Liquid mass transfer, substrate product diffusion effects, heat transport, mixing and agitation**;** Model of unlimited growth, modeling a continuous culture, substrate limited growth in chemostat, Theory of fed- batch culture control with application for baker's yeast production, Modeling of ethanol fermentation in a

batch large scale bioreactor **;** Modeling of Suspended Growth Reactors, Activated Sludge Systems and attached Growth Reactors ; Agitated and sparged bioreactor, tower – Aerobic and anaerobic

Text Books:

1. *Bailey, J. and Ollis, D. (1986), Biochemical engineering Fundamentals (2nd Edition) Mc.Graw Hill Kogakusha Ltd., Tokyo.*
2. *Dunn, I.J. et. al. (1992), Biological engineering Principles, Applications and Simulation, VCH, Weinheim.*

BT 417 Molecular Basis of Diseases 3 0 0 3

Cell injury – inflammation, repair and regeneration, immune response; Introduction to pharmacology - overview of drug action, molecular targets, pharmacodynamics; Pharmacokinetics; Autoimmune diseases and anemias; Introduction to genetic diseases; Genetic testing and drug development; Developmental and genetic diseases; Metabolic diseases; Genetic resistance; Infectious proteins –CJD, prion proteins, influenza, HIV; Mutational basis of Huntingtons disease; Aging – caspase mediated cell death, Maternal inheritance – diabetes; Diseases due to malfunction of signaling pathways; Cancer.

Reference Books:

1. *Lewin, B. First edition, (2003), Genes VIII, Prentice Hall.*
2. *Darnell, J. et al. Fourth edition, (1999), Molecular Cell Biology. W.H Freeman & Co.*
3. *Jameson (Ed) First edition, (1998), Principles of Molecular Medicine, Humana Press.*
4. *Scriver et.al., Eight edition, (2002), The Metabolic and Molecular Basis of Inherited Disease, McGraw Hill.*

BT418 Animal Biotechnology 3 0 0 3

Animal biotechnology – scope, organ transplant : moral standing, state of the art; Animal cell metabolism – regulation, mammalian genome, oncogenesis and cell transformation, preservation of cell lines, nutritional requirement, growth characteristics, kinetics; Reactant and product transport through mammalian cells; Microcarrier attached growth; Reactors used; Scaling-up; Regulatory issue, safety and containment; Novel applications.

BT422 IPR Issues in Biotechnology (Self-Study) 3 0 0 3

IPR in the global economy – in international trade; Biodiversity related global IPR regime – TRIPS agreement, objectives and general principles, patents, trade secrets, UPOV convention; IPR and Biodiversity – sustainable use, Plant variety rights, Rights of traditional knowledge holders, the CBD, WTO, UNCTAD biotrade initiatives, government and regional initiatives, non-governmental initiated community intellectual rights, SRISTI's local innovations databases, peoples biodiversity register; Unsolved questions.

BT423 Bioethics (Self Study) 3 0 0 3

Impacts of biotechnology – legal, socioeconomic, public elucidation of process of biotechnology in generating new forms of life; Biosafety – regulation, national and international guidelines, r-DNA guidelines, experimental protocol approval; Environmental aspect - use of GMOs and effect on environment; IPR issues; Beneficial applications and development of research.

BT511 Advanced Molecular and Cellular Biology 3 0 0 3

Introduction and Organization; Transcription I - *Cis*-Control Regions; Transcription II - Action at a Distance; Transcription III - *Trans*-acting Factors; Transcription IV – Modular Design and Functions; Transcription V - Factors and Interactions; Transcription VI - Post Initiation Control; Chromatin and Gene Expression; Chromatin Remodeling Origins of DNA Replication; Regulation of DNA Replication; Structure of Telomeric DNA; Telomere Replication; Centromeres; Chromosome Compaction; Sister Chromatid Adhesion; Checkpoints; Transcriptional Silencing; Stability of Repression Domains and Boundaries; Regulation at the level of the chromosome: Dosage Compensation; Small RNAs: RNA Processing.

Introduction: Principles of cell structure and function; Structure of membranes and membrane proteins; membrane potential, Membrane transport proteins and transport of small molecules; Epithelia and tight junctions; Ion channels and the action potential; Regulation of cell division; Cell division – mitosis and organelle partitioning; Motor proteins, spindle assembly and chromosome segregation; cytoskeleton; Motility and the cytoskeleton; Organelle biogenesis**;** Mitochondria, chloroplasts, and peroxisomes; Protein secretion – Overview; Transport of nascent protein across the ER membrane; Biogenesis of membrane proteins; Vesicle transport; Exocytosis and endocytosis; Regulated protein secretion; Synaptic plasticity; Extracellular matrix and cell-cell interaction; Cell Division in multicellular organisms, stem cells, mitogens; Cancer.

Reference Books:

1. *Lewin, B. (2004), Genes VIII, Oxford University Press.*
2. *Lodish et.al, Fifth edition, (2003), Molecular Cell Biology, W.H Freeman & Co.*
3. *Ptashne, M. Third edition, (2004), The Genetic Switch, Cold Spring Harbor Laboratory.*

BT512 Developmental Biology **3 0 0 3**

Animal and plant development; Differentiation; Pattern formation and morphogenesis; Cell lineage and positional information; Maternal information; Induction; Morphogenetic gradients; Developmental genetics; Epigenetic control of Development; Model organisms to study development.

Reference Books:

1. *Gilbert, S. F. Seventh edition, (2003), Developmental Biology. Sinauer Associates.*
2. *Greenspan, R. J. (1997), Fly pushing. The Theory and Practice of* Drosophila *Genetics, Cold spring harbour press,NY.*
3. *Howell, S. H. (1998), Molecular Genetics of Plant Development, Cambridge University Press.*
4. *Slack, J. (2001), Essential Development Biology, Blackwell Scientific.*
5. *Wolpert. L., et. al., (2002), Principles of Development, Oxford University Press.*
6. *www.plantsci.cam.ac.uk/Haseloff*

BT513 Tissue Engineering **3 0 0 3**

History and scope of tissue engineering – scientific challenges, general scientific issues; Tissue engineering in perspectives – origin, triad, acellular prosthesis, stem cells, vascularization *in vitro* and *in vivo*; Construct technology; Organization of cells into higher ordered structures – stimuli of the transformation, dynamics of cell – ECM interaction – composition and diversity of ECM, receptors for extracellular matrix molecules, relevance for tissue engineering; Matrix molecules and their ligands; Inductive phenomena – epithelial to mesenchymal signaling in endoderm development; Morphogenesis; Cell determination and differentiation, mechanical and chemical determinants of tissue development; Bioreactor modulation - cultivation of functional tissues, tissue assembly in microgravity : *in vitro* embryology, gravitational sensing; Kinetics, transport in tissue engineering – molecular interaction with cells, molecular and cell transport through tissue.

BT 517 Membrane Biology and Signal Transduction **3 0 0 3**

Membrane structure and organization; Membrane lipids and dynamics (translational and rotational diffusion, flip-flop); Membrane properties; Membrane transport; Structure-function relationship of membrane proteins – transporters, channels, receptors and adhesion proteins; Introduction of cell-cell signaling; Overview of signal transduction; Signal transduction pathways; Transmembrane receptors coupled to G-proteins; Receptor adaptation; Signaling from cell surface to the nucleus; TGF and cytokine receptors; Kinases and phosphatases; Growth factors and receptor tyrosine Kinases.

Reference Books:

1. *Hancock, J, T. (1997), Cell Signaling, Addison Wesley Pub. Co.*
2. *Kenneth, M. Merz, Jr and Roux, B. (1996), Biological membranes: a molecular perspective from computation and experiment, Springer Verlag.*

BT520 Plant Biotechnology **3 0 0 3**

Plant genomes – the organization and expression of plant genes; Plant tissue culture; Techniques for plant transformation; Binary vectors for plant transformation; Transposons, Engineering desirable traits such as genetic manipulation for herbicide resistance, pest resistance, disease resistance, stress and salt tolerance; The improvement of crop yield and quality (Molecular markers); Molecular farming/ "pharming."

Reference Books:

1. *Slater, A., Scott, N. W. and Fowler, M. R. (2003), Plant Biotechnology – The genetic manipulation of plants, Oxford University press.*
2. *Chrispeels, M. and Sadva, D. E. (2002), Plants, Genes and Crop Biotechnology, Jones and Bartlett Publishers International.*

5.2.3 Chemical Engineering

SEMESTER III

CH201 Chemical Engineering Thermodynamics **3 1 0 4**

Elementary concepts. The first and second laws. Extrema in work and criteria of equilibrium. Thermodynamics properties of pure substances. The ideal gas. Equations of state. Thermodynamic charts. Applications to engineering problems. Refrigeration & liquefaction. Thermodynamics of mixtures. Partial molar properties. The Chemical potential. Fugacity & fugacity coefficients. Ideal and nonideal solutions. Activity and activity coefficients, Gibbs-Duhem equations. Excess properties of mixtures. Phase equilibria and chemical equilibria.

CH203 Momentum Transfer **3 1 0 4**

CH

Properties of fluids. Forces on fluids. Stress and the concept of constitutive relations, Kinematics of flow.

Conservation of linear momentum and angular momentum, Euler's equation, Bernoulli's equation, Applications to pumps, Turbines and blowers, Application of dimensional analysis to fluid flow problems, Differential analysis of flow.

Boundary layer theory, Flow past immersed bodies, Drag, Turbulence, Flow through conduits. Non-Newtonian flow, Flow through porous media, Empirical correlations for calculating pressure drop for flow through different kinds of chemical process equipment, Fluid machinery.

Classification and performance of pumps, Turbines compressors and blowers, Selection and applications.

SEMESTER IV

CH202 Equilibrium Staged Operations **3 1 0 4**

Preliminary concepts on VLE – Raoults law, azeotropes, bubble and dew points, relative volatility, ideal and non ideal mixtures.

Single equilibrium staged operations – flash distillation.

Co-current, cross current and countercurrent contact arrangements.

Degrees of freedom analysis for single and multi staged mass transfer operations.

Gas absorption – isothermal operation, Kremser relations, absorption and stripping factors, dilute and concentrated solutions.

Distillation – Mc Cabe Thiele method, Ponchon Savarit method, Fenskes equation, shortcut methods for multicomponent distillation, batch distillation, introduction to the use of process simulators.

Design of Sieve tray column, types of trays used in chemical industries.

Principles of extraction – tie line relationships, triangular representation of liquid-liquid extraction processes, extraction with reflux, typical extractors.

Adsorption – adsorption isotherms, Freundlich equation, single and multistage cross current and counter current operation.

Leaching – concept of practical equilibrium, equilibrium diagrams, single and multistage crosscurrent and counter current leaching.

CH

References:

R E Treybal, "Mass Transfer Operations", 3rd Edition, McGraw Hill, 1980.
J D Seader & E J Henley, "Separation Process Principles", John Wiley & Sons Inc., 1998.

CH204 Mechanical Operations **3 1 0 4**

Fundamental properties of particulate solids: Particle size analysis, Storage and handling of solids, Mixing of solids and types of mixers.

Size change: Energy-size reduction relationships, Computer simulation of milling operation, Size reduction equipments, Open-circuit and closed-circuit operation, Size enlargement.

Mechanical separation: Size separation, Screening, Theory and practice of filtration, Centrifugal separation, Classification, Sedimentation and thickening, Mineral processing and froth flotation.

References:

Warren McCabe, Julian Smith and PeterHarriott, Unit operations in chemical engineering, 5th Ed., McGraw Hill, 1993.

CH206 Process Heat Transfer **3 1 0 4**

Conduction : Basic equations one and two-dimensional steady-state, one dimensional unsteady state and numerical methods.

Convection: Basic equations internal and external, laminar and turbulent flows, free convection. Analogies between heat and momentum Transfer.

Heat Transfer in particulate media and in two phase flows.

Radiation: Basic relations-energy exchange by radiation in non-participating, absorbing and emitting media. View factors.

Heat Transfer with Phase Change: Boiling and condensation.

Classification and design of heat exchangers.

References:

M N Ozisik, Heat Transfer: A Basic Approach, McGraw Hill, 1985.
B K Dutta, Heat Transfer: Principles and Applications, Prentice Hall of India, 2001.
J P Holman, Heat Transfer, 8th Edition, Tata McGraw Hill, 2002.

CH

CH210 Chemical Technology **3 0 0 3**

Introduction: Introduction to Chemical Engineering Processes, Unit Processes and Unit Operations, Introduction Chemical Process Industries, Economic and Technological Importance, Environmental impacts, Indian Scenario

Production of Sulphuric Acid: Types of Sulphuric Acid Plants, Process Description, Energy Recovery from the Suphuric acid Process, Emissions and Control

Chlor-Alkali Industry: Sodium Carbonate Manufacture (Ammonia-Soda Process), Uses, Environmental Aspects, Chlorine and Caustic Soda Production and Uses

Fertilizers And Ammonia: Nitrogen Fertilizers (Ammonium Nitrate, Urea), Phosphorus Fertilizers (Ammonium and Calcium Phosphate), Thermodynamics and Kinetics of Ammonia Synthesis, Catalysts, Manufacture of Ammonia

Silicas & Zeolites : Properties and Industrial Applications of Zeolites, Manufacturing Processes (Zeolite A)

Microelctronic Material Processing: Electronic terms and Devices, Material - Why Si? Preparation of E-grade Si, Crystal growth and Wafer Preparation, Fabrication Processes

Industrial Gases: Gas separation using membrane technology

Biopreocesses:: fermentation and enzyme catalyzed processes; Sugar, Insulin, Semi-synthetic penicillin

Petroleum refining and Petrochemicals and Polymers: Atmospheric and vacuum distillation processes, Cracking and down-stream processing of major petroleum products like gasoline, diesel, Manufacture of selected petrochemicals and polymers.

References:

Kirk-Othmer Encyclopaedia of Chemical Technology
Industrial Inorganic Chemicals: Production and Uses, Edited by R.Thompson (The Royal Society of Chemistry, 1995)
Dryden's Outlines of Chemical Technology (3rd Ed: Affiliated East-West Press, 1997)
Shreve's Chemical Process Industries: George Austin, 5th Ed., (McGraw-Hill 1986)

CH

SEMESTER V

CH301 Chemical Reaction Engineering I **2 1 0 3**

CH303 Mass Transfer **3 1 0 4**

Molecular diffusion in fluids, mass transfer coefficients, diffusion in solids, interphase mass transfer. Mass, Heat and Momentum transfer analogies. Gas absorption and distillation in packed towers. Design aspects of continuous contact equipment in liquid extraction and adsorption. Simultaneous heat and mass transfer-Humidification, Drying and Crystallization.

CH305 Computational Techniques **3 1 0 4**

Linear Algebra - Introduction to vector spaces, Matrix norms, Condition number of a matrix.

Solutions of Linear Algebraic Equations using iterative Methods - Gauss Siedel, Jacobi and Successive over relaxation methods, Convergence criteria, Special methods for sparse systems, Linear least square estimation, Rational least square approximation and pseudo-linear regression.

Nonlinear least square estimation - Necessary and sufficient conditions for unconstrained optimization, Steepest descent methods, Conjugate gradient and Levenberg-Marquardt method, Newton's method and quasi-Newton method.

Polynomial root finding techniques, Newton Raphson and Quasi-Newton methods, Successive substitution and its convergence, Optimization based methods, Homotopy continuation.

Ordinary Differential Equations (ODE) - Initial Value Problems : Eigen value, eigen vector decomposition, Euler, Runge-Kutta and Multistep predictor-corrector algorithms, Accuracy and stability of ODE solvers.

Ordinary Differential Equations - Boundary Value Problem: Finite difference method, Shooting method and Finite element (Gelarkin's) method, Function approximation using orthonormal functions, orthogonal collocation based method.

CH

Partial Differential Equations (PDE) - Classification of PDE, Finite difference technique, Method of lines, orthogonal collocation.

CH351 Momentum Transfer and MO Laboratory **0 0 6 2**

Experiments to highlight concepts learnt in the course on Momentum Transfer (CH203) Error analysis.

SEMESTER VI

CH302 Chemical Reaction Engineering - II **3 1 0 4**

Non-ideal reactors: Residence time distribution; Modelling of real systems; non-ideal parameters; concepts of micro and macromixing.

Heterogeneous reactors: Kinetics of fluid-solid, non-catalytic and catalytic reactions; external transport processes; diffusion and reaction within porous solids; laboratory reactors-analysis of rate data; development of design expressions; kinetics of gas-liquid reactions; slurry reactors.

Catalysts: Preparation, Testing and Characterization.

CH304 Instrumentation and Process Control **3 1 0 4**

Review of Laplace transforms.

Dynamics of process elements: Interacting and non-interacting systems, Open and closed loop systems. Sensors for pressure, flow, temperature and composition.

Valve dynamics. Action of various controller modes. Frequency response, stability analysis, process identification. Approximations to complex processes, optimization of control system response.

Advanced control techniques. Feed forward control, Ratio control, Cascade Control.

CH306 Transport Phenomena **3 0 0 3**

Prediction of transport coefficients and their dependence on temperature, pressure and composition.

Characteristics of one-dimensional solution by shell balances, General transport equations, Simple solutions of one dimensional boundary layer.

Transport theories of turbulence and simple solutions of turbulent transport.

CH

Macroscopic balances, design concepts based on transport phenomena models.

CH350 Summer Training **0 0 0 2**

During summer training, students will spend their time at an industry. The course is intended to give practical experience to the students.

SEMESTER VII

CH401 Chemical Process Design and Economics **3 1 0 4**

Process Economics - Economic feasibility of project using order of magnitude cost estimates. Plant and equipment cost estimation, Product cost estimation.

Cash Flows - Time value of money, Investment, Costs, Sales, Profits, Taxes, Depreciation.

Profitability Analysis - Rate of return, Payback period, Discounted rate of return, Net present worth, Internal rate of return, Comparing investment alternatives.

Conceptual Process Synthesis - Systematic hierarchical synthesis of flowsheets, Structural layers of a flowsheet.

Reactor Network Synthesis - Reactor type and conditions for simple reaction systems, Use of attainable regional diagrams for complex reaction systems.

Separation System Synthesis - Distillation column sequencing for ideal liquid mixtures. Separation system structure for non-ideal mixtures using distillation / residue curves.

Heat Exchanger Network Synthesis using Pinch Technology - Targets for minimum utilities, area, total cost. Maximum energy recovery design, Evolutionary synthesis for minimum number of exchangers design, Supertargetting, Heat and power integration, Integration of heat exchanger network with distillation columns.

CH451 CRE and TDC Laboratory **0 0 6 2**

Experiments based on the theory taught in CH302 and CH304

CH455 Project I **0 0 6 2**

Semester VIII

CH462 Industrial Lecture (Pass/Fail) **1 0 0 1**

CH456 Project II **0 0 18 6**

ELECTIVES:

CH312 Mineral Process Simulation **3 0 0 3**

Introduction to mineral processing operations, Process economics and operating efficiency.

Simulation of screens and classifiers, Process simulation of continuous and batch milling operations.

Control and optimization of closed circuit grinding systems.

Flotation circuits and their Simulation.

Case studies on optimization of industrial mineral processing circuits.

CH313 Polymer Technology **3 0 0 3**

Mechanism and kinetics of polymerisation reactions. Polymerisation reaction engineering. Different kinds of polymerisation - Physical and thermodynamic properties of polymerisation. Intrinsic viscosity - solubility parameters. Production and Technology of Formaldehyde based polymers - saturated and unsaturated polyesters.

CH315 Renewable Energy Sources **3 0 0 3**

Potential for renewable energy sources, energy conservation, Solar Energy - thermal and photoelectrical - Ocean thermal energy sources - Geothermal energy utilization - Wind energy – Bio Mass energy - Bio-gas principles, reactors. Hydrogen as source of energy, Solar and Chemical production of hydrogen, Metal Hydrides, Hydel energy, Hybrid systems, Heat pump applications in process engineering.

CH316 Polymeric Materials **3 0 0 3**

Classification, structure and morphology of polymers.

Manufacturing and processing of plastics and rubbers.

Physical, mechanical and electrical properties, yield and fracture behaviour of polymers.

Criteria for engineering design and utilization of polymers.

CH317 Ecological Engineering **3 0 0 3**

Introduction to Environment and Ecology, Ecosystems : Principles,Concepts, Components and functions.

Aquatic ecosystems and terrestrial ecosystems.

Energy flow in ecosystems, Biogeochemical cycles and limiting factor concepts.

Impacts of natural and human activities on ecosystems.

Demography and population ecology, Population growth theories and models.

Environmental impact assessment, Environmental monitoring and predictive modeling.

Ecosystem Management - Conservation and sustainable development, Reclamation / rehabilitation, Carrying capacity assessment modeling environmental standards, Environmental cost estimation, Case studies of specific ecosystem management.

CH318 Polymer Kinetic Theory **3 0 0 3**

Flow Phenomena in Polymeric Liquids.

The chemical nature of polymeric liquids; Non-Newtonian viscosity, Normal stress. effects, other elastic effects; Material functions for Polymeric liquids, shear and shear free flows.

Basic Concepts from Probability Theory; Events and probabilities; Random variables; Expectations and moments; Joint distributions and independence; Gaussian random variables; General discussion of the random walk ; Fokker-Planck equations

CH319 Introduction to Industrial Biotechnology 3 0 0 3

Fundamentals of biochemical engineering sciences; Biotechnology - ancient and modern; Exploitation of microbes - Large scale process, commercial exploitation, micro-gravity biotechnology (space biotechnology); Animal biotechnology - application of animal cell culture, monoclonal antibodies, transgenic animals and gene therapy; plant biotechnology - plant cell, tissue and organ culture processes - engineering perspectives; Large scale separation processes - ATPS, gradient elution and affinity interaction; Technoeconomics of biotechnology industries; Legal, social and ethical aspects of biotechnology; Biotechnology and the third world.

CH320 Chemical Engineering Principles in Paper Technology 3 0 0 3

Principles of paper making technology - Application of Chemical Engineering Principles to Pulp and Paper industry;

Wood - Selection, types, comparison with other raw materials.

Pulping - Process, including mechanical and Kraft pulping, bleaching, soda cycle for effluents

Paper Machine - Principles of forming paper, steam drying and its effects.

Coating and Finishing - Different coating principles, blade, rod metering etc. and supercalendering.

Effluent Treatment – Treatment of different waste water streams from each of these operations.

CH324 Introduction to Semiconductor Manufacturing Processes 3 0 0 3

Review of Chip Manufacturing Process, FEOL and BEOL Concepts.

PhotoLithography: Lithography basics, Wavelength, Layout and Optical Proximity Correction (OPC), Mask Making, Phase Shift Mask.

Deposition: Physical and Chemical vapor Deposition (PVD & CVD) basics, Electrochemical deposition, Electro-migration vs grain size, Implantation basics, Constant source and limited source diffusion.

Material Removal: Plasma and wet etching, Aluminimum and Oxide etching, Chemical Mechanical Polishing (CMP) basics, Dishing, Erosion, Issues in Shallow Trench Isolation, Oxide Polish and Copper Polish, Dummy fill.

Process Integration: BEOL Issues, Cu vs al metallization, oxide vs low-k integration.

Testing, Process Control and Yield: Scribeline Test (for process evaluation), Functional Test (for product) evaluation), Process stability and control, Yield Models, process and design modifications for yield optimization .

Test books:

1. *Introduction to Microelectronic Fabrication, Vol 5 of Modular Series on Solid State Devices (2nd Edition) by Richard C Jaeger, Prentice Hall, 2001.*
2. *Microchip Fabrication: A Practical Guide to Semiconductor Processing (2nd Edition) by Peter Van Zant, Carol Rose (Editor) , Daniel Gonneau (Editor), Semiconductor Devices, 1990.*

Reference Books;

1. ULSI Technology by CY Chang and S M Sze, McGraw Hill, 1996.
2. The Science and Engg. of Microelectronic Fabrication (2nd Edition) by S A Campbell, Ox Uni Press 2001.

CH405 Introduction to Computer Control of Processes 3 0 0 3

Introduction to Hardware Elements - Analog to digital and digital to analog converters, sample and hold circuit.

Introduction to distributed digital control system architecture.

Digital Signal Conditioning - Sampling of continuous systems, Shannon's sampling theorem, Practical guidelines for selection of sampling period, Signal reconstruction with sample and hold, Digital filters.

z-Transforms - z-transforms, Properties of z-transforms, Inverse z-transforms, Solution of difference equation using z-transforms.

Pulse Transfer Function - Development of pulse transfer function from Laplace transfer function, Development of linear discrete state space model from nonlinear first principles model.

System Identification - Identification of system parameters from input-output data, Statistical interpretation of least squares, Recursive least square estimation, Selection of perturbation signal for model identification.

Closed Loop Transfer Function - development of closed loop transfer function, Effect of disturbances on closed loop.

Stability Analysis - derivation of stability criteria for transfer function and state space models, Jury's stability test, Controllability and observability.

Classical Control Algorithms - Velocity form of PID controller, Dalhin's controller, State and output deadbeat controller, Vogel-edgar controller, Morari-Zafiriou algorithm, Internal model controller.

Modern Control Algorithms - Regulator and state observer design using pole placement (Ackermann's formulae).

Introduction to model predictive control and adaptive control schemes.

CH411 Biochemical Engineering **3 0 0 3**

Principles of biochemical reaction kinetics; Mass and energy balance in biological system, Transport phenomena, Enzymatic reaction kinetics; Free and immobilised enzyme cell systems; Microbial growth and product formation kinetics, classification of bioreactors, upstream processing - media and air sterilisation, Downstream bioprocessing; Physical separation processes, Chromatography; membrane processes; Modern Biotechnological applications.

CH412 Molecular Thermodynamics **3 0 0 3**

Average values of mechanical properties and classical thermodynamics. The assumptions of molecular thermodynamics, ensembles and partition functions. Fluctuations. The canonical and the Grand canonical ensembles. The ideal gas and the monotonic crystal. Lattice models for solids. The viral equations of state. Gas-like and Solid-like theories of liquids. Liquid mixtures and local Excess composition models for the Gibbs Free Energy Distribution. Distribution functions and equations for internal energy, pressure and isothermal compressibility, Distribution function theories of the liquid state.

CH413 Petroleum Refinery Engineering **3 0 0 3**

Occurance and composition and physical properties of petroleum. Various processing methods of petroleum including chemical and solvent treatment to remove wastes and other impurities. Fractionation, Cracking, Reforming, Tests to evaluate the properties of various products.

CH414 Hazard Assessment and Mitigation in Chemical Process Industries **3 0 0 3**

Hazards and Safety in Chemical Industries - Introduction to risk management, Principles and issues in risk analysis, Acts and regulations.

Hazard Management - Quantitative risk assessment, Hazard identification,

Hazard and operability studies.

Hazard Analysis - Event tree and fault tree analysis frequency analysis, Consequence analysis.

Data sources and data selection.

Risk criteria and cost benefit analysis, Safety audit and safety regulations.

Elements of emergency planning and preparation of disaster management plan, Case studies of chemical disasters.

CH415 Advanced Momentum Transfer **3 0 0 3**

Reynolds transport theorem, Conservation equations for mass, momentum, energy and a passive scalar.

Some exact solutions to Navier-Stokes equations, 'Creeping flow, Drag, Boundary layer theory.

Flow separation.

Laminar flow, Transition to turbulence, Turbulent flow, Reynolds stresses, Eddy viscosity, mixing length theory, Flow over a flat plate, Universal velocity profile.

Flow through conduits, Roughness, Empirical correlations for friction factor in straight pipes, Pressure losses due to pipe fittings, Pipes in series and in parallel.

Non-Newtonian fluids, Constitutive equations, Viscoelasticity.

Applications, Flow through porous media, Fluidizations, Multi-phase flow.

CH416 Processing of Polymeric Composites **3 0 0 3**

Introduction to polymeric composites, Thermoset and thermoplastic composites, Various techniques for processing, essential unit operations of composite processing, Key considerations during composite processing.

Reaction Kinetics - Molecular weight and molecular weight distribution, degree of cross linking, Polymerisation reaction kinetics.

Fluid Flow - Flow through porous media, Non-Newtonian and viscoelastic fluid Flow of Polymer solution, Prepolymer or polymer melt through arrangements of reinforcing fibres.

Heat Transfer - Anisotropy in polymeric composites, Heat transfer during composite processing.

CH417 Catalyst Science and Technology **3 0 0 3**

Basic concepts of catalysis. Theories of active centres. Adsorption and chemisorption. Rate theories and expressions. Catalysts specificity.

CH

Production, Testing and Characterisation of industrial catalysts.

CH418 Technology of Biopolymers and Biomaterials **3 0 0 3**

Importance of biopolymers and biomaterials.

Classes and Forms - Biotechnology derived polymers and composites and their applications.

Fermentative Production of Polyesters, Polymers of Lactic Acid - Monomer recovery, Lactoyllactic acid Lactaid processes, Process design of lactic acid based monomers.

Hydroxylated Aromatic Hydrocarbons - biological formation of speciality hydroxylated monomers, BCB and MHPA, Biotransformation processes for polymer precursors development.

Processes for Polysaccharides - Dextran, Curdlan, Xanthan, Gellan etc.

Bio-adhesives, Bio-diode, Polymer-coated blood, Biosynthesis of quantum semiconductor crystallites and magnetic composites, Tissue engineering, Process economics case study.

CH419 Protein Engineering **3 0 0 3**

Introduction to problems in protein engineering and its design cycle - Techniques of protein structure determination and prediction - sequence - sequence comparison , multiple sequence alignment, data bank scanning, pattern matching; sequence structure comparison - Expanding the genetic lexicon - Protein sequence to structure , sequence motifs - principles of protein turnover - Chemical approaches to protein engineering - specific modification, multiple substitution, chimeric proteins ,

Industrial applications of protein engineering and scale-up of protein production , genetic principles of the processing and secretory pathway , case studies , site-directed mutagenesis of protein in procaryotic and eucaryotic systems, design of antibody combining sites, changing surface loops of proteins.

CH420 Principles of Food Engineering **3 0 0 3**

Introduction to food with relation to microorganism, quality, contamination and standard. Application of engineering principles in the analysis of food process operation including unit operations. Nature of water in foods and its influence on food texture and processing methods etc., principles of food preservation - canning, AFD, irradiation etc. including process time calculation production of fermented foods. Post harvest technology of food products - processing and storage practices including CAS. Food sanitation, Control and inspection.

CH421 Plastics Engineering **3 0 0 3**

CH

Introduction: Polymeric Materials - Engineering Plastics, Thermosets, Polymer Blends, Liquid Crystal Polymers; Composites Selection of Plastics; Mechanical Properties - Stress-strain behaviour, Viscoelastic nature; Deformation Behaviour of Composites; Fracture Analysis - Stress Concentration, Energy approach, Fatigue behaviour, Impact behaviour; Processing of Plastics - Extrusion, Injection Moulding, Blow Moulding, Calendering, Thermoforming; Melt Flow - non-Newtonian behaviour, Elastic nature, Capillary Rheometer, Rotational Rheometers.

5.2.4 Civil Engineering

Semester III

CE231 Mechanics of Materials **3 1 0 4**

Stress and Strain: Tension, Compression and Shear; Uniaxial, Biaxial and general state of deformation; Basic equations of elasticity for plane elasticity problems; Elastic constants and their relations; Strain energy, Principal stresses and strains, Mohr's Circle; Membrane stresses in thin and thick cylinders and simple shells; Theories of failure; Impact and cyclic loading; Bending, Shear and Compression: Classical theory, various cross-sectional; shapes of beams, shear stresses in beams; Unsymmetrical bending and shear center; Deflection of beams: Double integration of governing differential equation; Euler buckling load of columns; Torsion: Torsion of circular shaft, close coiled helical springs; Torsion of thin walled open and closed sections and non-circular sections (formulae only without derivation)

CE

References:

1. *Beer, F.P., and Johnston, JR, E.R., "Mechanics of Materials", (2nd Edition), McGraw Hill, 1992.*
2. *Boresi, A.P., Schmidt, R.J. and Sidebottom, O.M., Advanced Mechanics of Materials (4th Edition), John Wiley and Sons, 1993.*
3. *Popov, E.P., Mechanics of Materials, Prentice Hall of India Private Limited, 1976.*
4. *Pytel, A. and Singer, F.L., Strength of Materials (4th Edition), Harper Collins Publishers, Singapore, 1987.*
5. *Srinath, l.S., Desayi, P.Murthy, N.S. and Anantha Ramu, S., Strength of Materials, McMilan India Ltd., 1997.*
6. *Timoshenko, S. and Young, D.M., Element of Strength of Materials (5th Edition), Affiliated East-West Private Limited, 1968.*

CE233 Building Materials and Construction **3 0 0 3**

Building Construction: Overview of building process; Foundations – deep and shallow foundations, shoring; Superstructure – Load bearing masonry, arches, lintels, scaffolding, formwork; Floors and roofs – Flat and pitched roofs, centering, floor finishes; Staircases and other elements of construction; Doors and windows; Framed construction – multi-storied buildings; Building services – vertical transportation, plumbing, electrical

Building Materials: Concrete – Concrete making materials, properties in fresh and hardened state, durability, special concrete; Steel – production, metallurgy, properties, and types; Bituminous materials – Types and properties of asphalt, bituminous concrete for pavement application; Masonry materials – Bricks, concrete blocks, lime and gypsum; Timber; Miscellaneous materials – Polymers and plastics, composites and smart materials; Failure mechanisms and degradation processes of materials

References:

1. *S. C. Rangwala, "Building Construction," Charotar Publishing House, Anand, 1993.*
2. *R. Chudley, "Construction Technology – Volumes 1 and 2," 2nd Edition, Longman, UK, 1987.*
3. *W. B. McKay, "Building Construction – Volumes 1, 2, 3, and 4," 5th Edition, Orient Longman, UK, 1993.*
4. *Michael S. Mamlouk and John P. Zaniewski, "Materials for Civil and Construction Engineers," Addison Wesley Longman Inc., USA, 1999*
5. *William D. Callister, Jr., "Materials Science and Engineering – An Introduction," 3rd Ed., John Wiley and Sons, New York, 1994.*
6. *S. C. Rangwala, "Engineering Materials," Charotar Publishing House, Anand, 1993.*
7. *A. V. Srinivasan and D. M. McFarland, "Smart Structures: Analysis and Design," Cambridge University Press, UK, 2001.*

CE

CE 205 Building Drawing **0 0 3 1**

Understanding of conventional signs and symbols; Building components: bonds and brickwork, doors, staircases, simple foundations; Site and building planning: Site plans, simple one-bedroom house, two-storied house, multi-storied apartment building; Planning and layout of large scale commercial facilities; Computer aided drafting (AutoCAD).

References:

1. *Balagopal T.S. Prabhu, K. Vincent Paul, and C. Vijayan, "Building Drawing and Detailing," Spades Publishers, Calicut, 1987.*
2. *M.G. Shah, C.M. Kale, and S. Y. Patki, "Building drawing with an integrated approach to built environment – 4th Edition," Tata McGraw Hill, 2002.*

Semester IV

CE 202 Structural Analysis **3 1 0 4**

Basic introductory concepts: structural systems, elements, joints, stability, equilibrium, compatibility, indeterminacy, types of loading, force-displacement relations, free-body diagrams.

Analysis of forces in statically determinate structures: trusses (including compound and complex trusses), beams and frames (including internal hinges), cables and three-hinged arches. Relation between bending moment diagram and elastic curve. Influence lines for beams and trusses under moving loads; criteria for maxima.

Work and energy principles: Principle of virtual work, Potential energy and Castingliano's theorems, Complementary energy theorems, Reciprocal theorems and Mueller Breslau's Principle, with applications.

Analysis of displacements in statically determinate structures: Unit (dummy) load and energy methods, Moment area and Conjugate beam methods, Williot-mohr diagram.

Analysis of statically indeterminate structures: Fixed beams and propped cantilevers by conjugate beam method; Theorem of three moments; Introduction to force and displacement methods: consistent deformation, energy method, slope-deflection and moment distribution.

References:

1. *Elementary Structural Analysis – Norris, Wilbur and Utku, McGraw Hill.*
2. *Basic Structural Analysis – C.S. Reddy, Tata McGraw Hill.*
3. *Intermediate Structural Analysis – C. K. Wang, McGraw-Hill*
4. *Theory of Structures – Volumes 1 and 2, S P Gupta and G S Pandit, Tata McGraw Hill.*
5. *Structural Analysis – L.S.Negi & R.S. Jangid, Tata McGraw Hill.*

CE 204 Hydraulic Engineering **3 1 0 4**

Introduction, Fluid Properties: density, viscosity, compressibility, ideal and real fluids

Hydrostatics: fluid force on plane and curved surfaces, manometry, buoyancy, Uniformly accelerated motion

Fluid Dynamics: Reynolds Transport equation, application to conservation of mass, momentum and energy, Bernoulli equation. Classification of flows: Laminar and turbulent flow, boundary layer flow. Dimensional Analysis and hydraulic modelling

Flow through pipes: Friction loss equation, minor losses, application to networks, network design, buried pipelines. Pumping Systems: Classification of pumps, pump characteristics, selection, operation, cavitation, pump-pipeline systems, transients and transient control

Flow in open-channels: Energy and momentum equations, specific energy, critical depth, transitions, uniform flow, gradually varied flow profile classification and computation, hydraulic jump, lined and unlined irrigation canal design. Flow Measurement: pitot tube, venturi and orifice meters, weirs and notches, pressure transducers, LDA

References:

1. *Roberson, J.A., and Crowe, C.T., "Engineering Fluid Mechanics", Houghton-Mifflin.*
2. *Roberson, J.A., Cassidy, J.J., and Chaudhry, M.H., "Hydraulic Engineering", Jaico Publishing House, 1998*

CE 206 Geology and Soil Mechanics **3 1 0 4**

General geology, Mineralogy, Crystallography, Petrology, Physical geology, Structural geology, Engineering Geology, Physico-Mechanical properties of rock. Origin and formation of soils, Outline of stratigraphy of India.

Water-Air void relationship, Soil grain and aggregate properties, Index properties including consistency limits and grain size distribution, Identification and classification of soils; Clay mineralogy; Permeability of soils, Effective stress law, Seepage forces and quick sand phenomenon, Seepage through soil including Flow Net diagrams; Capillarity of soils; Stress distribution in soils; Compaction of soils; Consolidation of soils, Consolidation theory, Stress history and settlement in soils.

References:

1. *Johnston, R. B. and DeGraff, J. V. (1988). Principles of Engineering Geology, John Wiley and Sons, New York.*
2. *Waltham, T. (2002). Fundamentals of Engineering Geology, Spon Press, London.*
3. *Singh. P. (1995). A Textbook of Engineering and General Geology, S. K. Kataria and Sons, New Delhi.*
4. *Mukerjee P. K. (1998). A Textbook of Geology, The World Press Pvt. Ltd., Kolkata.*
5. *Bowles, J.E (1984). Physical and Geotechnical Properties of Soils, McGraw-Hill Book Co., New York*
6. *Craig, R.F. (1987) Soil Mechanics, Van Nostrand Reinhold, U.K.*
7. *Gopal Ranjan and Rao (1991) Basic and Applied Soil Mechanics, Wiley Eastern*

Limited, New Delhi.
8. *Cernica, J.N. (1995) Geotechnical Engineering- Soil Mechanics, John Wiley & Sons Inc.*

CE 208 Surveying **3 1 0 4**

Introduction, Overview of plane surveying.

Distance: Distance measurement conventions and methods; use of tape; Electronic Distance, Measurement (EDM).

CE

Directions: Meridians, Azimuths and Bearings, Declination computations Angle

Measurement; Vemier transits; theodolites, Electronic theodolites, Tachometric surveying.

Levelling : Concept and terminology; differential leveling instruments; field methods, contouring

Traverse: Using theodoite; plane table; Methods of adjustments; Areas by coordinates. Construction surveys: Introduction, Building siting, foundation layout etc.

Earth work: LS & CS; Volume Calculation; prismoidal correction Introduction top geodetic surveying, photogrammetry, remote sensing and global positioning systems. Introduction to Geographic Information Systems (GIS).

References:

1. *Arthur R. Benton and Philip J. Taety, Elements of plane surveying, 'McGraw – Hill – 2000*
2. *Arorakr " Surveying Vol. I & II, Vol. III Standard Book House, 2000*
3. *Pradip Kumar Guha, " Remote Sensing for the Beginner" East-West Press 2003.*

CE 210 Surveying practical **0 0 3 1**

Field exercises in traversing, theodolite, leveling LS and CS and tachometry. Setting out building layout and curves. Field exercises using EDM, GPS, Electronic Theodolite, Electronic total station.

References:

1. *Alak De, " Plane Surveying" Chand & Company Limited, 2000*

Semester V

CE 301 Transportation Engineering I **3 0 0 3**

Introduction to transportation systems, characteristics.

Highway engineering: Classification of roads, Highway planning; Geometric design – Road cross section, Sight distance and applications, Superelevation, Horizontal and vertical alignment;

Types of pavements; Pavement materials – Aggregate and bitumen characteristics, Bituminous mix design; Pavement design – Design elements and loads, CBR and Group Index methods, Rigid pavement design; Pavement construction and maintenance.

CE

Airport Engineering: Taxiways, runways and aprons; Wind Rose diagram, Runway orientation; Runway pavement design; Terminal area planning.

Docks and Harbours: Definitions of terms, Basic planning principles, General layout and basic operational aspects.

References:

1. *Khanna, S.K. and Justo, C.E.G., Highway Engineering, 8th Edition , Nem Chand and Bros., Roorkee, 2001.*
2. *Banks, J. H., Introduction to Transportation Engineering, McGraw-Hill Book Co., 2002.*
3. *S. K. Khanna, Arora, M. G. and Jain, S. S., Airport Planning and Design, Sixth Edition, Nem Chand and Bros., Roorkee, 1999.*
4. *Horonjeff, R. and McKelvy, F. X., Planning and Design of Airports, McGraw-Hill International Editions, 1993.*
5. *Agerschou, H., Lungren, H., and Sorensen, T., Planning and Design of Ports and Marine Terminals, John Wiley & Sons, 1984.*
6. *Oza, H. P. and Oza, G. H., Dock and Harbour Engineering, Charotar Book House, New Delhi, 1996.*

CE 303 Water Resources Engineering **3 1 0 4**

Introduction, Hydrologic Cycle, Precipitation: forms, classification, variability, measurement, data analysis, Evapotranspiration: Penman-Monteith method, Irrigation water requirement computation, Infiltration: factors affecting, estimation by NRCS, Green-Ampt methods, Runoff: drainage basin characteristics, hydrograph; concepts, assumptions and limitations of unit hydrograph, derivation of unit hydrograph, flow duration curve, rainfall-runoff modeling.

Groundwater: occurrence, hydraulics of wells, yield, artificial recharge, Hydrologic Analysis and Design: design flood estimation, frequency analysis, flood routing, storm drainage design, Dams: types, forces, failure types and causes; design of gravity dams.

Reservoirs: safe yield, capacity design, reliability, design of overflow spillway, Role of economics in water resources planning, multipurpose projects, issues in water resources planning and development, systems techniques, risk analysis.

Hydroelectric Power: low, medium and high head plants, powerhouse components, microhydel Flood management: flood mitigation, flood damage analysis

Irrigation: diversion structures, cross drainage structures, regulation structures, field irrigation methods.

References:

1. *Linsley, R. K., Franzini, J. B., Freyberg, D. L., and Tchobanoglous, G. (1992). "Water Resources Engineering", McGraw-Hill Inc., Singapore.*
2. *Singh, V. P. (1992) "Elementary Hydrology". Prentice Hall, Englewood Cliffs, New Jersey.*

CE 305 Basic Structural Steel Design **3 0 0 3**

Properties of Steels: Structural Steel Sections, Systems. Limit States Design Concepts, Loads on Structures, bearing and friction type of bolts, Welding, Concentric and eccentric connections. Tension Members, Compression Members. Laterally supported and unsupported beams, Builtup beams, Plate Girders. Composite Beams and Columns, Beam columns, Simple Beam to Column connections, column base plates.

References:

1. *Steel Structures Design and Behavior – Charles G. Salmon and John E. Johnson, Harper and Row Publishers.*
2. *Steel Designer's Manual (Fifth Edition) – Graham M. Owen & Peter R. Knowles – ELBS.*
3. *Design of Steel Structures – P. Dayaratnam. Wheeler Publishing.*
4. *Design of Steel Structures – A. S. Arya & J. L. Ajmani Nemchand & Bros., Roorkee.*
5. *Teaching Resources for Structures Steel Design" Volume 1 & 2. INSDAG, Calcutta.*

CE 335 Geotechnical Engineering **3 1 0 4**

Shear strength of soils; Site investigation and subsoil exploration; Earth pressure theories, Retaining walls, Sheet piles and Bulk-heads, Earth pressure in open cuts; Stability of slopes; Bearing capacity of soils, Shallow foundations, Footings and rafts, Deep foundations; Introduction to Soil Dynamics.

References:

1. *Atkinson, J.H. and Bransby, P.L. (1975) The Mechanics of Soils- An Introduction to Critical State Soil Mechanics, McGraw-Hill Book Company (J.K) Limited.*
2. *Bowles, J.E (1984) Physical and Geotechnical Properties of Soils, McGraw-Hill Book Co., New York*
3. *Tomlinson, M.J. (1988) Foundation Design and Construction, 6th Edition, English Language Book society, Longman.*
4. *Gopal Ranjan and Rao (1991) Basic and Applied Soil Mechanics, Wiley Eastern Limited, New Delhi.*
5. *Cernica, J.N. (1995) Geotechnical Engineering- Foundation Engineering, John Wiley & Sons Inc.*

CE 341 Construction Materials Laboratory **0 0 3 1**

Normal Consistency, initial setting time and compressive strength of cement. Sieve analysis of coarse and fine aggregate, Bulk density, Specific gravity of aggregates and bulking of sand. Flakiness and elongation indices, angularity number, crushing, impact and abrasion values of aggregates. Slump, compaction factor and Vee Bee time of fresh concrete. Compressive, tensile, and flexural strengths of concrete. Water absorption, Compressive strength, efflorescence of bricks. Flexural strength and abrasion resistance of tiles. Tension tests on mild, HYSD, and high tension steels. Proctor Compaction and field density test, Atterberg limits, permeability test , consolidation test, Direct shear test, and UCC test of soil. Specific gravity, Penetration, Ductility, Softening point, and Viscosity tests on bitumen. CBR test.

References:

1. *Relevant Bureau of Indain standards and ASTM standards*
2. *Khanna, S.K. and Justo, C.E.G., Highway Engineering, 8th Edition , Nem Chand and Bros., Roorkee, 2001.*
3. *Khanna, S.K. and Justo, C.E.G., Highway Material Testing, 4th Edition , Nem Chand and Bros., Roorkee, 2001.*

Semester VI

CE 302 Transportation Engineering II **3 0 0 3**

Traffic engineering: Road user and vehicle characteristics; Traffic volume and composition, Speed, Headway, Concentration, Delay; Flow principles; Micro and macroscopic stream characteristics; Traffic studies - Volume, Speed, Delay, O-D

and Parking surveys; Statistical applications in traffic engineering; Traffic regulations and control - Traffic signs, Signals, Markings, Islands, and Rotaries; Traffic signals - Basic concepts and principles, Analysis and design; Types and layout of at-grade and grade separated intersections; Parking facilities; Capacity analysis and Level of Service (LOS) for uninterrupted flow facilities – Performance measures, LOS analysis, Design; Intelligent Transportation Systems (ITS) – Components, Advanced Traffic Management Systems (ATMS), Advanced Traveler Information System (ATIS) applications.

CE

Transportation Planning: Land use - transportation interaction; Introduction to urban transportation planning; Transportation Systems Management (TSM) techniques.

Railway Engineering: Location surveys and alignment; Permanent way – Gauges, Components of permanent way; Points and crossings; Stations and yards.

References:

1. *Kadiyali, L. R., Traffic Engineering and Transport Planning, Khanna Publishers,Delhi, 1997.*
2. *Banks, J. H., Introduction to Transportation Engineering, McGraw-Hill Book Co., 2002.*
3. *Papacostas, C. S., and Prevedouros, P. D. Transportation Engineering and Planning, Prentice Hall, 3rd edition, 2000.*
4. *Agarwal, M. M., Indian Railway Track, 14th Edition, Prabha and Co., Delhi, 2002.*

CE 304 Environmental Engineering **3 1 0 4**

Water/wastewater quantity – population forecast – Water demand, wastewater production, Variation of quantity of water and wastewater – Source of water : ground and surface. Water quality : Physical, chemical and biological parameters, water quality index.

Characteristics of wastewater, Water and wastewater quality enhancement: Philosophy of treatment. unit operation and processes, physical chemical and biological – Plain sedimentation, coagulation and flocculation, filtration, disinfection, softening, adsorption and reverse osmosis.

Grit chamber, suspended and attached growth systems for BOD removals, conventional and advanced anaerobic systems. Activated sludge, trickling filter, rotating biological contactors, pond systems, anaerobic digestor, Introduction to UASB, and anaerobic filters. Disposal of treated effluent, Inland waters, land and Ocean. Introduction to air pollution, global environmental issues,

Introduction to solid waste management and noise pollution. Introduction of EIA.

References:

1. *Environmental Engineering by Peavy H.S, Rowe D.R. and Tchobanoglous G – Tata McGraw Hills, New Delhi*
2. *Introduction to Environmental Engineering & Science 2nd Edn.*

Gilbert M. Masters, Prentice Hall, New Jerssey

3. *Waste Water Engineering: Treatment and Reuse, Metcalf & Eddy, T.M.H. Publication.*

CE 306 Basic Reinforced Concrete Design **3 0 0 3**

CE

Introduction to R.C Structures

Basic Material Properties: constituents of concrete mix, grade of concrete; behaviour of hardened concrete under uniaxial compression, tension, and combined stresses; creep, shrinkage and temperature effects; durability; properties of reinforcing steel.

Basic Design Concepts: working stress, ultimate load and limit states design.

Behaviour in Flexure: analysis at service and ultimate loads; singly and doubly reinforced rectangular and flanged sections; design of beams and one-way slabs for flexure at ultimate limit state as per IS 456; deflection control.

Behaviour in Shear and Torsion: analysis and design with and without shear rein forcement at ultimate limit state as per IS 456.

Design for Bond: development length, splicing, curtailment, code requirements.

Design of two-way rectangular slabs (wall-supported).

Design of Compression Members: effective length, short columns subject to axial compression with and without uniaxial/biaxial eccentricities; introduction to slender columns.

Design of Footings: types of footings, design of isolated and wall footings

References:

1. *Reinforced Concrete Design (Second edition) – S. Unnikrishna Pillai and Devdas Menon, Tata McGraw Hill*
2. *Limit State Design of Reinforced Concrete – P. C. Varghese, Prentice Hall India*
3. *Design of Concrete Structures (12th edition) – Arthur H Nilson, Tata McGraw-Hill Reinforced Concrete Limit State Design – Ashok K Jain , Nemchand &Bros.*

CE 310 Structural Engineering Laboratory **0 0 3 1**

Structures: Bond strength tests on steel reinforcement; Flexural behaviour of under and over reinforced concrete beams; Flexural behaviour of rolled steel section; Symmetric and unsymmetric bending on singly symmetric section; Buckling behavior of steel struts; Torsional behavior of open and closed sections; Shear strength of beams with and without web reinforcements; Behaviour of reinforced concrete short column; Torsional behaviour of reinforced concrete elements; Lateral torsional buckling of steel beams; Behaviour of steel bolted lap splices; Plastic behaviour of steel propped cantilever.

References:

1. *Laboratory Instruction Sheets – Structural Engineering Lab, IIT Madras*
2. *Timoshenko, S. and Young, D.M., Element of Strength of Materials (5th Edition), Affiliated East-West Private Limited, 1968.*
3. *Popov, E.P., Mechanics of Materials, Prentice Hall of India Private Limited, 1976.*
4. *Design of Steel Structures – A. S. Arya & J. L. Ajmani Nemchand & Bros., Roorkee.*
5. *Reinforced Concrete Design – S. Unnikrishna Pillai and Devdas Menon, Tata McGraw Hills*

CE 312 Structural Drawing **0 0 3 1**

Design and Detailing of RC beams, Slabs, Columns, Footings, Retaining Walls. Design and Detailing of Steel connections. Design of Trusses, Beams, Columns and Beam columns, Simple Beam to Column connections.

References:

1. *Structural Design & Drawing – Reinforced Concrete and Steel, N. Krishna Raju, University Press.*

CE 328 Industrial Training (Summer) **0 0 6 2**

Semester VII

CE 401 Estimation & Construction Management **3 1 0 4**

Estimation:- Objectives –Process components - Basic Principles of measurement – Units of measurement – Quantification of various items of construction – Illustrative examples for different types of structures – Reinforcement bar bending and bar requirement schedules – Principles of rate analysis – Standard data and schedule of rates approximate estimates, valuation.

Construction Management: -Overview of construction – Construction sequence and discrete construction activities – Specifications of typical construction items – Construction scheduling – Network analysis – Introduction to resource levelling and allocation.

References:

1. *Glenn M. Harde, "Construction Estimating Techniques"- Prentice Hill Inc. Englewood Cliffs New Jersey, 1986*
2. *B.N. Dutta " Estimating & Costing in Civil Engineering Theory and Practice" UBS Publishers & Distributors Limited New Delhi 1996.*
3. *M. Chakrabrti " Estimating, Costing, Specification and Valuation on Civil Engineering" Calcutta, 2002*
4. *IS: 1200 – 1974- Parts 1 to 25, Methods of Measurement of Building and Civil Engineering Works, Bureau of Indian Standards, New Delhi*
5. *Standard Data Books of Central Public works Departments and Public Work Department of States.*
6. *Jerome D. Wiest, Ferdinand K. Levy " A Management guide to Pert /CPM." Prentice – Hall of India Pvt. Ltd., New Delhi – 1991.*

CE 403 Hydraulic and Environmental Engineering Laboratory **0 0 3 1**

Orifice and Notch, Reynolds Experiment and Impact of Jet, Hydraulic Jump, Current Meter/Velocity Distribution, Pipe Friction and Basic Hydrology Experiment, Infiltration Experiment, Electrical Analogy,

Determination of types of hardness (Carbonate and non carbonate), alkalinity, acidity and removal of hardness by boiling, Determination of optimal alum dose and Determination of break point chlorination, Determination of Iron, Fluoride, Sulfate and Chlorides, MPN/Membrane Filter Technique (Demonstration) and Solids in water and wastewater, BOD/COD/TOC

Air Quality Monitoring (SOx, NOx, TSP and Respirable dust)

References:

1. *Roberson, J.A., Cassidy, J.J., and Chaudhry, M.H., "Hydraulic Engineering", Jaico Publishing House, 1998.*
2. *Waste Water Engineering: Treatment and Reuse, Metcalf & Eddy, T.M.H. Publication.*

CE 406 Project II **2 cr**

Semester VIII

IL402 Industrial Lecture (Pass Fail) **0 0 3 1**

CE 406 Project II **7 cr**

Electives :

CE 331 Advanced Structural Analysis **3 0 0 3**

Review of Flexibility Methods: Consistent Deformation, Least work, Matrix formulation. Analysis for support settlement, temperature variation and lack-of-fit. Two-hinged and fixed arches. Suspension and cable stayed bridge systems. Slope Deflection and Moment Distribution Methods. Stiffness Method: matrix approach. Direct stiffness method. Comparison of flexibility and stiffness methods. Approximate methods of frame analysis. Introduction to Finite Element Analysis.

CE

References:

1. *Structural Analysis – A Unified Classical and Matrix Approach – Ghali, A and Neville, A.M., Chapman and Hall.*
2. *Classical Structural Analysis – Anthony E. Armenikas, McGraw Hill.*
3. *Elementary Structural Analysis – Norris, Wilbur and Utku, McGraw Hill.*
4. *Intermediate Structural Analysis – C.K. Wang, McGraw Hill.*
5. *Structural Analysis – L.S. Negi & R.S. Jangid, Tata McGraw Hill.*
6. *Basic Structural Analysis – C.S.Reddy, Tata McGraw Hill.*

CE 332 Design of Steel Structural Systems **3 0 0 3**

Design of moment resisting beam to column connections, Plastic analysis and design of continuous beams and simple frames; Multistoried buildings. Industrial Structures, Gantry girders, Liquid storage tanks, bunkers, silos, Conveyors structures, Chimneys; Highway and railway bridges. Electric overhead and Microwave Towers.

References:

1. *Design of Steel Structures – Arya and Ajmani, Nemechand Bros.*
2. *Design of Steel Structures – Ram Chandra, Standard Book House.*
3. *IS: 800 – 1984 "Use of Structural Steel in General Building Constructions", BIS.*
4. *IS: 802 – "Use of Structural Steel in Overhead Transmission Line Towers"*
5. *IS: 875 – 1987 "Code of Practice for Design Loads" (Parts I, II & III).*
6. *IS: 6533 – 1992 "Steel Chimneys".*
7. *IS: SP (6) – 6 – 1972 "Application of Plastic Theory in Design of Steel Structures".*

CE 333 Computer Methods in Civil Enginering **3 0 0 3**

Evolution of program design concepts: Basic object oriented design concept. Object oriented languages: C++/Java constructs & syntax, Algorithm development and implementation; Application of object oriented programming in Civil Engineering Systems. Introduction to data structures, computer graphics and graphical user interfaces. Overview of technical application software: spread sheets, databases, CAD and GIS.

References:

CE

1. *Brian W. Kernighan, Dennis M.Ritchie . "C Programming Language" (2nd Edition), Prentice Hall PTR Publisher.*
2. *Stephen Prata "C Primer Plus" (4th Edition), SAMS Date Publisher, 2001.*
3. *C S Krishnamoorthy, Rajeev and Rajaraman," CAD in Civil engineering", Narosa Publisher New Delhi, 2004.*
4. *A.Rajaraman , "OOP in engineering Design", Narosa Publisher New Delhi, 2003.*

CE 341 Planning and design of building services **3 0 0 3**

Water supply, sewage disposal, solid waste disposal, storm water drainage - with respect to multistorey buildings- Design of different types of systems - design of underground and overhead storage tank capacities. Heating, ventilation and airconditioning- cooling and heating load calculations. Artificial lighting design - daylight analysis - lumen methods of design. Design of elevators and escalators. Electrical services- wiring design for different types of buildings. Fire safety design- Means of egress, active and passive fire safety systems. Security systems design - CCTV, Access control systems, burglar alarm systems.

References:

1. *W.J. McGuinness and B.Stein, « Mechanical and electrical equipment for buildings», 7th Ed., John Wiley & Sons Inc., New York, 2000.*
2. *Riley Shuttleworth. «Mechanical and electrical systems for construction», McGraw Hill Book Co., U.S.A., 1983.*
3. *IS SP30-1990 National electrical code*
4. *IS SP35 [S&T] - 1987 Handbook on water supply and drainage [with special*

emphasis on plumbing.

5. *IS SP41 [S&T]-1987 Handbook on functional requirements of buildings [other than industrial buildings] Parts 1 to 4.*
6. *IS SP32 [S&T]-1986 Handbook on functional requirements of industrial buildings [lighting and ventilation*

CE 342 Concrete Technology **3 0 0 3**

CE

Concrete-making materials: Cement – Production, composition, types, tests and standards; Aggregates – properties, types, tests and standards; Chemical and mineral admixtures

Structure and behaviour of concrete: Structure of concrete; Mixture proportioning of conventional and high-performance concrete; Behaviour in the fresh state – workability, placement considerations and pumping, curing of concrete; Properties of hardened concrete – response to various types of loading, constitutive relations, treatment of concrete as a composite material; Durability and dimensional stability of concrete

Special topics: High performance concrete; trends in concrete technology; fracture mechanics of concrete; special concrete, concreting practice

References:

1. *Neville, A. M., 'Properties of Concrete,' Pitman Publishing, Inc., MA, 1981.*
2. *Mehta, P. K., and Monteiro, P. J. M., 'Concrete: Structure, Properties, and Materials,' Prentice Hall, Inc., NJ, 1993*

CE 351 Ground Improvement **3 0 0 3**

Properties of weak soils like soft clay and loose sand. Problems associated with weak deposit; Requirements of ground improvements; Methods of ground improvement like stone column, compaction piles, Dynamic compaction: Vertical drains and preloading; Chemical Stabilisation; Deep explosion; Use of geo textile and modern materials; Control of improvement; Field instrumentation; Design and analysis of bearing capacity and settlement of improved deposits.

References:

1. *Bowels, J.E (1988) Foundation Analysis and Design, McGraw-Hill International Edition, Singapore.*
2. *Das, B.M. (1999), "Principles of Foundation Engineering", 4th Edition, PWS Publishing, Singapore.*
3. *Hausmann M.R (1990) Engineering Principles of Ground Modification, McGraw-Hill International Editions.*
4. *Moseley M.P (1993) Ground Improvement, Blackie Academic & Professional, Boca Raton, Florida, USA*
5. *Xanthakos P.P., Abramson, L.W and Bruce, D.A (1994) Ground Control and Improvement, John Wiley & Sons, New York, USA.*

CE 352 Foundation Engineering **3 0 0 3** CE

Bearing capacity and settlement analysis of shallow foundations. Design of shallow foundations; Ground improvement techniques; Lowering of ground water; Design of pile foundations and pile load tests; Design of well foundations and bulkheads; Earthwork excavations; Underpinning of foundations; Introduction to Machine Foundations.

References:

1. *Bowels, J.E. (1988), "Foundation Analysis and Design", 4th Edition, Mc. Graw International, Book Company.*
2. *Tomlinson, M.J. (1988) "Foundation Design and Construction" 6th Edition, English Language book society, Longman.*
3. *Das, B.M. (1999), "Principles of Foundation Engineering", 4th Edition, PWS Publishing, Singapore.*
4. *Singh, A. (1990) "Modern Geotechnical Engineering", 2nd Edition, CBS Publishers, New Delhi.*
5. *Murthy, V.N.S. (1992), "A text book of soil Mechanics and Foundation Engineering", Sri Kripa Technical Consultants, Bangalore.*

CE 353 Introductory Rock Mechanics **3 0 0 3**

Geographical formation and petrological classification of rocks; Structural geology; Classification of Rock Masses; Physico-Mechanical properties of rock; Failure criteria for rocks; Application to Tunnels. Caverns, Foundations and Slopes; Support Measures; Case studies.

References:

1. *Mukerjee, P.K. (1995) "A text book of Geology", World Press, New Delhi.*

2. *Brady, B.H.G. and Brown, E.T. (1993) "Rock Mechanics for Underground Mining", Chapman & Hall, London, U.K.*
3. *Goodman, R.R. (1989) "Introduction to Rock Mechanics", John Wiley & Sons, New York, N.Y., USA.*
4. *Jaeger, J.C. and Cook, N.G.W. (1976), "Fundamentals of Rock Mechanics", Champman and Hall, London, U.K.*
5. *Hudson J.A and Harrison J.P (1997) Engineering Rock Mechanics, Pergamon, London, U.K.*
6. *Obert L. and Duvali W. I (1967) Rock Mechanics and the Design of Structures in Rock, John Wiley & Sons, New York, N.Y., USA.*

CE 361 Flow Measurements 3 0 0 3

Demand and necessity of flow measurements. Principles and methods of measurement of Hydromechanical quantities such as time, angle and linear quantities, surface, volume, pressure, velocity, intensity of flow, total flow.

Measuring Devices: Reliability, accuracy and repeatability of devices; Conventional devices to measure pressure, velocity, rate of flow and total flows (such as gauges, current meter, wiers, flumes and watermeters).

Brief account of Modern Techniques of Measurements: Ultrasonic flow meters for large conduits and open channel, river flows. Tracer techniques. Nuclear magnetic resonance technique, Optical anemometers for volumetric flow measurements of liquids and gases. Radar technique for rainfall measurements, Remote sensing.

Two phase flow: Sediment samples, Air concentration measuring device, Shear and drag measurement, Unsteady flow measurement, Waves and surges.

References:

1. *Herschy, R.W., "Streamflow Measurement", Elsevier, 1985.*
2. *USBR, "Water Measurement Manual", II Edition, 1967*
3. *Bos, M.G., "Discharge Measurement Structures", Oxford Publishers, 1976*

CE 362 Ground Water Engineering 3 0 0 3

Ground Water Hydrology: Occurrence and movement of ground water, classification of aquifers, resources evaluation.

Ground Water Hydraulics: Aquifer characteristics, flow into wells in confined and unconfined aquifers, flow into underground drains and galleries.

Well development: Well drilling techniques, tools, well screens, well losses, pumping test on wells to determine safe yield. Artificial Recharge, Optimal pumping for contamination control.

References:

1. *Willis, R. and W.W.G. Yeh, "Groundwater Systems Planning and Management", Prentice-Hall, 1987.*
2. *Todd, D.K., "Groundwater Hydrology", John Wiley, II Ed., 1980. Driscoll, F., "Groundwater and Wells", St. Paul, Minnesota, II Ed., 1986.*

CE 431 Design of Concrete Structural Systems 3 0 0 3

Flat slabs; Design for serviceability (deflection, crack-width); Stairs; Combined footings; Raft foundation and Pile caps; Multistoreyed buildings systems; Basics of wind and earthquake analysis; Detailing of structures for ductility; Elements of prestressed concrete; Retaining walls: Cantilever and counterfort retaining walls; Water tanks; Introduction to bunkers, silos and chimneys. Introduction to concrete bridges: IRC loading, slab bridges, T-beam bridges.

References:

1. *Reinforced Concrete Design – S.U.Pillai and D.Menon, Tata Mc-Graw Hill Publishing Co.*
2. *Limit State Design of Reinforced Concrete – P.C.Varghese, Prentice Hall of India P. Ltd.*
3. *Advanced Reinforced Concrete Design – P.C.Varghese, Prentice Hall of India P. Ltd.*
4. *Prestressed Concrete – N.Rajagopalan, Narosa Publishing House.*
5. *Essentials of Bridge Engineering – D. Johnson Victor, Oxford & IBH Publishing Co. Pvt. Ltd.*

CE 432 Analysis and Design for Wind and Earthquake Effects 3 0 0 3

Review of Damages to Buildings due to Wind and Earthquake. SDOF Systems: Free and Forced Vibrations; Damping, Response Spectrum. MDOF Systems: Dynamic properties: Response spectrum analysis, Wind design philosophy; Earthquake Resistant Design Philosophy; ductility, Codal Provisions for Wind and Earthquake Effects; Design and Detailing for Ductility.

References:

1. *Wind Effects on Structures – Emil Simth and Robert Scanlan*

2. *Dynamic of Structures (2nd Edition) – Ray W. Clough, Joseph Penzien, McGraw Hill International Editions.*
3. *Dynamics of Structures – Theory and Applications to Earthquake Engineering – Anil K. Chopra, Prentice-Hall of India (1996).*

CE 441 Structural Masonry **3 0 0 3**

CE

Historical development, advantages & limitations, classification of masonry construction, codes and standards. Material and manufacture of masonry components. Structural and Functional properties. Unreinforced Masonry: Factors influencing compressive strength of masonry. Standard test methods. Unit and mortar interaction. Stress-strain properties. Strength and behaviour of masonry subjected to eccentric compression, direct/flexural tension, shear and compression, biaxial stresses. Effect of workmanship. Design of vertically loaded masonry. Loads: Dead, imposed, and snow loads, water and earth pressure, wind and earthquake loads, load combinations. Concepts of working stress method and limit state design, code provisions, Design for axial compression, design for concentrated load, design for eccentric compression, design of walls with openings, design for lateral and transverse loading. Masonry arches. Practical design examples of single and multistorey residential and office buildings with different planforms. Concepts of reinforced and prestressed masonry. Earthquake resistant design of loadbearing masonry. Seismic strengthening of existing masonry walls.

References:

1. *Arnold W. Hendry, «Structural masonry», MacMillan Education Ltd. London, 1990.*
2. *Christine Beall. «Masonry design and detailing for Architects, Engineers and Builders» Second Ed., McGraw Hill book co., New York, 1987.*
3. *Curtin, W.G., et al. «Masonry designers' manual», Third ed., BSP Professional books, London, 1995.*
4. *Hendry, A.W., Sinha, B.P., and Davis, S.R. «An introduction to load bearing brickwork design», Ellis Horwood, 1987.*
5. *Dayarathnam, P. «Brick and reinforced brick structures», Oxford & IBH publishing co. Pvt.Ltd., New Delhi, India, 1987.*
6. *IS 1905-87: Code of practice for structural use of unreinforced masonry, IS :SP-20(S&T)-1981: Explanatory handbook on masonry code, and other relevant BIS codes.*

CE 442 Remote Sensing **3 0 0 3**

Introduction, Basic concepts and principles of remote sensing; Photogrammetry; Aerial and Terrestrial; photo interpretation. Sensors; Radar imaging; colour scanners; thematic mapper. Data acquisition: Use of modern instruments; electronic theodolite: Global positioning system: landset imageneries. Data Processing: Computing aided error analysis, max - min algorithm, selecting land combination, image matching; spatial spectral information. Application; Meteorology, land use, networking, hydrological studies, soil studies and coastal zoneanalysis

CE

CE 451 Dynamics of Foundations **3 0 0 3**

Sources of vibration; Fundamentals of vibration theory; vibration criteria; Foundation vibration analysis using simple physical models; Design of block and framed foundations; Measurement of dynamic soil properties: Laboratory and field testing techniques; Vibration isolation techniques. Isolators and isolating materials; Introduction to earthquake Geotechnical Engineering.

References:

1. *Prakash S. and Puri V. K. (1998) Foundation for machines: Analysis and Design, John Wiley & Sons, New York, USA.*
2. *Prakash S. (1981) Soil Dynamics, McGraw-Hill, New York*
3. *Kameswara Rao N. S. V (1998) Vibration Analysis and Foundation dynamics, Wheeler Publication Ltd.*
4. *Kramer S.L (1996) Geotechnical Earthquake Engineering, Prentice Hall, New Jersey.*
5. *Rao S.S (2004) Mechanical Vibrations, Fourth Edition, Pearson Education, Singapore.*

CE 452 Principles of Reinforced Soil Structures **3 0 0 3**

Fundamental principles; Conventional and modern reinforcement products; Various functions of geotextiles, geo grids, geo membranes and geo composites; Laboratory tests for determining their properties; Design of reinforced soil structures like retaining walls, embankments, pavements; Case histories of reinforced soil structures.

References:

1. *Clayton, C.R.I., Milititsky, J. and woods, R.I. (1993) Earth Pressure and Earth Retaining Structures, Blackie Academic & Professional, London, U.K.*

2. *Ingold T. (1982) Reinforced Earth, Thomas Telford Ltd., London, U.K.*
3. *Jones C.J.F.P (1985) Earth Reinforcement and Soil Structures, Butter worth, London, U.K.*
4. *Koerner R.M (1993) Designing with Geosynthetics, Prentice Hall, Englewood Cliffs, New Jersey, U.S.A*

CE 461 Water Management **3 0 0 3**

Introduction: Need for Water Management, Development of Water Resources, Crop water requirements. Irrigation efficiencies.

Methods of Irrigation: Flood Irrigation Border Check basin, Sprinkler and Drip irrigation systems.

Canal Network: Alignment of canals, Canal losses, Assessment of water supply, Drainage, Canal automation.

Canal Design: Transport of sediment, channel design with and without sediment.

Planning of Water Resources Systems: Physical factors, Economical considerations, Environmental Impact Assessment, Planning of reservoir system.

Water system Management: Optimal cropping pattern, Irrigation scheduling, Water allocation procedures; Equality and equity concepts; application of optimization and simulation techniques in Water Management, Optimal operation of reservoir system. Water Quality Management, Watershed Management, Wasteland development, on-farm development.

Ground Water Management: Regional development, Conjunctive use of surface and groundwater resources, Optimal pumping strategies. Application of Modern Tools of Water Management. Remote Sensing; GIS for Water Resources assessment, development and management; Gaming models.

References:

1. *Cuenca, R.H., "Irrigation System Design – An Engineering Approach", Prentice-Hall, 1989.*
2. *2. Goodman, A.S., "Principles of Water Resources Planning", Prentice-Hall, 1989.*
3. *Willis, R. and W.W.G. Yeh, "Groundwater Systems Planning and Management", Prentice-Hall, 1987.*

4. *Garg, S.K., "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, New Delhi, 1991.*

CE 462 Watershed Management **3 0 0 3**

History of Watershed Management and its relevance to India: Characteristics of watersheds, base hydraulic considerations for different land use. Role of different types of vegetation in watershed management, Role of ecosystem, Foresting, Agriculture, Grassland and Wild land management techniques, Mountain terrains, administrative requirements, Evaluation of control measures, Command Area Development. On-farm management.

References:

1. *J.V.S. Murthy, "Watershed Management", New Age International, II Ed., 1998.*
2. *Wurbs, R.A., and James, W.P., "Water Resources Engineering", Prentice-Hall, NJ, 2002.*

CE 471 Transport Project Planning and Evaluation **3 0 0 3**

Project Planning: Principles; Planning surveys; Forecasting future requirements; Preparation of master plan; Phasing of projects.

Project Evaluation: Economic criteria; Capital and maintenance costs, Operating costs, Time costs, Accident and social costs; Benefit quantification; Methods of evaluation and decision-making.

References:

1. *Kadiyali, L. R., Traffic Engineering and Transport Planning, Khanna Publishers, Delhi, 1997.*
2. *Khanna, S.K. and Justo, C.E.G., Highway Engineering, 8th Edition , Nem Chand and Bros, Roorkee, 2001.*
3. *Papacostas, C. S., and Prevedouros, P. D. Transportation Engineering and Planning, Prentice Hall, 3rd edition, 2000.*
4. *Salvatore, D., Schaum's series on Theory and Problems of Microeconomics Theory, 2nd Edition, McGraw-Hill Book company, 1984.*
5. *Cole, S., Applied Transport Economics, Kogan Page, 1998.*

CE 472 Computer Applications in Highway and Traffic Engineering 2 1 0 3

Introduction to computer applications; Analysis, design and computer modelling related to highway and traffic engineering, and

transportation planning; Software applications and interpretation of outputs and results.

References:

1. *Kadiyali, L. R., Traffic Engineering and Transport Planning, Khanna Publishers, Delhi, 1997.*
2. *Khanna, S.K. and Justo, C.E.G., Highway Engineering, 8th Edition , Nem Chand and Bros, Roorkee, 2001.*
3. *Meyer, M. D. and Miller, E. J., Urban Transportation Planning, McGraw-Hill International Edition, 2001.*
4. *Papacostas, C. S., and Prevedouros, P. D., Transportation Engineering and Planning, Prentice Hall, 3rd Edition, 2000.*
5. *Ortuzar, J. D., and Willumsen, L. G., Modeling Transport., John Wiley and Sons, 3rd Edition, 1996.*
6. *TRB, Highway Capacity Manual, Transportation Research Board, Washington, D. C., 2000.*
7. *Horowitz, A. J., Quick Response System II for windows – Reference Manual, AJH Associates, Mulwaukee, Wisconsin, USA, 1997.*
8. *RST International, Inc., UFOSNET User's Guide, Bellevue, Washington, USA, 1994.*
9. *Other related software manuals.*

CE 481 Air Pollution control and Solid waste management 3 0 0 3

Air quality: Standards and criteria, Air pollutants: Sources, their effects on human, plants and materials, Meteorology and Stability of environment

Transport of air pollutants: Advection, dispersion, diffusion. Dispersion models.

Particulate control technology: settlers, scrubbers, cyclone separators filters and electrostatic precipitators, Gaseous pollutant control – adsorption, scrubbing, incineration, Control of vehicular pollution: NOx, Sox, CO, catalytic converters

Introduction to biofilters

Solid waste: Sources, quantification and characterization of Municipal solid waste, collection transport and disposal. Treatment and disposal: Composting, chemically secured land fill, Pysolysis & gasification incineration.

Noise pollution: Decibels, Acoustics, Noise control techniques

Introduction to hazardous, radio active and biomedical waste.

References:

1. *Peavy, H.S., Rowe, D.R., and Tchobanoglous, G., "Environmental Engineering, McGraw Hill, Newyork, 1985.*
2. *Wark, K., and Warmer, C.F., "Air Pollution: Its origin and Control", Harper and Row Publishers, New York, 1981.*
3. *Tchobanoglous, G, Theisen, H., and Vigil, S.A. " Integrated Solid Waste Management", McGraw Hill, New York.*

CE 482 Advanced Environmental Engineering 3 0 0 3

Advanced water Treatment: Adsorption, Ion exchange, membrane processes

Advanced wastewater Treatment: Tertiary treatment: nutrients removal by nitrification, denitrification, biological phosphate removal.

Selection of appropriate technology for the recycle and reuse of water, Zero pollution.

Waste minimization: Volume reduction and strength reduction technologies, bi-product recovery, recycle and reuse, process and equipment modification]

Preventive maintenance – Case Studies: Sugar and Distillery, Textile paper and pulp, Food processing.

Common Effluent treatment plants: polluters pays policy, ISO-14,000, Environmental Auditing.

References:

1. *Nemerow, N.L., and Dasgupta, A. "Industrial and Hazardous Waste Management", Van Nostrand Reinhold, New York, 1988.*
2. *Eckenfelder, W.W., "Industrial Water Pollution Control", Mc Graw Hill International Edition, 2000.*
3. *Weber, W.J., "Physico-Chemical Processes for Water Quality Control", John Wiley and Sons, 1983.*
4. *Jackson, S.L., "The ISO 14001 Implementation Guide: Creating an Integrated Management Sysytem", John Wiley and Sons, NY, 1996.*

CE 483 Computational Methods in water Resources and Environmental Engg **3 0 0 3**

Historical Development of computing techniques, Programming languages. Numerical Methods: Finite difference and finite element methods, Method of characteristics. Case study applications. Artificial intelligence & Expert Systems; Artificial intelligence, Data base management, Expert systems, Classification of expert systems, methods of knowledge acquisition, Methods of knowledge acquisition, Methods of knowledge inferencing, Application to case studies; Object oriented programming applications to Environmental/Water Resources problems. Optimization methods, Genetic algorithm, neural network, Cellular Automata and their applications to Environmental and water resources engineering. Basics of GIS and application of GIS to case studies in assessment, Planning and management of water Resources and Environmental Systems. Basics of parallel processing and Evolutionary computation, Introduction to Hydroinformatics.

CE

References:

1. *Thomas Back, "Evolutionary Algorithms in Theory and Practice", Oxford University Press, 1996*
2. *Burrough, P.A., and McDonnell, R.A., "Principles of G.I.S., "Oxford University Press, 1998.*
3. *Hoggan, D.H., "Computer Assisted Flood Plain Hydrology & Hydraulics", McGraw Hill, 1989.*
4. *Openshaw, S., and Abrahart, R.J., "Geo-Computation", Taylor and Francis, NY, 2000.*

5.2.5 Department of Computer Science & Engineering

Semester III

CS 210 Foundation of Computer Science **3 1 0 4**

Computer Science: Mechanization of Abstraction, Data models, The Pascal data model, Algorithms and Design of programs, Iteration, Induction and Recursion, Elementary algorithm analysis

Data models for the computer, Typical computer hardware elements, Main memory, Secondary storage devices, A typical instruction set, supporting pascal data model, representing structures, List data model.

The set data model, Basic definitions, Operation on sets, List implementation of sets, Characteristic vector implementation of sets, Relations and functions, Implementing functions as sets, Implementing binary relations, Infinite sets, Relational data model

Propositional logic, logic expressions, truth tables, tautologies, proof by resolution, predicate logic

References:

Alfred. V. Aho and Jefferey. D. Ullman, "Foundations of Computer Science", Computer Science Press, 1992.

CS 211 Computer Programming Lab **0 0 3 1**

Programming in Pascal/C, Coding conventions, debugging techniques, document standards, simple problems using elementary data structures.

CS 230 Switching Theory and Digital Design **3 0 0 3**

Representation of Data: Number systems and codes, Representation of unsigned and signed integers, Fixed-point representation of real numbers, Floating-point representation of real numbers, Representation of character data, Representation of signals.

Switching Theory: Laws of Boolean algebra, Theorems of Boolean algebra, Switching functions, Methods for specification of switching functions – Truth tables and Algebraic forms, Realization of functions using logic gates.

Digital Logic Elements: Electronic logic gates, Positive and negative logic, Logic families –TTL, ECL and CMOS, Realization of logic gates.

Simplification of Boolean Expressions and Functions: Algebraic methods, Canonical forms of Boolean functions, Minimization of functions using Karnaugh maps , Minimization of functions using Quine-McClusky method.

Design of Combinational Logic Circuits: Gate level design of Small Scale Integration (SSI) circuits, Modular combinational logic elements – Decoders, Encoders, Priority encoders, Multiplexers and Demultiplexers.

Design of Integer Arithmetic Circuits using Combinational Logic: Integer adders – Ripple carry adder and Carry look ahead adder, Integer subtractors using adders, Unsigned integer multipliers – Combinational array circuits, Signed integer multipliers –Booth's coding, Bit-pair recoding, Carry save addition and Wallace tree multiplier, Signed integer division circuits – Combinational array circuits, Complexity and propagation delay analysis of circuits.

Design of Combinational Circuits using Programmable Logic Devices (PLDs): Programmable Read Only Memories (PROMs), Programmable Logic Arrays (PLAs), Programmable Array Logic (PAL) devices, Design of multiple output circuits using PLDs

Sequential Circuit Elements: Latches –RS latch and JK latch, Flip-flops-RS, JK, T and D flip flops, Master-slave flip flops, Edge-triggered flip-flops

Analysis and Design of Synchronous Sequential Circuits: Models of sequential circuits – Moore machine and Mealy machine, Flip-flops – Characteristic table, Characteristic equation and Excitation table, Analysis of sequential circuits- Flip-flop input expressions, Next state equations, Next state maps, State table and State transition diagram, Design of sequential circuits – State transition diagram, State table, Next state maps, Output maps, Expressions for flip-flop inputs and Expressions for circuit outputs, Modular sequential logic circuits- Shift registers, Registers, Counters and Random access memories, Design using programmable logic sequencers (PLSs)

Design of Arithmetic Circuits using Sequential Logic : Serial adder for integers, Unsigned integer multiplier, Unsigned integer division circuits, Signed integer division, Floating-pint adder/subtractor – Design of control circuit, Floating – point multiplier.

Sequence detection and state reduction methods: Moore and Mealy state graphs for sequence detection, Methods for reduction of state tables, Methods for state assignment

VLSI Realization of Digital Systems: Field-Programmable Logic Arrays (FPLAs) and Logic Cell Arrays (LCAs),

Reference:

1. *C. H. Roth, Fundamental s of Logic design, Jaico Publishers, 1998.*
2. *V. P. Nelson, H.T. Nagle, E.D. Caroll and J.D. Irwin, Digital Logic Circuit Analysis and Design, Prentice Hall International, 1995*
3. *S. Brown and Z Vranesic, Fundamentals of Logic Design with VHDL Design, Tata McGraw-Hill , 2000*
4. *F.J. Hill and G.R.Peterson, Computer Aided Logical Design with Emphasis on VLSI, John Wiley & Sons, 1993*
5. *C. Hamacher, Z. Vranesic and S. Zaky, Computer Organization, McGraw-Hill, 2002.*
6. *J.P. Hyes, Computer Architecture and Organization, McGraw-Hill, 1998.*

CS 231 – Digital Logic And Design Laboratory **0 0 3 1**

1. Design AND, OR and EX_ OR gates using Nand (7400) gates and verify them.

2. (A) Design a BCD to 6-3-1-1 Code converter and verify.

   (B) Design a 6-3-1-1 to Gray Code converter and verify.

3. Design a full adder circuit using AND, OR and XOR gates. Verify it.

4. Design a 4 – Bit comparator using logic gates.

5. Design a Pseudo-random bit generator and check its performance.

6. Design a 4 – bit ripple carry adder, and verify by adding unsigned and signed integers. Check the overflow condition. Use BCD-to-SSD Decoders to demonstrate the results.

7. Design a Master – Slave J-K Flip-Flop using Logic gates.

8. (A) Design a Bi - directional counter using J-K Flip-flops.

   (B) Design a Counter which counts the following arbitrary sequence:

   0101, 0001, 1000, 1001, 1010, 0000, 0101…

9. Design a priority multiplexer for 8 Devices. Each device has one data output line, a request output line, and an acknowledgement input line. The data from the highest priority device has to be made available at the output of the priority multiplexer, and an acknowledgement has to be sent to that device.

Hint: The circuit may be designed using priority encoder, multiplexer and decoder.

10. Write and verify a VHDL code, using verilog, for simulation of a 4- Bit fast look ahead carry adder using

    Logic gates, full adders etc.

11. Write and verify a VHDL code, using verilog, for simulation of an 8-bit signed integer multiplier using carry save adders.

Semester IV

CS 220 Languages, Machines and Computation **3 0 0 3**

Grammars – Production systems – Chomskian hierarchy – Right linear grammar and Finite state automata – Context free grammars – Normal forms – uvwxy theorem – Parikh mapping – Self embedding property – subfamilies of CFL – Derivation trees and ambiguity.

CS

Pushdown automata – Acceptance by empty store and final state – Equivalence between push-down automata and context-free grammars – Closure properties of CFL – Deterministic push-down automata.

Turing machines – Techniques for Turing machine construction – Generalized and restricted versions equivalent to the basic model – Universal Turing machine – Recursively enumerable sets and recursive sets – Recursive functions – Time and space complexity measures – Context sensitive languages and linear bounded automata.

Parsing – CYK algorithm – Deterministic bottom-up and top-down parsing – LR(k) and LL(k) grammars – Complexity of parsing algorithms, Lex and Yacc, Compiler tools.

Decidability; Post's correspondence problem; Rice's theorem; decidability of membership, emptiness and equivalence problems of languages.

Time and tape complexity measures of Turing machines; Random access machines; the classes P and NP; NP-completeness; Satisfiability and Cook's theorem; Polynomial reduction and some NP-complete problems.

Computable functions; primitive recursive function; primitive recursive predicates; bounded and unbounded minimization; μ recursive functions – Godel numbering – equivalence to Turing computable functions.

Text Books

1. *J. E. Hopcroft, R. Motwani and J. D. Ullman, "Introduction to automata theory, languages and computation", Pearson Education Asia, 2001.*
2. *John. C. Martin, "Introduction to languages and the theory of computation, Third edition, Tata McGrawHill, 2003.*

Reference Books

1. *Peter Linz, "An introduction to formal language and automata", 3rd edition, Narosa publishing house, 2002.*
2. *H. R. Lewis and C.H. papadinitriou, "Elements of the theory of computation", Prentice Hall International Editions, 1981.*

CS 240 Principles of Communication **3 0 0 3**

The Communication Process:

Sources of information, Communication channels, Modulation process, and Communication networks.

CS

Representation of Signals and Systems:

Signals and sequences: Continuous Fourier transform, Sampling process, Discrete Fourier transform, Z-transform, Convolution and correlation, and Discrete-time filtering.

Introduction to Stochastic processes:

Probability theory, Random processes, Power spectral density, Gaussian process, and Noise.

Modulation and Transmission:

Continuous Wave Modulation – Amplitude and Frequency modulation, Frequency division multiplexing, Noise in continuous wave modulation;

Pulse Modulation – Pulse amplitude modulation, Pulse code modulation, Time division multiplexing;

Baseband Transmission – Matched filter, Error rate due to noise, Inter symbol interference, Baseband M-ary PAM transmission, Digital subscriber lines;

Passband Transmission – Frequency shift keying, Phase shift keying.

Information Theory:

Uncertainty, Information, Entropy, Source coding theorem, Mutual information, Channel capacity theorem, Channel coding theorem, Information capacity theorem, Rate-distortion theory, and Data compression.

Error Control Coding:

Linear block codes, Cyclic codes, Convolutional codes, Turbo codes.

References:

1. *Simon Haykin and Barry Van Veen, Signals and Systems, John Wiley & Sons, 1998.*
2. *Simon Haykin, Communication Systems, 4th edition, John Wiley & Sons, Inc (2001).*

CS 260 Computer Organization **3 0 0 3**

Introduction: Function and structure of a computer, Functional components of a computer, Interconnection of components, Performance of a computer.

Representation of Instructions: Machine instructions, Operands, Addressing modes, Instruction formats, Instruction sets, Instruction set architectures – CISC and RISC architectures.

Processing Unit: Organization of a processor – Registers, ALU and Control unit, Data path in a CPU, Instruction cycle, Organization of a control unit – Operations of a control unit, Hardwired control unit, Microprogrammed control unit.

Memory Subsystem: Semiconductor memories, Memory cells – SRAM and DRAM cells, Internal Organization of a memory chip, Organization of a memory unit, Error correction memories, Interleaved memories, Cache memory unit – Concept of cache memory, Mapping methods, Organization of a cache memory unit, Fetch and write mechanisms, Memory management unit – Concept of virtual memory, Address translation, Hardware support for memory management.

Input/Output Subsystem: Access of I/O devices, I/O ports, I/O control mechanisms – Program controlled I/O, Interrupt controlled I/O, and DMA controlled I/O, I/O interfaces – Serial port, Parallel port, PCI bus, SCSI bus, USB bus, Firewall and Infiniband, I/O peripherals – Input devices, Output devices, Secondary storage devices.

References:

1. *C.Hamacher, Z.Vranesic and S.Zaky, "Computer Organization", McGraw-Hill, 2002.*
2. *W.Stallings, "Computer Organization and Architecture – Designing for Performance", Prentice Hall of India, 2002.*
3. *D.A.Patterson and J.L.Hennessy, "Computer Organization and Design – The Hardware/Software Interface", Morgan Kaufmann, 1998.*

4. J .P.Hayes, "Computer Architecture and Organization", McGraw-Hill, 1998.

CS 261 Assembler Language Programming Laboratory **0 0 3 1**

The laboratory course is intended for giving exposure to students on machine language programming using the Assembler. Topics in Assembler syntax, Assembler directives and Assemler Macros are discussed for an assembler for 80x86 instruction set. The students are given assignments in the following topics.

- implementation of different types of high level language statements: arithmetic, control transfer (if...then...else, loop etc)
- macros
- subroutines: passing parameters
- interrupt service routine, software interrupts, OS calls
- device drivers
- communication between computers
- assembly language programming in C language

CS 280 Data Structures and Algorithms **3 1 0 4**

1. Problem Solving using Computers - Abstraction - Abstract data types; Data Representation; Elementary data types; Basic concepts of data Structures; Mathematical preliminaries - big-Oh notation; efficiency of algorithms; notion of time and space complexity; performance measures for data structures.
2. ADT array - Computations on arrays - sorting and searching algorithms
3. ADT Stack, Queue, list - array, linked list, cursor based implementations of linear structures.
4. ADT Tree - tree representation, traversal of trees;
5. ADT Binary tree - binary trees, threaded binary trees, application of binary trees - Huffmann coding; application of threaded binary trees - differentiation;
6. Search Tree - Binary search tree; balanced binary search trees - AVL tree; Applications of Search Trees - TRIE; 2-3 tree, 2-3-4 tree; concept of B-Tree.
7. ADT Dictionary - array based and tree based implementations; hashing - definition and application - LZW encoding.

8. ADT Priority Queue - Heaps; heap-based implementations; applications of heaps - sorting;
9. Graphs - shortest path, minimum spanning tree, DFS, BFS - an application of DFS and BFS.
10. Algorithm Design Paradigms - greedy, divide and conquer, dynamic programming, backtracking

References:

1. *Mark Allen Weiss, "Data Structures and Algorithms in C++", Addison Wesley, 2003.*
2. *Adam Drozdek, "Data Structures and Algorithms in C++," Brooks and Cole, 2001.*
3. *Aho, Hopcroft and Ullmann, "Data structures and Algorithm, "Addison Welsey, 1984.*

CS

CS 281 Advanced Programming Laboratory **0 0 3 1**

Applications, which emphasize use of Data structures to supplement the discussions in the course "Data Structures and Algorithms". Typical applications, long integer arithmetic (List), expression evaluation (stack), simulation (queues), Huffmann coding (binary tree + heaps), LZW coding (dictionary ADT), longest common subsequence (Sets, dynamic programming), shortest path related applications, course sequencing based on prerequisite (topological sorting).

Semester V

CS 310 Paradigms of programming **3 1 0 4**

Introduction to different paradigms of programming -Imperative - Object Oriented - Functional - Logic

Imperative and Object-oriented Programming - Role of Types - Static and Dynamic Type Checking - Scope rules ; Grouping Data and operations, Information Hiding and Abstract Data Types, Objects, Inheritance, Polymorphism,Templates.

Functional Programming - Expressions and Lists, Evaluation, types, type systems, values and operations, function declarations, lexical scope, lists and programming with lists, polymorphic functions, higher order and Curried functions, abstract data types.

Logic Programming - Review of predicate logic, clausal-form logic, logic as a programming language, Unification algorithm, Abstract interpretor for logic programs, Semantics of logic programs, Programming in Prolog.

Reference :

Programming Languages: Concepts and Constructs; 2nd Edition, Ravi Sethi, Pearson Education Asia.

CS330 Language Translators **3 0 0 3**

Compilers — Lexical analysis, Syntax analysis, Syntax-directed

translation, Semantic analysis, Run-time environments, Intermediate

code generation, Code generation, Code optimization; Design of interpreters and incremental compilers; Design of assemblers, macro processors, linkers and loaders;

Reference:

A.V. Aho, R. Sethi and J.D. Ullman, "Compilers: Principles, Techniques, and Tools", Addison-Wesley, 1988.

CS

CS 350 Operating Systems **3 0 0 3**

1. Basics

Operating System Functionalities, Types of Operating Systems, Computer Architecture support to Operating Systems

2. Process Management

Process Scheduling - Uniprocessor scheduling algorithms, Multiprocessor and Real-time scheduling algorithms, Process Synchronization - Peterson's Solution, Bakery Algorithm, Hardware Support to Process Synchronization, Semaphores, Critical Regions, Monitors - Deadlock prevention, deadlock avoidance and Deadlock Detection and Recovery - Bankers Algorithm, Threads.

3. Memory Management

Segmentation and space allocation, Basics of linking and loading, Demand Paging, Page replacement algorithms, Analysis of page allocation policies - Working Set

4. File Systems

Contiguous, Sequential and Indexed Allocation, File system interface, File System implementation, Case study of Unix File system - Buffer Cache, Inodes, The system calls - ialloc, ifree, namei, alloc and free, Mounting and Unmounting files systems, Network File systems.

5. I/O System

Disk Scheduling, Device drivers - block and character devices, streams, Character and Block device switch tables

6. Protection and Security - Accessibility and Capability Lists

Text Books:

1. *Operating System Concepts – Operating System Concepts, Sixth Edition, Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, John Wiley & Sons Inc.*
2. *Design of the Unix Operating System – Maurice Bach, Prentice Hall.*

Reference Books

1. *Modern Operating Systems- Andrew S Tanenbaum, Prentice Hall*
2. *Operating Systems – Operating System: Internals and Design Principles (4th edition), William Stallings*
3. *Operating Systems – System Programming and Operating Systmes D M Dhamdhere, tata Mc Graw Hill*
4. *Operating Systems – Operating Systems: A Modern Perspective, 2/E, Gary Nutt, Addison Wesley*
5. *Operating Systems - Operating Systems, Achyut S Godbole, Tata Mc Graw Hill*

CS 331 Language Translators Laboratory **0 0 3 1**

A language subset will be defined and used during the lab course. The programming exercises here consist of implementing the basic components of a compiler for a subset of Pascal/C using LEX and YACC tools. The constructs in this subset are found in most programming languages. They allow programs such as recursive and non-recursive sorting, and matrix multiplication to be expressed.

Reference:

A.T. Schreiner and H.G. Friedman, Jr., "Introduction to Compiler construction with UNIX", Prentice Hall, 1985.

CS 351 Operating Systems Lab. **0 0 3 1**

1. Implementation of a command shell.
2. Implementation of Synchronization constructs.
3. Study of scheduling algorithms
4. Implementation of File system constructs
5. Advanced file system constructs

Currently, the whole set of five experiments are done in Java, on top of a java mini-kernel. A Nachos based solution may also be used. For parts (4) and (5) Unix file system is used as a case study.

CS 370 Introduction to Database Systems **3 1 0 4**

Introduction - General introduction to database systems; Database – DBMS disctinction, approaches to building a database, data models, database management system, three-schema architecture of a database, challenges in building a DBMS, various components of a DBMS.

E/R Model - Conceptual data modeling - motivation, entities, entity types,

various types of attributes, relationships, relationship types, E/R diagram notation, examples.

Relational Data Model - Concept of relations, schema-instance distinction, keys, referential integrity and foreign keys, relational algebra operators: selection, projection, cross product, various types of joins, division, example queries, tuple relation calculus, domain relational calculus, converting the database specification in E/R notation to the relational schema.

SQL - Introduction, data definition in SQL, table, key and foreign key definitions, update behaviors. Querying in SQL - basic select- from –where block and its semantics, nested queries - correlated and uncorrelated, notion of aggregation, aggregation functions group by and having clauses, embedded SQL.

Dependencies and Normal forms - Importance of a good schema design, problems encountered with bad schema designs, motivation for normal forms, dependency theory - functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization, multi-valued dependencies and 4NF, join dependencies and definition of 5NF.

Data Storage and Indexes - file organizations, primary, secondary index structures, various index structures - hash-based, dynamic hashing techniques, multi-level indexes, B+ trees.

Transaction processing and Error recovery - concepts of transaction processing, ACID properties, concurrency control, locking based protocols for CC, error recovery and logging, undo, redo, undo-redo logging and recovery methods.

References:

- *Fundamentals of Database Systems; 3rd edn.; Ramez Elmasri and Shamakanth Navathe, Addison Wesley 2000.*
- *Database Systems - The complete book Hector Garcia-Molina, Jeffrey D Ullman and Jennifer Widom, Pearson Education, 2002.*
- *Database Management Systems 3rd edn, Raghu Ramakrishnan and Johannes Gehrke, McGraw Hill, 2003.*

Semester VI

CS 320 Computer Networks **3 0 0 3**

CS

Motivation: goals of networking, well-known applications such as web, e-mail and ftp => need for a layered architecture, OSI and Internet.

Host-to-host communication: RS-232 over serial line; handshaking and error handling; packet switching; reliable transmission - stop-and-wait, sliding window; logical connections.

Multiple co-located hosts: addressing, LAN access methods; CSMA/CD, Ethernet, Token passing, wireless LANs; Simple performance models; WAN access methods - PPP.

Remotely located hosts: addressing, interconnection of LANs; repeaters, bridges, routers; ATM cell-switching

IP: routing protocols (RIP and OSPF); congestion control concepts and mechanisms (choke packets, leaky bucket); IPv4

End-to-end reliability: the end-to-end argument; protocols - TCP, UDP, RPC; connection establishment, flow control.

Applications protocols for email, ftp, web, DNS.

Advanced topics (any 2 of the following): Wireless networks and mobile computing; network management systems; security threats and solutions; IPv6; ATM; Multimedia applications and its impact on networking.

References:

1. *Peterson & Davie, "Computer Networks, A Systems Approach", 2nd ed., Morgan Kaufmann, 2000.*
2. *Andrew S. Tanenbaum, "Computer Networks", 4th ed., Prentice Hall, 2003.*
3. *Keshav, "An Engineering Approach to Computer Networks", Addison Wesley, 1998.*

CS 321 Computer Networks Lab **0 0 3 1**

Configuration of networking in Linux using ifconfig, route, bind, etc.; configuration of firewall and masquerading in Linux; network trouble-shooting and performance monitoring using netstat, ping, tcpdump, etc.

Configuration and performance measurement of commonly-used Linux servers such as E-Mail (sendmail, pop3/imap) and Web (Apache).

Socket programming - TCP and UDP, peer-to-peer applications; reliable communications using unreliable datagrams; client-server using RPC; concurrent servers using threads or processes.

CS

References:

1. *"Linux Network Administrators Guide": http://tldp.org/LDP/nag2/index.html.*
2. *W.R. Stevens, "Unix Network Programming, Vol 1", 2nd ed., Prentice-Hall Inc., 1998.*

CS 340 Principles of Software Engineering **3 0 0 3**

The process of software development – Process models.

Software measurement - Software process improvement by metrics- Size-oriented metrics and function point metrics.

Engineering of software systems - Analysis concepts and principles - Analysis modeling – Data modeling – Specification techniques for software.

Design concepts and principles – Abstraction – Refinement – Modularity – Architectural design – Cohesion coupling concepts – Refactoring of designs.

O-O Approach to software design – Concepts – Design issues – Modeling techniques Design process – Design patterns.

Software Testing – Principles – Designing test cases – Testing strategies - Debugging – Introduction to O-O testing.

Software project planning - Effort and cost estimation techniques – LOC-based and Function-point based measures - The COCOMO model.

Software Quality Assurance(SQA) - Software Reliability - The ISO 9000 Quality standards – Capability Maturity Model (CMM).

Software Configuration Management (SCM) - The SCM process and standards CVS (Concurrent Versions System)- Change control –Source Code Control System (SCCS).

Software Reuse - Reusable artifacts – Reusable process models- Domain Analysis – Domain Engineering - Component-Based development.

Formal methods in software engineering - Basic concepts – Formal specification languages – Z and VDL.

CS

Reengineering - Software reengineering process model – Reverse engineering to understand data, and processing – Importance of software maintenance.

Advanced Topics in software engineering: Cleanroom software engineering – Introduction to Agile Processes – eXtreme Programming – Challenges of software engineering for distributed and mobile systems.

References:

1. Software Engineering – *A Practitioner's approach by Roger Pressman, 5e, 2001.*
2. Software Engineering Economics *by Barry Boehm.*
3. Fundamentals of Software Engineering *by Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli.*
4. *IEEE Software Engineering Standards.*
5. Software Metrics : A rigorous and practical approach*", 2nd edition, Norman E Fenton and Shari Lawrence Pfleeger, " Thomson Asia, 2002.*

CS 341 Software Engineering Laboratory **0 0 3 1**

System Requirement Specification (SRS) and related analysis documents as per the guidelines in ANSI/IEEE Std 830-1984.

Design documents representing the complete design of the software system.

The design can further be improved by the principles learned in this module.

Analysis and design for the same problem should be done using O-O approach.

Test documents as per ANSI/IEEE Std. 829/1983 Software Test Documentation.

Simple exercises in effort and cost estimation in COCOMO model.

Application of COCOMO and Function Point (FP) model for the actual project that has been chosen.

Familiarization of SCM tools with some public domain software like SCCS, CVS.

Familiarization of some reverse engineering tools available in the public domain.

At the end of the semester, there should be a presentation of the project with demonstration.

It is also advisable to have the students present the documents associated with the projects as and when they are ready. This will help the instructor identify pointing out the mistakes to them and the rest of the students.

CS

CS 366 Industrial Training **0 0 6 2**

Semester VII

CS 410 Computer System Design **3 0 0 3**

Basic principles of System Design: system components in simple system; Workstations, servers.

Building blocks for Computer Systems; CPU, Storage, I/O, Multimedia devices

The hardware-software interface, Hardware features influenced by software requirements.

Specifications of the performance of a system.

How to effectively utilize the strength of a component to get improvement in performance?

Testing systems for performance.

Computing with distributed resources.

Basic principles of system integration, when building larger systems.

Text books:

1. *Wayne Hendrix Wolf, "Computers as Components: Principles of Embedded Computer Systems Design", Academic Press 2001.*

2. *Vincent P. Heuring and Harry F. Jordan, "Computer Systems Design and Architecture", Pearson Education Asia, 2001.*

CS 411 Computer System Design Lab **0 0 3 1**

Students are expected to design modules and sub-systems which may be put together to form computers. Several experiments are included for software design for computer systems. These will be based on workstations and development systems working in a networked environment.

The laboratory experiments will supplement the lectures given in the course CS 410.

CS 479 Project I **3 cr**

Semester VIII

CS

CS488 Industrial Lecture **1 0 0 1**

CS480 Project II **8 cr.**

5.2.6 B.Tech. Electrical Engineering

Semester – III

EC 101 - Electrical and Magnetic Circuits **3 1 0 4**

DC Circuits – Independent and dependent sources – resistors – linear – non-linear – Node and Mesh methods of analysis of linear resistive networks containing independent and dependent sources – Network theorems – super position - reciprocity – Thevenin - Norton and Maximum power transfer. Sinusoidal AC sources – steady state analysis – self and mutual inductances - capacitance – phasor representation – impedance – admittance – Mesh and Node methods for ac circuits – power and reactive power – power factor – series and parallel resonance – three phase circuits – star – delta – balanced – unbalanced – power in three phase circuits – star – delta transformation – symmetrical components.

Magnetic circuit – dc excitation – hysterisis – loop – B – H – curve – reluctance – airgap – iterative design – ac excitation – eddy current losses – dynamic B-H curve – simple design.

Text Book

1. *William Hayt and Kemmerly JE, Engineering circuit analysis Tata Mcgraw Hill.*
2. *Murthy KVV and Kamath M.S., Basic current analysis, Tata Mcgraw Hill.*

Reference Books:

1. *Vincent Del Toro, Electrical Engineering Fundamentals, Prentice Hall, India*

EC 104 – Digital Systems **3 1 0 4**

Number systems and codes - Logic gates - Truth tables - minterms, maxterms - sum of products and product of sums - simplification of logic functions using Boolean algebra and Karnaugh maps - design of combinational circuits - flip-flops – counters - shift registers - design of sequential circuits - state graphs and state tables - MSI and LSI implementation of digital circuits - programmable logic devices - Top down approach to digital system design - simple design examples.

Text Book:

1. *M. Mano, "Digital Design", 3rd Ed., Prentice Hall, India.*
2. *D.D. Givone, "Digital Principles and Design", Tata McGraw Hill.*

References:

1. *J.F. Wakerly, "Digital Design Principles and Practices", Practice Hall.*
2. *R.J. Tocci, "Digital Systems Principles and Applications", Prentice Hall, India.*

EC 204 Networks & Systems **3 1 0 4**

System types and classifications - Fourier series - Fourier Transforms - classical differential equations - Initial conditions - Graph theory for network solution - Laplace transforms and inverse transforms - Network functions: poles, zeros, transfer functions - one and two port network parameters - network theorems - state variable analysis.

Text Book:

1. *Van Vallenburg, Network Analysis, Prentice Hall.*
2. *Oppenheim A.V., Willsky A.S. & Nawab S.H., Signals & Systems, Prentice Hall.*
3. *V.K. Aatre, Network Theory and Filter Design, Wiley Eastern.*

References:

1. *Ley, Lutz and Rehberg, Linear Circuit Analysis, McGraw Hill.*
2. *Seshu and Balabanian, Linear Network Analysis, John Wiley & Sons.*
3. *Murdoch, Network Theory, McGraw Hill.*
4. *Mix & Schmitt, Circuit Analysis for Engineers; John Wiley & Sons.*

EC 209 - Computer Organization and Microprocessors **3 1 0 4**

Microprocessor architecture - Computer arithmetic, ALU design, register-les Control unit: hardwired *vs.* microprogrammed Performance metrics (MIPS, MFLOPS etc.) - ipelining, RISC architectures - Design examples from 8086 processor

Programming model - Instruction sets, with examples like 8086 Assembly language programming Tools: assemblers, debuggers- Operating systems concepts

Computer Organization (System design) - I/O interfacing -Interrupts, polling, DMA, Ports, memory mapping -Peripheral interfaces (8255 example)

Text Books:

1. *D. A. Patterson and J. L. Hennessy, .Computer Organization and Design, The Hardware/Software Interface., Morgan Kaufmann.*
2. *J. Uffenbeck, .The 8086/8088 family: design, programming, and interfacing., Prentice-Hall of India Pvt. Ltd.*

REFERENCES

1. *V. Carl Hamacher, Zvonko Vranesic, and Safwat Zakay, .Computer Organization, 5th ed.., McGraw-Hill IE.*
2. *M. Morris Mano, .Computer System Architecture, 3rd edition., Prentice-Hall,Inc.*
3. *J. P. Hayes, .Computer Architecture and Organization, 3rd edition., McGraw Hill.*

4. *A. Tanenbaum, .Structured Computer Organization, 4th ed.., Prentice-Hall.*
5. *Y.C. Liu and G.A. Gibson, .Microcomputer Systems: the 8086/8088 family., Prentice-Hall of India Pvt. Ltd.*

EC205 CAD Lab **1 0 3 2**

Circuit simulation using SPICE, Problem solving using SCILAB, Object-oriented programming using Java, Digital circuit design and testing using TK Gate.

References:

1. *Tutorials on SPICE and SCILAB in the www.ee.iitm.ac.in website.*
2. *Introducing UNIX system, V.R. Morgan, H. McGilton, McGraw- Hill.*
3. *C and UNIX – tools for software design M.C. Barrett, C.H. Iwagner, John Wiley, Singapore.*
4. *Java, The complete reference, P. Naughton, H. Schildt, Tata McGraw Hill.*

EC211 – Digital Circuits Laboratory **0 0 3 1**

1. Combinational circuits: Adders, multipliers, magnitude comparators. Identification of critical path, maximum frequency of operation

2. Clock generation and timing circuits.

   Multivibrators, 555, clock generation using crystal oscillators, two-phase clock generators, ring oscillator

3. Sequential circuits : Flip flops, counters, shift registers.

4. A/D and D/A converters – static characteristics.

5. Design and implementation of simple systems. eg. Frequency meter, digital clock, arbitrary waveform generator

6. Design and simulation of combinational and sequential circuits using HDLs.

Text books

1. *Digital Integrated circuits – H. Taub and D. Schilling McGraw-Hill International edition*
2. *Digital design – M. Morns Mano, Prentice – Hall of India*
3. *Art of Electronics – P. Horowitz and W. Hill, Cambridge University press.*

References :

1. *The Verilog Hardware description language – D. Thomas and P. Moorby, Kluwer Academic Publishers.*

2. *Verilog HDL – A guide to digital design and synthesis S. Palnitkar ; Pearson Publishers (Indian branch)*

Semester IV

EC220 Analog and DSP **3 1 0 4**

Review of LTI systems; Fourier Transform for discrete-time signals and its properties, comparison with continuous-time F.T.; Z-transform and its inverse, region of convergence, properties, frequency selective filters, pole-zero locations and frequency response, stability, IIR and FIR filters, linear phase filters, response of first and second order filters; Signal analysis using the F.T., impulse function and complex exponential signal, modulation and frequency translation, duality, Fourier Transform of periodic signals, correlation, energy and power spectral density, Hilbert Transform, complex envelope representation, examples from AM, SSB-AM, and FM; Fourier Transform of finite-duration discrete- time sequences, relationship to discrete-time Fourier Series, circular convolution, FFT; Sampling of continuous-time signals, comb function, spectrum of sampled signals, relationship between spectra of discrete- and continuous- time representations, Nyquist's Sampling Theorem, aliasing, interpolation.

Text Books:

1. *A. Oppenheim, R. Schafer and J. Buck Discrete-Time Signal Processing, Prentice Hall.*
2. *Oppenheim, Willsky and Nawab, Signals and Systems, Prentice Hall.*
3. *J.G. Proakis and M. Salehi, Communications System Engineering , Prentice Hall.*

EC201 Analog Circuits **3 1 0 4**

Elementary theory of semiconductor diodes, BJTs, JFETs and MOSFETs – Design of diode circuits, design of discrete and integrated transistor small signal, large signal, wideband, dc, differential, and tuned amplifiers, power supplies – Operational amplifiers – Feedback, compensation, oscillators – Design of representative op amp application circuits – OTAs and PLLs.

EC 207 – Electromechanical Energy Conversion **3 1 0 4**

Transformers: Ideal Transformer, Losses, Equivalent Circuit, Construction and Design, Variable frequency operation. Transformers for poly phase systems.

D.C. Machines: Magnetic system, Armature windings, Methods of excitation, Equivalent circuit and General equations. Performance of generators and motors, Permanent magnet motors.

Induction Machines: Alternating current machine windings, Construction of A.C. machines, 3-phase induction motors – Equivalent circuits and performance characteristics, Single phase induction motors, Linear induction motors.

Synchronous Machines: Three-phase synchronous machine, equivalent circuit, principle of operation, operation on an infinite bus, synchronous condenser, Principles of stepping motors.

Text Book:

1. *"Electric Machines", I.J. Nagrath and D.P. Kothari Tata McGraw – Hill Publishing Co. Ltd.*
2. *"Electrical machines", P.K. Mukherjee and S. Chakravarthi, Dhanpat Rai Publications (P) Ltd.*

References:

1. *"Performance and design of A.C. Machines", M.G. Say Sir Isaac Pitman & Sons Ltd. And ELBS.*
2. *"Performance and design of direct current machines", Albert E. Clayton, Sir Isaac Pitman & Sons Ltd. and ELBS.*
3. *"Electrical Machines" Vol.I & II, M. Kostenko E.L. Piotrovsky MIR Publishers.*

EC 210 – Solid State Devices **3 1 0 4**

Valence band and Energy band models of intrinsic and extrinsic semiconductors. Thermal equilibrium carrier concentration. Carrier transport by drift, resistivity. Excess carriers, lifetime, carrier transport by diffusion, Continuity equation.

Quantitative theory of PN junctions : Steady state I-V characteristics under forward bias, reverse bias and illumination. Dynamic behavior under small and large signals. Qualitative theory of breakdown mechanisms. Quantitative theory of bipolar junction transistors having uniformly doped regions. Static characteristics in active and saturation regions. Emitter efficiency, transport factor, transit time, (and their calculation as functions of frequency. Charge control description.

Theory of Field Effect Transistors : Static characteristics of JFETs. Analysis of MOS structure. Calculation of threshold voltage. Static I-V characteristics of MOSFETs.

Text Book :

1. *'Solid State Electronic Devices' by Ben G. Streetman and Sanjay Banerjee, Prentice Hall International, Inc.*
2. *'Semiconductor Devices Physics and Technology' by S.M.Sze, John Wiley & Sons.*

3. *'Semiconductor Devices Modelling and Technology' by Nandita Das Gupta and Amitava Das Gupta, Prentice Hall of India Pvt.Ltd.*

References :

1. *'Physics of Semiconductor Devices' by S.M. Sze, John Wiley and Sons.*
2. *'Introduction to Semiconductor Materials and Devices' by M.S. Tyagi, John Wiley and Soks.*

EC225 Principles of Measurement Lab **1 0 3 2**

SI units – Conversion – Errors in measurement system – Random errors – Propagation of errors – Significant figures – Analog indicating instruments measurement of voltage, current, power and reactive power – Potentiometric and Bridge methods – Digital Instruments – Experiments to support the above theory.

Text Book:

1. *Helfric A.D.and Cooper W.D., Modern electronic Instrumentation and Measurement techniques, Prentice Hall, India.*
2. *Fronk Ernest, Electrical measurement analysis.*

References:

1. *Golding EW, Electrical Measurements & Measuring Instruments.*
2. *Gregory B A , Wheeler , Introduction to Electrical Instrumentation and Measurement Systems, John Wiley.*

Semester V

EC301 – Electromagnetic Fields **3 1 0 4**

Review: Electrostatics, Magnetostatics, Ampere's Law, Faraday's Law, Electromagnetic Energy. (Topics covered in PH 102) - **Solution Techniques** Laplace/ Poisson's equation with Dirchlet/ Neumann boundary conditions. Method of images, separation of variables, finite difference schemes - **Time varying fields** Maxwell's equations, wave equation, Poynting theorem, phasor notation - **Plane Waves:** Solution of the wave equation in vacuum. Wave velocity and impedence. Normal and Oblique incidence at interfaces. Penetration into conducting surfaces - skin effect. Reflection off dielectric layers - **Introduction to waveguides:** Guided waves. Interpretation as superposition of obliquely travelling plane waves. Modes and their cutoffs. The TEM wave and the transmission line limit - **Transmission Lines:** The high-frequency circuit. Time domain reflectometry. *LCR* ladder model for transmission lines. The transmission line equation. Analogy with wave equation. Solution for lossless lines. Wave velocity and wave impedence. Reflection and Transmission coeffcients at junctions. VSWR. Introduction to Smith Chart - **Antennas:** The free space antenna. The half-wave dipole antenna. Radiation patterns. Antenna gain and directivity - **Case studies:** Semiconductors, bio-electromagnetics, data storage, RF circuits, optics, telecommunications.

Text Book:

1. *Nannapaneni Narayana Rao, Elements of Engineering Electromagnetics, Prentice Hall of India.*
2. *Hayt, Engineering Electro-magnetics, McGraw-Hill.*

References:

1. *Kraus and Fleisch, Electromagnetics with applications, McGraw-Hill.*
2. *Ramo, Whinnery and Van Duzer, Fields and Waves in Communication Electronics, John Wiley and Sons (Asia)*

EC321 – Control Engineering **3 1 0 4**

Introduction : Open-loop and closed-loop systems, servomechanisms and regulator systems; Transfer function; Block diagram reduction; Signal flow graphs.

Mathematical models of Physical Systems: Mechanical translational and rotational systems, gear trains; D.C. generator and motor; Transportation Lag Systems. Components of feedback control systems: Potentiometers as error sensing devices, synchros, a.c. servo motor; tachometers.

Stability: Concept of stability, necessary and sufficient conditions of stability; Closed-loop systems, merits and demerits; Routh Hurwitz Criterion.

Transient Response: Typical inputs, convolution integral; Time domain specifications, steady state errors.

Frequency Response: Definition, equivalence between transient response and frequency response; Bode plots.

Nyquist stability criterion: Development of the criterion; Gain and phase margins; M circles and Nichol's chart.

Root Locus method: Rules for sketching of root loci; Root contours.

State space representation of control systems.

Synthesis: Lag and lead network; Proportional, derivative and Integral controllers.

Text Book:

1. *"Control Systems Engineering" by I.J. Nagrath & M. Gopal, end Edn. Wiley Eastern, New Delhi.*
2. *"Automatic Control Systems" by B.C. Kuo, 4th Edn. Prentice Hall of India, New Delhi.*

EE

3. *"Control System Engineering" by Norman S. Nise, Wiley Text Books.*

References:

1. *"Modern Control Engineering" by Ogata K. 4th Edn. Prentice Hall.*
2. *"Modern Control Systems Theory" by M. Gopal, John Wiley & Sons, Inc.*

EC 303 – Power System Practice **3 1 0 4**

Introduction to Power Systems: Historical Development, performance requirements , typical power station and substation layouts, single line diagrams-Conventional and non-conventional electrical energy sources- Recent Trends.

Transmission and Distribution: Overhead Lines, insulators, underground cables, distribution systems.

Power System Analysis: Modeling of power system components- basics of load flow studies, load frequency control, power system stability.

Power System Protection: Switchgear; fuses, circuit breakers, symmetrical fault calculations- Basic Principles of protection by relays.

Economics of Power Supply Systems: Economic choice of conductor size and voltage level; maximum demand and diversity factor, tariffs, power factor correction, energy conservation.

Text Book:

1. *Electric Power Systems, by B.M.Weedy, 4th Edition, John Wiley.*
2. *A Text Book on Power System Engineering, by A. Chakraborthy, M.L,Soni, P.V .Gupta, U. S. Bhatnagar, Dhanpat Rai & CO.*

References:

1. *Power System Analysis and Design, by J. Duncan Glover and M. Sarma, PWS Publishing House.*
2. *Modern Power System Analysis, by D.P.Kothar and I.J.Nagrath, 3rd Edition, Tata Mc Graw Hill.*
3. *Power Systems Analysis, by A. R. Bergen and Vijay Vittal, Prentice Hall.*
4. *Power Systems Analysis, by H. Saadat, McGraw Hill.*

EC305 Communication Systems **3 1 0 4**

Telephony - voice digitisation, log-PCM, architecture of the modern PSTN, subscriber and trunk signalling, digital switching, time-division multiplexing, PDH/SDH; Radio Communications - thermal noise, AWGN model, noise figure; AM, DSB-SC, SSB, VSB, FM - demodulators, spectra, SNR performance, relative merits; Fiber-optic communications - components of an optical link, dispersion and attenuation, link design, repeaters and regenerators, WDM; Data Communications - data networks and layered architecture, clock synchronisation in digital communications, line coding, framing and data link control, CRC and ARQ protocols, the Internet and its structure; Cellular Wireless Communications - cellular concept and spectrum re-use, handoff, interference as the limiting impairment, capacity, introduction to FDMA, TDMA and CDMA.

Text Books :

1. *J. Bellamy, Digital Telephony, Wiley.*
2. *Simon Haykin, Communication Systems, Wiley.*
3. *Bertsekas and Gallager, Data Networks, Prentice-Hall.*

Reference :

Joseph Palais, Fiber Optic Communications, Prentice Hall.

EC312 Microprocessor Laboratory **0 0 3 1**

Programming Exercises using 8086 software development tools. Experiments in Microprocessor interfacing using 8086 Single Board Computers. Design of Microrprocessor components using hardware description languages.

References:

1. *Y C Liu and G A Gibson "Microcomputer Systems: the 8086 / 8088 family". Prentice Hall of India Pvt Ltd 2002.*
2. *J Uffenbeck, "The 8086/ 8088 family: Design, Programming and Interfacing," Prentice Hall of India Pvt Ltd 2002.*

Semester VI

EE309 Electromechanical Energy Conversion Lab **0 0 3 1**

Transformers: Predetermination of performance of single phase transformers using open circuit and short circuits tests and verification by actual load test – Sumpner's test and heat run – polyphase transformer connections.

DC Machines: Characteristics of DC generators and motors, predetermination from Swinburne's and Hopkinson's test, speed control, motor starters and controllers.

Induction Machines: Prediction of performance of 3 phase motors by equivalent circuit and circle diagram and verification by actual load test – Winding study through pole change connections – Induction generators – Single phase induction motors.

Synchronous machines: Regulation of an alternator, synchronization and V-curves of synchronous motors and generators.

References:

"Laboratory manual for electrical machines" by curriculum Development Cell, IIT Delhi, Wiley Eastern Ltd.

EC330 - Analog Circuits Laboratory **0 0 3 1**

Building, testing and evaluation of representative diode, BJT, JFET, MOSFET and Operational Amplifier circuits designed in the course EC201 Analog Circuits.

EE 350 Industrial Training **0 0 6 2**

Semester VII

EC 400 Advanced EE Lab **0 0 3 1**

Experiments in Communication systems, Microwave Engineering, microelectronics, Control Systems, Power Systems and High Voltage Engineering.

EE 489 Project I **0 0 62**

Semester VIII

IL 402 Industrial Lecture (Pass/Fail) **1 0 0 1**

EC490 Project II **0 0 30 10**

Electives:

EC356 Analog Communication Systems **3 1 0 4**

Review of probability and random variables, Random processes, Specification of random process, stationary and ergodicity, Correlation functions and power Spectra. Gaussian processes, Noise in Communication systems, Thermal noise, shot noise and white noise. Noise equivalent bandwidth and noise figure. Time domain representation of narrowband noise. Properties of narrowband noise.

Noise in CW modulation systems, Figure of merit, Noise performance of linear and exponential modulation. Preemphasis and deemphasis in FM. Comparison of the noise performance of CW modulation schemes.

Noise performance of PCM, DPCM and DM.

Introduction to digital signaling, Geometric representation of signals. Optimum receiver for the AWGN channel.

EE358 Analogue and Digital IC's **3 0 0 3**

Basic building blocks of IC's, Differential amplifier, Operational amplifier, Comparator, Multiplier, Voltage regulator, Phase locked loop, Special purpose communication IC's.

Logic families: TTL, ECL, I^2L, CMOS, NMOS, PMOS. Memories. PLA's, PAL.

ASIC's, Analog and Digital VLSI's.

EE362 Device Modeling **3 0 0 3**

Basic Semiconductor Physics: Distribution function and carrier concentration. Heavy doping effects and band gap narrowing. Majority and minority carrier mobilities. SRH and Auger models for recombination. Avalanche multiplication. Noise sources in semiconductor devices.

Bipolar Device Modeling, Injection and Transport models. Collector and base currents and stored charges. Early effect, Quasisaturation, base widening and Kirk effect, Series resistances, capacitances and high frequency equivalent circuit. Transit time and cutoff frequency f_T. b and f_T variation with I_c. Small geometry BJTs, Two dimensional considerations, current crowding, lateral base widening, side-wall injection. Parasitics, Scaling consideraton and limitations. Poly Emitter Transistor (PET) models.

MOSFET modeling: Threshold voltage and body effect, Mobility of inversion layer. Long channel models for drain currents of transistors in uniformly doped substrates and in substrates with threshold adjustment implant, saturation mode behaviour, channel length modulation and dynamic operation. Small geometry transistor models for drain current, threshold voltage, substrate effect and drain saturation voltage. Subthreshold charges and currents. Substrate current and hot electron effect. Parasitic resistance and capacitances.

Models for JFET and MESFET: Drain currents of JFET and MESFET. Classical description and models for short channel transistors.

Parameter Extraction methods for BJT and MOSFET.

EE401 Instrumentation Systems. **3 0 0 3**

Measurement Systems and Components. Performance characteristics, Amplitude modulation for data handling – demodulator circuits.

Transducers – Passive and active – Resistance, inductance and capacitance types – Generator, thermoelectric and piezo - electric types. Measurement of non electrical quantities such as displacement, pressure, force, flow and temperature.

Data Acquisition Systems – PC-based Instrumentation Systems.

EE403 High Voltage Engineering **3 0 0 3**

High voltage technology – Historic development, high voltage design and applications, over voltages and insulation coordination.

Electrical insulating materials – Insulation behaviour of gaseous, liquid and solid dielectrics.

Electric field calculations – Analytical, analogue and numerical methods- use of field plots in high voltage design.

Generation of high voltages – Alternating, direct, lightning and switching surge voltages, generation of impulse currents.

High voltage measurements – Electrostatic voltmeters, sphere gaps, low voltage instruments with potential dividers, impulse voltage and current measurements, dielectric loss and partial discharge measurements. High voltage testing of power apparatus.

EE419 Digital Communication Systems. **3 0 0 3**

Digital Carrier modulation: Binary ASK, PSK and FSK. Error performance and bandwidth requirements. QPSK, OQPSK, and MSK, implementation and performance comparison with the binary schemes. Probability of error computation of the M-ary orthogonal, biorthogonal and simplex signals. Union bound on the probability of error.

Error Correction Coding: Linear block codes, generator and parity check matrices, Syndrome and decoding based on the standard array. Cyclic codes, properties, implementation of encoders and decoders. Convolutional codes, description based on generator matrix and polynomials. Maximum likelihood decoding of convolutional codes, viterbi algorithm. Trellis coded modulation.

Information theory: Information measure and entropy. Coding of discrete sources, Shannon – Fano and Haffman codes. Discrete memoryless channels and channel capacity. Noisy channel Coding theorem.

EE421 Microwave Engineering **3 0 0 3**

Microwave Components – Microwave Tubes: Klystron amplifiers, Reflex klystron oscillators, Magnetrons, Backward – Wave Oscillators – Microwave solid-state devices, Varactor diodes, Gunn diodes, impatt diodes, P - i - n diodes, etc., and their applications.

EE422 EM Waves and Antennas. **3 0 0 3**

Review of wave equation and its solution, polarization of waves, plane wave reflection and refraction at dielectric-dielectric and dielectric-conductor boundaries, total internal reflection.

Wave propagation in bounded media: Parallel-plate waveguides, rectangular waveguides and cylindrical waveguides.

Propagation in optical fibres.

Antennas: Potential functions, Analysis of elemental monopole and dipole antennas, Analysis of Antenna arrays, broadside, end fire, Yagi, frequency-independence antennas, log-periodic antennas, spiral antennas, Horn, Parabola and micro strip antennas.

Antenna equivalent circuits, Antenna directivity, Gain and Coupling, Impedance, Radiation patterns.

Practical design aspects of above antennas.

EE424 Image Signal Processing **3 0 0 3**

2-D / 3-D image representation. Time domain/frequency domain representation, correlation characteristics. Sampled data structures in 2-D/3-D representation.

PCM coding for image digitization. Redundancy in images and psycho – visual characteristic, IP and E techniques for image coding. Image coding without memory and with memory. DPCM, ADPCM, Block / Transform coding. Entropy coding, Enhancement/ Restoration techniques.

Image Analysis / Synthesis and image understanding techniques.

EE425 Fibre Optic Communication **3 0 0 3**

Optical guided medias. Slab wave-guide, rectangular wave-guide, cylindrical wave-guide. Polarization loss, disperson characteristics of the propagating media

Sources, LED, LASER, FIBRE lasers for optical communication through guided media.

Modulation techniques – Direct modulation and indirect modulation. Injection modulation, A/O, E/O modulation techniques.

Detection systems. PIN/APD detectors.

Optical communication systems. Analog and digital communication system. Low BW/LOW bit rate to Ultra-wide band/Ultra high bit rate communication systems.

Introduction to communication networks (LANs/MANs/WANs).

EE428 VLSI Design **3 0 0 3**

MOS structure. Threshold voltage, its correction by body bias and ion implantation. NMOS, PMOS, CMOS.

MOS IC technology: Masking steps in metal gate and silicon gate technologies.

Basic bipolar IC technology: Masking steps, component isolation techniques, problems of metal cross over.

Digital MOS circuits with saturated mode, triode mode and depletion mode loads and CMOS. Static and dynamic performance. b_R ratio, ratioless logic.

MOS Circuit design on the chip for given set of technology parameters and voltages. Effect of tolerances or spreads in V_{DD}, V_T, V_P, mobility and temperature design. Influence of "body effect" on design. Manufacturer's design rules, Circuit layout in metal gate and silicon gate technologies. Design using Lamda based design rules of Mead and Conway.

Pass transistor logic in NMOS and CMOS systems, Mapping from relay logic into silicon to evolve pass transistor logic, pass transistor ALU, tree network, multiplexer-demultiplexer circuits, selector logic, tally circuits, delays in pass transistor logic, use of level restoring inverters.

Driving large capacitive loads, ordinary buffer chain and super buffers.

EE

Two phase clocking schemes, gate capacitance as a temporary store and pass transistor shift registers. Register to register transfer, Structured design methodology of Mead and Conway.

Use of stick diagrams for design of topology of layout. MOS PLA's, their stick diagrams and layout, finite state machines.

Bottom up and top down design. Custom design. Various semicustom design approaches.

Choice of technology, I^2 L logic. Computer aids for design, logic simulation, circuit simulation, layout, VLSI testing.

Problems in going from LSI to VLSI. Scaling for VLSI.

EE429 Power Semiconductor Devices And Power IC's

Avalanche Breakdown voltage of plane and planar pn junctions. Breakdown voltage improvement Techniques.

High injection level effects in pn junctions. Forward voltage drop in high voltage PIN diodes , and its dependence on carrier lifetime.

Bipolar Power Transistor structures and characteristics. Current-gain, Switching operation, second breakdown and safe operating area. Overlay transistor.

Power MOSFET structure. I-V characteristics. On resistance, Minimum size chip design for specific drain breakdown voltage. Switching characteristics, Safe operating area.

Insulated Gate Transistor (IGT) – Structure, Operation principle, I-V characteristics and turn off transients, Latch up and its prevention.

Thyristor operation principles, Reverse and forward blocking voltage and forward conduction characteristics. Cathode shorted and Anode shorted Thyristor. di/dt and dv/dt ratings of thyristors, Triacs and GTO.

Power Integrated Circuit Problems and isolation techniques in HVIC's. Smart PIC's and HVIC's.

EE432 Digital Electronics **3 0 0 3**

Switching properties of semiconductor devices: Diodes, BJT, FET, switching characteristics and switching speeds.

Logic Families: Characteristics, current and voltage levels; Diode Transistor Logic, Transistor Logic, Emitter Coupled Logic, MOS gates.

Interfacing Logic Families.

EE

Analog-to-Digital conversion: Sampling theorem, quantization, different types of A/D converters, counter type, successive approximation type, dual-slope integration type, A/D Converter specifications and errors.

Digital-to-Analog conversion: Different types, weighted resistors type, R-2R ladder type, voltage to frequency converter type, Dual-slope integration type; D/A converter specifications and errors.

Semiconductor memories: Different types, access times, read-write cycles, interfacing dynamic RAMS, advanced memory concepts, Associative memory, cache memories, virtual memory, memory interleaving.

Applications of Digital ICs: 555 timers, voltage to frequency converters, monostable multivibrators.

Noise in Digital Systems: Grounding and shielding techniques, transmission lines.

EE433 Design of Control Systems **3 0 0 3**

Review of frequency response – Frequency domain specifications – Design of controllers for single loop systems in the frequency domain, lag, lead, lag-lead networks as compensators – Design of P, PDT, I , PI and PID controllers for first, second and third order systems – Control loop with auxiliary feedback – Feed forward control – Multivariable control.

Ziegler and Nichol's methods – Oppelt's method – State variable representation of control systems – Design using state variable feedback.

A.C. Carrier control systems.

EE434 Modern Control Theory **3 0 0 3**

Formulation of equations of a system – Linearization – Input – Output relations – State space methods – State transition matrix – Stability – Controllability, observability and transfer function.

Lyapunov's direct method – Sensitivity – Optimal control formulation – Calculus of variations – Performance indicies – Pontryagin's maximum principle – Time optimal control – Principle of optimality – Dynamic programming.

Pole placement – Quadratic performance index – Linear regulator problem.

EE435 Guidance and Control **3 0 0 3**

Classification of guidance systems – Beam riding guidance – Homing guidance – Command guidance – Navigational systems – Radio navigation – Inertial navigation – Principles of gyroscopes, accelerometers, Stable platforms – Schueler tuning and mechanization – strapdown INS – Control of aircraft and missiles, general principles.

EE436 Introduction To Robotics. **3 0 0 3**

Definition of robots – Areas for application of robots – Classification of robots and laws of robots – Robots as tele-operators and manipulators, Robotic grippers – Sensors for robots, robotic drives and controls, Computer control robots - Configuration of manipulator robots – Wrist and gripper configurations – Robot manipulators – Kinematics, dynamics, modeling, dynamic and recursive dynamic equations – Outline of principles of robot workspace and trajectory design.

EE437 Network Synthesis **3 0 0 3**

Positive real functions – Realization of two-element kind one-port networks – Brune synthesis – Properties of 2-port network functions – Synthesis of 2-ports – ladder development - Darlington synthesis – Realization of filters using operational amplifiers – Sensitivity.

EE438 Analog And Digital Filters **3 0 0 3**

Network functions of 1-port and 2-port networks. Positive real function. Properties and realization of d.p. functions of lossless and passive RC-networks.

Filter approximations. Butterworth, Chebyslev, Bessel and Elliptic approximations. Frequency transformation.

Realisation of passive 2-port networks. Ladder networks. Lattice networks, Darlington methods.

Active RC filters. Direct realization methods. Use of simulated inductance and FDNR elements. Realization with RC 1-ports and 2-ports. Cascade realization approach. Single amplifier and multiple amplifier biquads. State variable technique. Leapfrog simulation of ladder networks. Sensitivity Considerations.

Digital signals and systems and their analysis. Review of Z- transform techniques, Discrete Fourier transform. Introduction to FFT.

Design of FIR filters: Invariant impulse response and bilinear transformation. Frequency transformations.

Design of FIR filters: Design using Fourier series-window functions. Frequency sampling methods. Relative merits of IIR and FIR filters. Realization of digital filters. Direct and indirect realization. Lattice structures.

EE439 Applications Of Graph Theory To Networks. **3 0 0 3**

Basic concepts – Directed and undirected graphs – Trees, circuits, cutsets -

Planar and non-planar graphs – Matrix representation of graph – Incidence, circuit and cutest matrices – Application to electrical network analysis and synthesis - Topological formulae for network functions – Applications to passive and active networks – Algorithms for enumeration of trees and 2-trees – Transportation and flow networks – Capacity matrices and properties – Maximum flow – Application of graph theory to various network problems.

EE442 Design and Layout of Power Apparatus and Systems **3 0 0 3**

Industrial power supply system configurations and components, preparation and analysis of typical layout diagrams for electric motor drives; design principles of electric machines including transformers – Short circuit calculations, design aspects of transmission line supports, design principles of power distribution systems, substation layouts.

EE443 Power System Operation and Control **3 0 0 3**

Basic concept of load dispatch centers, Functions of Energy Management Centres, Energy Management Systems, System states, Computer Control of Power Systems – AGC, ELD.

Reactive Power Management – Power Loss Minimization.

Emergency and Restoration Procedures, Interchange Scheduling and Costing.

EE444 Power System Analysis **3 0 0 3**

Representation of power systems and power system components – Network model formulation – Matrix notation – Construction of network admittance and impedance matrices in the bus frame of reference.

Load – Flow studies – Formulation of the problem and its solution with digital computers using iterative techniques – Gauss-Seidel and Newton-Raphson methods – Decoupled and Fast-Decoupled Load flow analysis – DC load flow analysis.

Economic operation of power systems – Optimal generation scheduling between units of a power plant – Unit commitment – Optimal generation scheduling between the power plants of a power system using Transmission line losses – Concept of Energy Management Centre.

EE

Short-circuit studies – Importance of the problem – Symmetrical and unsymmetrical faults in a power system – Fault analysis using bus impedance matrices of power networks.

Introduction to Power System Stability Analysis.

EE446 EHV AC and DC Power Transmission **3 0 0 3**

Basic design aspects of EHV AC and DC lines, transmission line models for steady-state and transient studies – AC transmission systems, series compensation, shunt compensation. Concepts of high phase order transmission – Flexible AC transmission and compact lines.
HVDC transmission systems, Comparison of AC and DC transmission systems, HVDC converters and their control, harmonics and filters, Multiterminal DC systems.

EE447 Computer Methods in Electrical Engineering **3 0 0 3**

Concept of Analog and Digital Simulation of Systems – Analog computers, solution of ordinary differential equations – Scaling, Simulation of Transfer Functions.
Digital computation – approximation and Errors, system of Linear Algebraic Equations – Gauss Elimination, LU, LDLT decomposition – Iteration Method. Roots of Equations, Solution of Ordinary differential equations – One-step and multi-step methods – Boundary value and Eigen value Problems. Partial Differential Equation, Introduction to Finite Element Methods.
Characteristic Equation, Eigen value and Eigen-vector Computations.

EE448 Solid State Drives **3 0 0 3**

Principles of electric drives – torque speed characteristic of D.C motors fed from phase-controlled converters. Chopper fed D.C. Drives.
Induction motor drives – variable frequency operation, slip energy recovery schemes, chopper controlled rotor resistance.

EE452 Electromechanical Energy Conversion II **3 0 0 3**

Transformers: Polyphase connections, 3-winding Transformers. HVDC transformers, Parallel operation. On-load tap changing. Transient phenomena and their effects. Effects of saturation / nonlinearities. Principles of design of transformers.
D.C. Machines: Armature reaction and commutation phenomena. Parallel operation of DC generators, 4-quadrant operation. Brushless, commutatorless DC machines including permanent magnet machines. Principle of design.
Induction Machines: Methods of speed control and braking, unbalanced operation, Self-excited induction generator. Effect of space and time harmonics on induction motor performance.
Synchronous machines: Operation on infinite bus bars and capability chart. Sudden short circuit of an alternator. Starting of synchronous motors. Speed control, Two-axis theory.
Basic concept of design of polyphase synchronous and induction machines.
Small electrical machines.

EE454 Power System Protection and Switchgear **3 0 0 3**

EE

Protection: Importance of protective relaying in power systems – Fundamental requirements of a good protection scheme – Primary and Back-up Relaying.

Classification of Relays- Constructional (viz., Electro mechanical and Static Relays) and Functional viz., Overcurrent, Directional, Differential, Distance Relays etc. Their principles and applications.

Current trends in Protective Relaying – Microprocessor and PC based relaying.

Switchgear: Classification of Switchgear – Fault Analysis – Symmetrical Faults on a synchronous machine – Fault clearing process – Arching phenomena and principles of arc interruption – AC and DC circuit breakers – Different types of circuit breakers and their constructional features – Testing and Selection of circuit breakers.

EN 210 Electrical Science **1 0 3 2**

Transofrmers : Polarity test - equivelent circuit - open circuit and short circuit tests - regulation - efficienty - single phase and three phase.

Induction machines : Performance calculation - equivelent circuit - OC and SC test - loses - efficiency.

Synchronous Machines : Equivalent circuit of an alternator - pre determining regulation by emf method - OC and SC tests.

DC Machines : Types of dc machines - OCC - load tests - dc motors - Speed conrrol losses and efficientcy.

Electrical Measurement : Current, Voltage, power and energy measurement.

Analog Electronics : Rectifiers - Filters - application of operational amplifiers.

Digital Electronics : Combinational and sequential logic circuits - counters - timer - shift registers.

A/D and D/A Converters : Sampling theoram - Digital multimeters - sample and hold circuits.

Text Books :

1. Introduction to Electrical Engineering - C.R. Paul, S.A. Nasar and L.E. Unneweher, Mc Graw Hil, 2001.
2.Principles of Electrical Engineering - Del Toro, Vincent, Prentice Hall, 1985.

Reference :

1. Performance and Design of AC Machines - MG Say, ElBS & Pitman, 1986
2. Electronic Principles - Albert Paul Malviono, Mc Graw Hill, 1999
3. A User's Handbook of D/A and A/D converters - Hnatek, Eugene R, Wiley, 1976.
4. Electronic Instrumentation and Measurement Techniques - William David Cooper and Albert D Herlfrick, Prentice Hall, 1990.

5.2.7 Engineering Physics

Semester IV

EP211 INTRODUCTION TO MATHEMATICAL PHYSICS **3 0 0 3**

Scalars, Vectors and tensors in index notation. Kronecker and Levi-Civita tensors. Del and Laplacian operators. Vector calculus in Index notation.

Dirac delta function, representation and properties. Linear vector spaces Dual space. Bra and ket notation. Basis sets. Orthogonality and completeness. Hilbert space. Linear operators. Self – adjoint and unitary operators.

Families of orthogonal polynomials as basis sets in function space, Legendre, Hermite, Laguerre, Chebyshev and Gegenbauer polynomials, Generating functions, Expansion of functions. Inversion formulas.

Ratotation group in 2 and 3 dimensions. Pauli matrices. Generators of rotations.

Fourier series and Fourier transforms, Fourier expansion and inversion formulas, convolution theorem.

Elements of analytic function theory, Cauchy-Riemann conditions, Cauchy's integral theorem and integral formula, Singularities-polesand essential singularities, residue theorem and contour integration.

Occurrence of laplace, Poisson, Helmholtz wave and diffusion equations in physical applications, Elementary properties of these equations and their solutions.

References :

1. *G. Arfken, Mathematical Method for Physicists (5th Edition) (Academic Press, 2000).*
2. *L.A. Pipes and L.R. Harwell, Applied Mathematics for Engineers (Dover, 1990).*
3. *B. Friedman, Principles and Techniques of Applied Mathematics (Dover, 1990).*
4. *D.W. Lewis, Matrix Theory (Allied Publishers, 1991).*
5. *K.F. Riley, M.P. Hobson and S.J. Bence, Mathematical Methods for Physics and engineering (Cambride Univ., Press, 1998)*
6. *MP. Boas, Mathematical Methods in the Physical Sciences (2nd Edition) Wiley, 1983).*

EP 214 HIGH VACUUM SCIENCE & TECHNOLOGY **3 0 0 3**

Nature and behaviour of gases at low pressures – Gas laws – Kinetic theory of gases – Gas flow viscous and molecular flow – Pumping speed and conductance – Measurement of pressure in vacuum systems – Mc Leod, thermal conductivity and ionization gauges – Mass spectrometer. Production of Vacuum – Types of Pumps: Rotary and Diffusion pumps, Cryo Pumps, Ion pumps, Turbomolecular pumps. Materials used in Vacuum Technology

References:

1. *A. Roth, Vacuum Technology, North Holland Publishing Company, Amsterdam (1976).*
2. *V.V. Rao, T.B. Ghosh, K L Chopra, Vacuum Science and Technology, Allied Publishers Ltd., New Delhi (1998).*

Semester V

EP 221 PRINCIPLES OF QUANTUM MECHANICS 3 0 0 3

Postulates of quantum mechanics. Linear spaces, state vectors. Probability amplitudes, probability interpretation. Schrodinger equation. Physical observables and operators. Eigenstates and eigenvalues. Expectation values of observables. Hermitian and unitary operators. Generalized uncertainty relations. Stationary states. Orthonormal basis sets. Expansions in complete sets of states. Position and momentum representations. Wavefunctions. Schrodinger equation for a particle in the position representation. Probability densities, normalization. Bound states and scattering states of a particle.

One-dimensional potentials. Particle in a box. Linear harmonic oscillator – energy eigenvalues and eigenstates using the operator method.

Charged particle in a uniform magnetic field. Landau levels.

Motion in a central potential. Orbital angular momemtum. Hydrogen atom – energy levels, degeneracy.

Eigenvalues and eigenstates of angular momentum. Spin. Pauli matrices.

References:

1. *E. Merzbacher, Quantum Mechanics, 2nd Edition, Wiley International Student Edition.(1970).*
2. *S. Gasiorowicz, Quantum Physics, 2nd Edition, Wiley and Sons (1996).*
3. *J.J. Sakurai, Modern Quantum Mechanics, Revised Edition, Addison-Wesley International Student Edition (1994).*

EP310 ATOMIC AND MOLECULAR SPECTROSCOPY 3 0 0 3

The Electromagnetic Spectrum. The spectrum of Hydrogen And Sodium Atoms. X-ray Spectra. Selection Rules. Fine Structure in Alkali-Metal Spectra/Electron Spin. Stern-Gerlach Experiment. Spin-Orbit Coupling. Vector Coupling of Angular Momenta Helium atom spectrum/Schrodinger Equation for an electron in a central field. First Order Perturbation Theory – Non-degenerate and Degenerate. Zeeman effect. Normal and anomalous Zeeman Effect. Lande's Spectroscopic Splitting Factor. Paschen-Back Effect. Stark Effect of Hydrogen Ground State and Excited States/Time-dependent Schrodinger Equation – Fermi Golden Rule, Einstein A and B Coefficients, Transition Rates, Population Inversion, Lasers.

Nature of the Chemical Bond – Ionic, Covalent, Van-der Waals, Hydrogen Bond. Diatomic Molecules. Schrodinger Equation for a rigid rotator.. Molecular Spectra. Rotational Spectra. Ro-Vibrational Spectra. Electronic Spectra of Molecules. Raman Effect.

Introduction to NMR. Relaxation Times. Chemical Shifts. Biomolecular Spectroscopy.

Introduction to Quantum Statistics. Bose-Einstein condensation. Laser trapping of atoms.

References:

1. *H.E. White, Introduction to Atomic Spectra, McGraw Hill, Kogakusha, Tokyo (1934).*
2. *T.A. Littlefield, N. Thorley: Atomic & Nuclear Physics, ELBS & Van Nostrand Reinhold Co., London (1968).*
3. *R. Eisberg & R. Resnick, Quantum Physics of Atoms, Molecules, Solids, Nuclei & Particles, John Wiley, New York (1974).*

EP311 ELECTROMAGNETICS AND APPLICATIONS 3 0 0 3

Application of Maxwell's equations, boundary conditions, reflection and refraction of electromagnetic waves at the boundary of two non-conducting media for normal and oblique incidence. Reflection from a conducting plane.

Propagation between parallel conducting plates. Wave guides and cavity resonators.

Radiation from an oscillating electric dipole and a half wave antenna. Eddy currents, Thermo-electric and thermo-magnetic phenomena Hall effect./ Scattering and dispersion

References

1. *J.R. Reitz & F.J. Milford, Foundations of electromagnetic theory, Addison-Wesley, London (1967).*
2. *R.K. Wangsness, Electromagnetic fields, John Wiley & Sons, New York (1979).*
3. *Yu.V. Novozhilov & Yu.A. Yappa, Electrodynamics, Mir Publishers, Moscow (1981).*
4. *P. Mukhopadhyay, Electromagnetic theory and applications, Tata Mcgraw-Hill, New Delhi (1993).*

EP 312 STATISTICAL PHYSICS AND APPLICATIONS **3 0 0 3**

Partition function and calculation of thermodynamic quantities in canonical and grandcanonical ensembles. Fluctuation in energy and number of particles.

Bose-Einstein and Fermi-Dirac statistics. Application to semiconductors, Pauli paramagnetism, Debye theory of specific heat. Examples of first order and continuous phase transitions. Mean field (van der Waals and Weiss)

Theories/Ising model and binary alloys, Bragg-Williams approximation/Brownian motion, Langevin equation, Fluctuation-dissipation theorem, Markov processes, Master equation, Fokker-Planck equation.

References

1. *K. Huang, Statistical Mechanics, Wiley Eastern, New York (1987).*
2. *M. Plischke & B. Bergersen, Equilibrium Statistical Physics, Prentice-Hall, New Jersey (1989).*
3. *F. Reif, Fundamentals of Statistical and Thermal Physics, McGraw-Hill, New York (1965).*

EP 319 ENGINEERING PHYSICS LAB I **0 0 3 1**

1. Regulated Power Supply
2. Operational amplifier
3. Instrumentation amplifier
4. Hall effect
5. Young's modulus by elliptic/hyperbolic fringes
6. Rigidity modulus by torsional oscillations
7. Viscosity by capillary flow
8. Surface tension and angle of contact
9. Latent heat of liquid nitrogen
10. McLeod Gauge

References:

1. *B.L. Worsnop and HT Flint, Advanced Practical Physics for Students, Methuren and Co., London (1950).*
2. *E.V. Smith – Manual for Experiments in Applied Physics, Butterworths, London (1970).*
3. *R.A. Dunlop, Experimental Physics, Modern Methods, Oxford University Press, New York (1988).*

Semester VI

EP 322 PHYSICS AND TECHNOLOGY OF MATERIALS **3 0 0 3**

Crystalline and noncrystalline materials – crystal symmetry – point groups, bravais lattices and space groups – crystal systems – Miller indices – hexagonal close packed, diamond, alkali holide, zinc sulphide and cesium chloride structures – reciprocal lattice – bonding in solids – liquid crystals – quasi crystals.

Imperfections in crystals – vacancies and inter-stitials solids – F centers – impurity atoms – edge and screw dislocations – planar defects and surfaces – diffusion in solids – Alloys and solid solution – phase diagrams – phase rule – phase transformation – Stress-strain curve and ctibical sheer stress – toughness – hardness – creep, fatigue and fracture – superalloys – Lattice vibrations – phonons – Debye theory of specific heets – Thermal expansion and thermal conductivity.

Free electrons in solids – Drude expression for electrical conductivity and Ohm's Law – Wiedemann – Franz law – electronic specific heat of metals – periodic potential and band structure – Brillouin zones – metals, insulators and semiconductors – effective mass and holes in semiconductors – carrier equilibrium in intrinsic and doped semiconductors – Hall effect – pn junction – superconductors.

Dielectrics – polarization mechanisms – internal electric field –Clausius – Mossottirelation – Dielectric loss – ferroelectrics.

Para, dia and ferromagnetism – Curie Weiss law and molecular field – exchange interactions – hysteresis loop – domains – hard and soft magnets – ferrites – antiferromagnetism.

Reflection, scattering, refraction and transmission of light through media – optical properties of metals – luminescence – lasers and optical fibres .

Polymer, ceramics and composites.

References:

1. *A.J. Dekker, Electrical Engineering Materials, Prentice Hall, Englewood Cliffs (1958).*
2. *Kittel, Introduction to Solid State Physics, 7th Edition, Wiley Eastern Ltd., New Delhi (1996).*
3. *John Wulff, The structure and properties of Materials, in 4 volumes, Wiley Eastern Ltd., New Delhi (1965).*
4. *Van Vlack, Materials Science for Engineers, Addison Wesley, New York (1985).*

EP 329 ENGINEERING PHYSICS LAB II **0 0 3 1**

1. Fourier analysis of signals
2. Lock in amplifier
3. Timer
4. Thermal conductivity – Lee's disc method
5. B-H loop of a ferromagnetic material
6. Ultrasonic diffraction
7. Michelson interferometer
8. Fabry-Perotetalon
9. Pirani gauge

References:

1. *B.L. Worsnop and HT Flint, Advanced Practical Physics for Students, Methuen and Co., London (1950).*
2. *E.V. Smith – Manual for Experiments in Applied Physics, Butterworths, London (1970).*
3. *R.A. Dunlop, Experimental Physics, Modern Methods, Oxford University Press, New York (1988).*

EP 361 Industrial Training (Summer) **0 0 6 2**

Semester VII

EP 419 ENGINEERIGN PHYSICS LAB III **0 0 6 2**

1. X-ray powder diffraction
2. Magnetic susceptibility – Guoy method
3. Optical absorption
4. Triple point of argon
5. Thickness of films
6. Microwave Bridge
7. Capacitance bridge
8. GM counter
9. Thermoluminescence
10. Magnetic resonance

References:

1. *B.L. Worsnop and HT Flint, Advanced Practical Physics for Students, Methuren and Co., London (1950).*
2. *E.V. Smith – Manual for Experiments in Applied Physics, Butterworths, London (1970).*
3. *R.A. Dunlop, Experimental Physics, Modern Methods, Oxford University Press, New York (1988).*

EP

EP 414 Project I **1**

Semester VIII

IL402 Industrial Lecture **0 0 3 1**

EP 416 Project II **7**

EP 404 Seminar **1**

Electives:

EP214 High Vacuum Science & Technology **3 0 0 3**

Nature and behaviour of gases at low pressures – Gas laws – Kinetic theory of gases – Gas flow viscous and molecular flow – Pumping speed and conductance – Measurement of pressure in vacuum systems – Mc Leod, thermal conductivity and ionization gauges – Mass spectrometer. Production of Vacuum – Types of Pumps: Rotary and Diffusion pumps, Cryo Pumps, Ion pumps, Turbomolecular pumps. Materials used in Vacuum Technology

References:

1. *A. Roth, Vacuum Technology, North Holland Publishing Company, Amsterdam (1976).*
2. *V.V. Rao, T.B. Ghosh, K L Chopra, Vacuum Science and Technology, Allied Publishers Ltd., New Delhi (1998).*

EP 314 Quantum Electronics & Applications **3 0 0 3**

Quantum description of radiation field – second quantization of electromagnetic field – photons. Photon counting experiments and photon counting distributions for various states radiation fields: thermal light, ideal laser light, coherent states etc. The use of coherent states to describe radiation field.

Atom – radiation field interactions – semiclassical and quantum description – fluorescence, parametric amplification, superradiance and ideal laser. Laser systems – Ruby laser, He-Ne laser and Co_2 laser.

Use of quantum states of radiation for statistical detection and informational entropy. Decision among a finite number of linearly independent pure states; communication with thermal and coherent states – noiseless channels, rate-distortion.

Reference Books:

1. *Quantum Electronics, A Yariv, John Wiley & Sons, 4th Edition (1999).*
2. *Introduction to Photon communication, C Bendjaballah, Springer (1995).*

EP 315 Physics for Surfaces & Interfaces 3 0 0 3

Introduction to surfaces and interfaces – Formation of clean, "well-defined" surfaces – Different techniques – Importance of UHV for surface studies.

Thermodynamic aspects: Surface tension and macroscopic shape, surface and interface free energies, Wulff plot – Surface structure: 2D Bravias lattices and point groups, ideal and real crystal surfaces, reconstruction and superlattices, 2D reciprocal lattices – Surface defect structures, dislocations and other defect structures – surface sites and adsorbate structures – Wood's and Matrix notations.

Surfaces and growing interfaces: Thermodynamic and kinetic considerations – Nucleation and Growth of thin films – Volmer-Weber (VW), Frank-van der Merve (FM), Stransky-Krastanov (SK) and Columnar growth modes, Epitaxy, Commensurability, Lattice Strain and Incoherence.

Introduction to Fractals and scaling – Rough and smooth surfaces – Theoretical considerations of growing interfaces – Discrete growth models: Random and Ballistic deposition models,, Eden model, Diffusion limited aggregation and Solid-on-solid mdels.

Introduction to linear and non-linear theoretical descriptions (the Edwards-Weilkinson (EW) equation and the Kardar-Parisi-Zhang (KPZ) equation).

Metal-Metal and Metal-Semiconductor Interface – Schottky contacts: ideal and real characteristics, Intrinsic and extrinsic defects at the interface – Surface phenomena in semiconductors: surface states, Tamm levels, surface space-charges and band bending, depletion, inversion and enrichment layers, MOS devices.

Introduction to surface characterization techniques – FIM, SPM, Ellipsometry, Optical and Electron microscopes (SEM, TEM), LEED, RHEED, XPS, AES, SIMS and RBS.

References:

1. *M. Prutton, Surface physics, Clarendon Press, Oxford (1983).*
2. *Andrew Zangwill, Physics at Surfaces, Cambridge University Press (1988).*
3. *Hans Luth, Solid Surfaces, Interfaces and Thin Films, Springer-Verlag, New York (2001).*
4. *Winfried Monch, Semiconductor Surfaces and Interfaces (Revised), Vol. 26, Springer-Verlog, New York (2001).*
5. *A.L. Barabasi and H.E. Stanley, Fractal Concepts in Surface Growth, Cambridge University Press, Cambridge (1995).*
6. *S.M. Sze, Physics of Semiconductor Devices, 2nd edn., Wiley New York (1981).*

EP

5.2.8 Department of Mechanical Engineering

Semester III

ME 205 Machine Drawing Practice **1 0 6 3**

ME

Advanced assembly drawings, detailed manufacturing drawing, specifications like fits and tolerances, surface finish, welding symbols, production methods. Introduction to functional design.

1. References :

i. Luzadder. W.J., Fundamentals of Engineering Drawing, Prentice Hall India, 1990.

ii. French and Vierk., Fundamentals of Engineering Drawing, McGraw Hill, 1996.

iii. Narayana.K.L. & Kannaiah.P., Engineering Drawing, Charotar Publishing House, 1998.

iv. Bhatt.N.D., Engineering Drawing, New Age International, 2000.

AM220 Strength Of Materials **3 1 0 4**

Analysis of stress and strain – Hook's law – Relation between elastic constants – Bending stress and shearing stress distribution in beams Torsion of circular cross section – Transformation of stresses – Principal stresses and principle strains – Mohr's circle – Strain Rosettes – Deflection of beams by successive integration method and moment area method – Thin walled pressure vessels. Elastic instability – Euler formula.

Semester IV

AM253 Foundations of Fluid Mechanics **3 1 0 4**

Fluid continuum – Properties of fluids – Methods of describing fluid motion – Kinematics of fluid streamlines, streak lines, path lines – equation of Continuity, Euler's equations of motion – Navier Strokes equations.

Hydrostatics – Manometry – Fluid force on planes and curved surfaces, submerged and floating bodies – stability of submerged and floating bodies – Aerostatics – variation of pressure, temperature and density with altitude – stability of atmosphere – Relative equilibrium – Fluids subjected to uniform linear acceleration and uniform rotation.

Analysis of fluid motion in integral form – Concept of a system and a control volume – equations of continuity, energy, linear momentum and angular momentum as applied to a control volume in fluid flow and their applications to propellers, cascades and pumps and turbines.

Dimensional analysis, similitude and model testing – Laminar and turbulent flows – Viscous effects – Boundary layer – Separation phenomena – Losses in pipes and minor features.

Hydrodynamics – Two dimensional ideal fluid motion, stream function and potential functions – Source, sink, vortex and double flows – flow around a circular cylinder with and without circulation – transformation of a circular cylinder to an aerofoil – aerofoil characteristics- Effects of viscosity.

ME

AM254 Applied Mechanics Laboratory **0 0 3 1**

Laminar and turbulent flow – Venturi principle – Friction coefficients in pipe flow – Flow visualization – Measuring instruments to measure velocity and pressure in fluid flow – Measurement of pressure distribution over body contour – Experiments designed to cover the above.

Mechanical extensometers – Uniaxial tension – Diffractogauge – Deflection and bending stress in beams – Spring constants – impact test – Stress concentration – Photoelasticity – Experiments designed to cover the above.

AM271 Dynamics Of Machinery **3 1 0 4**

Kinematics of machinery, Definition, condition of constrained motion, inversion, Velocity and acceleration diagrams of machines – Instantaneous center Theory of cams – Theory of Gears and gear trains.

ME 224 Instrumentation and Control **4 0 0 4**

Sensitivity, linearity and resolution of instruments; Uncertainty of measurements; Signal conditioners - bridge circuits, amplifiers and filters.; Measurement of displacement, velocity, acceleration, force, torque, pressure, flow, temperature, and level.

Classification of control systems; Block diagram representation and reductions; Mathematical background and mathematical model of physical systems; Time domain analysis, transient response and stability; Frequency response methods, polar plot, bode diagrams, Nyquist stability criteria, relative stability; Controllers

1. References :

i. Beckwith, T.G. and Buck, N.L., Mechanical Measurements, Addison Wesley, 1965.

ii. Holman, J.P., Experimental Methods for Engineers, McGraw Hill, 1966.

iii. Raman, R., Elements of Precision Engineering, Oxford and IBH, 1984.

iv. Sawhney, A.K., A course in Mechanical Measurements and Instrumentation, Dhanpat Rai, 1984.
v. Doebelin, E.O., Measurement Systems Application and Design, McGraw Hill, 1990.
vi. Ogata K., Modern Control Engineering, Prentice Hall, 1992.
vii. Dorf, R.C., Modern Control Systems, Seventh Edition, Addison-Wesley, 1995.
viii. Kuo, B.C. Automatic Control Systems, Sixth Edition, Prentice Hall India, 1996.
Raman, R., Principles of Mechanical Measurements, Oxford & IBH, 1997.

ME 226 Materials and Design **3 1 0 4**

Structure-Property correlation and its evolution in engineering materials. Heat Treatment, Mechanical Behaviour of Engineering Materials-Tensile, Compression, Torsion, Bending, Hardness, Impact, Fracture, Fatigue, and Creep. Measurement of Mechanical Properties. Design for Static and Dynamic Loading - Failure Theories, Buckling, Fatigue, Impact and Creep. Applications in Mechanical Design

1. References :

i. Dieter G.E., Mechanical Metallurgy, McGraw Hill, Metric Edition, 1988
ii. J.E. Shigley and S.R. Mischke, Mechanical Engineering Design, McGraw Hill, 1989
iii. Dieter G.E., Engineering Design, II Edition, McGraw Hill, 1991
iv. Ashby, M.F. Materials Selection in Mechanical Design, Pergaman Press, 1992.
v. Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
vi. R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998

ME 228 Manufacturing Technology **4 0 0 4**

Methods of manufacture – metal casting, metal forming and metal joining: Basic Principles, Processes, equipment, process variables; Basic methods of manufacture of plastics, ceramics and composite parts;

Non Traditional manufacturing processes – Basic Principles, features of equipment, process variables – Mechanical, thermo-mechanical, Thermo-electrical, Chemical, thermo-chemical and hybrid processes.

1. References :

i. Herman W. Pollack, Manufacturing and Machine Tool Operations, Prentice Hall, 1968.
ii. Benedict, G.F., Non-Traditional Manufacturing Processes, Marcel, 1987.
iii. McGeough, J.A., Advanced Methods of Machining, Chapman and Hall, 1988.
iv. Lindberg, R.A., Processes and Materials of Manufacture, Prentice Hall India, 1990.

v. Chapman, W.A.J. Workshop Technology, Edward Arnold, 1990. Kalpakjian, S., Manufacturing Engineering and Technology, Addison Wesley, 1995.

Semester V

ME317 Heat Trasnfer **3 1 0 4**

Introduction – Steady State Conduction in one and two-dimensional systems – One dimensional unsteady state conduction; analytical and numerical methods

Convection: Basic equations, Boundary layers; Forced convection: External and internal flows, correlations , Natural convection

Radiation heat transfer: Basic laws, Properties of surfaces, view factors, network method and enclosure analysis for gray – diffuse enclosures containing transparent media, Engineering treatment of gas radiation

Boiling and condensation

Analysis of heat exchangers

1. References :

i. A.Bejan, Heat Transfer John Wiley, 1993
ii. J.P.Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
iii. F.P.Incropera, and D.P.Dewitt, Fundamentals of Heat & Mass Transfer, John Wiley, Fourth Edition, 1998.
iv. Massoud Kaviany, Principles of Heat Transfer, John Wiley, 2002
v. Yunus A Cengel, Heat Transfer: A Practical Approach, McGraw Hill, 2002

ME 319 Machining and Metrology **4 0 0 4**

Principles of Metal cutting – orthogonal and oblique cutting; Shaping, turning, drilling, milling – Machine Tools and their working – Process variables; Cutting tools – Nomenclature, Tool life; Abrasive machining processes – grinding, honing, lapping, burnishing and super finishing – Equipment, process variables and surface features; Surface integrity concepts.

Introduction to NC and CNC – Concepts and programming – Constructional features of various machine tools: Introduction to CIM.

Fundamentals of Measurement, Errors, Length Standards, Gauging, Comparators, Fits and Tolerances; Role of metrology in quality assurance; Linear and angular measurements; Optical metrology and laser

interferometry; Slip gauges; Form measurements – Flatness, Straightness, Form errors; Surface finish measurements; Coordinate measuring machines; Vision applications in Metrology; Nano measurements.

1. References :

i. *Hume, K.J., Engineering Metrology, Macdonald, 1960.*

ii. *Parsons, S.A.J. – Metrology and Gauging, Macdonald and Evans, 1964.*

iii. *Thomas, G.G., Engineering Metrology, Butterworth, 1974.*

iv. *Yoram Koren, Computer control of manufacturing Systems, Mc Graw Hill, 1983.*

v. *Anthony, D.M. Engineering Metrology, Pergamon Press, First Edition, 1986.*

vi. *Boothroyd. G., Fundamentals of Machining and Machine Tools, Marcel Dekker, 1989.*

vii. *Shotbolt, C.S. and Galyer. J. Metrology for Engineers, Cassell Publ., Fifth Edition, 1990.*

viii. *Milton C. Shaw, Principles of Metal Cutting, Clarendon Press, 2004*

ME 327 Mechanical Engineering Laboratory - I **0 0 3 1**

Measurement of temperature, Calibration of Bourdon pressure gauge, Measurement of outside ambient conditions and air movement in an air conditioned space, Flow measurement using a Pitot tube, Speed and torque measurement, Thermal conductivity comparator, Boiling experiment, Radiation experiment, Measurement of flow using a ring balance flow meter, Calibration of wedge probe, Measurement of friction.

ME329 Machine Tool and Metrology Laboratory **0 0 3 1**

Study of various machine tools their operational details and attachments.

Study and use of various measuring instruments - length, angle, surface finish and thread measurements.

ME 331 Turbomachines **3 0 0 3**

Definition and classification of turbomachines; Principles of operation; Specific work – its representation on T-s and h-s diagrams; Losses and efficiencies; Energy transfer in turbomachines; Flow mechanism through the impeller – velocity triangles – ideal and actual flows – slip and its estimation; Degree of reaction – impulse and reaction stages; Significance of impeller vane angle; Similarity; Specific speed and shape number.

Steam turbines – flow through nozzles – compounding – effect of wetness in steam turbines; Gas turbines; Hydraulic turbines – Pelton, Francis and Kaplan turbines – draft tube – performance and regulation of hydraulic turbines; Cavitation in pumps and turbines; Performance characteristics of pumps and blowers – affinity laws – regulation; Wind turbines; Fluid couplings and torque converters; Unconventional turbomachines – Wells turbine, reversible turbines and new cross flow machines.

1. References :

i. *Shepherd, D. G., Principles of Turbomachinery, Macmillan, 1956.*

ii. *Jagdish Lal, Hydraulic Machines, Sixth Edition, Metropolitan Book, 1975.*

iii. *Cherkassky, V. M., Pumps, Fans and Compressors, Mir Publishers, 1980.*

iv. *Sayers, A.T.,Hydraulic and Compressible Flow Turbomachines, McGraw Hill, 1990.*

v. *Kadambi, V. and Manohar Prasad, An Introduction to Energy Conversion Vol. III: Turbomachinery, Seventh Reprint, Wiley Eastern, 1997.*

vi. *Gopalakrishnan, G. and D. Prithvi Raj, A Treatise on Turbomachines, Scitech Publications, 2002.*

vii. *Vasandani, V.P., Hydraulic Machines: Theory and Design, Tenth Edition, Khanna Publishers, 1992.*

viii. *Wright,T., Fluid Machinery:Performance, Analysis and Design, CRC Press, 1998.*

ME 333 Internal Combustion Engines **3 0 0 3**

Working principle and classification, ideal and actual cycles of operation: Fuels, Combustion thermodynamics, stoichiometry, first, second and third Laws of Thermodynamics applied to combustion, Combustion in SI and CI engines and combustion chambers, mixture preparation in SI and CI engines, ignition, lubrication and cooling systems, exhaust emissions, and control, test cycle and emission standards, supercharging and turbo charging, engine testing, recent developments including electronic monitoring and control of engines.

1. References :

i. *Obert, E.F., Internal Combustion Engines and Air Pollution, Harper & Row, 1973.*

ii. *Jones, J.B. and Hawkins, G.A., Engineering Thermodynamics, John Wiley, 1986.*

iii. *Heywood, J.B., Internal Combustion Engine Fundamentals, McGraw Hill, 1989.*

iv. *Stone, R., Introduction to Internal Combustion Engines, Macmillan, 1992.*

v. Mathur M.L. and Sharma, R.P., A Course in Internal Combustion Engines, Dhanpat Rai, 1993
vi. Heisler, H., Advanced Engine Technology, Edward Arnold, 1995.
vii. Ganesan, V., Internal Combustion Engines, Tata McGraw-Hill, 2003.

ME 335 Design of Machine Elements **3 1 0 4**

Design considerations - limits, fits and standardisation.

Design of shafts under static and fatigue loadings. Design of springs-helical compression, tension, torsional and leaf springs. Design of joints – threaded fasteners, pre loaded bolt joints, welded and glued joints. Analysis and design of sliding and rolling contact bearings. Analysis and applications of power screws and couplings. Analysis of clutches and brakes. Design of belt, and chain drives. Design of spur, helical, bevel and worm gears.

1. References :

i. Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.
ii. Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.
iii. Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
iv. Spottes, M.F., Design of Machine elements, Prentice-Hall India, 1994.
v. R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998

Semester VI

ME 325 Refrigeration and Air Conditioning **3 0 0 3**

Methods of Refrigeration - Vapour Compression cycle - Thermodynamic analysis - Compressors, Condensers, Expansion devices and Evaporators – Refrigerants and their mixtures: properties and characteristics - Ozone depletion and global warming issues - Performance matching of components of refrigeration systems

Vapour absorption refrigeration systems - Thermodynamic analysis - Refrigerant-absorbent combinations.

Psychrometry - Properties of air and water vapour mixture - Air-conditioning processes - Concept of enthalpy potential - Cooling towers, Evaporative condensers, Air washers, Cooling and dehumidifying coils - Comfort air-conditioning - Cooling load calculations.

1. References :

i. Gosney W.B, Principles of Refrigeration, Cambridge University Press, 1982.
ii. Stoecker, W.F., and Jones, J.W., Refrigeration and Airconditioning, Tata McGraw Hill, 1986.
iii. Arora, C.P., Refrigeration and Airconditioning, Tata McGraw Hill, Second Edition, 2000.

ME 326 Thermal Power Engineering **3 0 0 3**

Energy sources and scenario – Power Plant Cycles – Reheat – Regenerative – Supercritical -Coupled and combined – Cogeneration Plants, Exergy analysis of power plant cycles

Solid fuels and combustion, Fluidized bed combustion

Analysis and sizing of Power Plant Components: Steam generator, Condenser, Cooling tower and other heat exchangers.

Principles of Nuclear Energy – Nuclear Power Plants

Power plant economics - Recent trends in power production.

1. References :

i. R.W.Haywood, Analysis of Engineering Cycles, Pergamon Press, 1975
ii. A.W.Culp, Principles of Energy Conversion, McGraw Hill, 1979.
iii. M.M.Elwakil, Power Plant Technology, McGraw Hill, 1984.
iv. J.Weisman, and R.Eckart, Modern Power Plant Engineering, Prentice Hall, 1985
v. T.D.Eastop and A.McConkey, Applied Thermodynamics, ELBS, 1986.
vi. P.K.Nag, Power Plant Engineering, Tata McGraw Hill, 2002

ME328 Mechanical Engineering Laboratory - II **0 0 3 1**

Experiments on I.C. Engines, Steam power system, Centrifugal blower, Pumps/ Turbines, Refrigeration and airconditioning, Precision engineering, M/C Design elements and Enmasse conveyor.

ME330 Control and Manufacturing Technology Laboratory **0 0 3 1**

Experiments in pneumatic control loop simulator. Experiments and demonstration of EDM. Ultrasonic, ECM, Abrasive jet machining. Superfinishing, lapping etc.

ME 350 Industrial Training **0 0 0 2**

Semester VII

IL 402 Industrial Lecture (Pass/ Fail) **0 0 3 1**

ME 455 Project I **0 0 6 2**

Semester VIII

ME 456 Project II **0 0 24 8**

Electives :

ME 334 Selected Topics in I.C Engines(Pass/Fail) **3 0 0 3**

Thermodynamic analysis of engine process. Simulation of idea, fuel air and actual engine cycles.

Alternative gaseous and liquid fuels for SI and CI engines, prodection, stroge and distribution of different alternative fuels. Combustion and emission characteristics of fuels like hydrogen, natural gas, liquefied petroleum gas, biogas, producer gas, alcohols and vegetable oils.

Recent developments like different types of gasoline injection systems for SI engines, various types of electronically controlled fuel injection systems of diesel engines and homogeneous charge compression ignition concept.

Text Books/References:

+ *Ganesan V, "Computer simulation Four-stroke spark ignition Engines", University Press (Orient Longman Ltd.), Hydrabad, 1996 or 1999.*
+ *Colin R. Ferguson, "Internal Combustion Engines and applied Thermodynamics ", John Wiley and Sons, New York, 1986 .*
+ *Osamu Hirao and Richard K Pefley, present and Future of Automotive Fuels", Jhon Wiley and Sons ,1988, USA.*
+ *Michelle Health, "Alternative Transportation Fuels", Canadian Energy Research Institute, Canada, 1991.*
+ *O.P.Chawla, "Advances in Biogas Technology", Indian Council of Agricultural Research, New Delhi,1984.*
+ *Bosh Technical Instruction Booklets, 3rd Edition,1996,Bosh,Gremany*
+ *Eric Chowanietz, "Automotive Electronics", SAE International USA, 1995.*

ME 338 Trends in Manufacturing (Pass/Fail) **3 0 0 3**

New Materials and their processing – Approaches and technologies for rapid response manufacturing – Quality aspects and quality engineering – Machine Vision and its applications in manufacturing – Numerical methods and its applications in manufacturing – Optimization in Manufacturing – Trends in Automation : AGV, AS/RS, Advances in MRP , JIT, GT – Design for assembly.

References:

1. *Paul G Ranky : The Design and Operations of FMS , IFS Publishers , UK , 1988.*
2. *John C Ross, The Impage Processing Handbook, CRC Press USA 1992*
3. *Dauglas C Montogomery, Introduction to Statistical Quality Control, John Wiley & Sons, US 1985.*
4. *Jian Dong, Rapid Response Manufacturing , Chapmann & Hall, London 1988*
5. *RD Cook, Concepts & Applications of Finite Element Analysis, John Wiley, USA 1989.*
6. *Jamesh F Shackleford, Introduction to Material Science for Engineering, Mcmillan , US 1985.*
7. *Andresan, Myrup M, S Kehler and T Lund, Design for Assembly , Springer – Verlag , Germany 1983.*
8. *Boothroyd , Geoffrey, Assembly Automation & Product Design, Macel Dekker 1992.*

ME 344 I.C Engine Processes (Self-Study) **3 0 0 3**

Gas Exchange processes in two and four stroke engines, factors affecting volumetric efficiency, floe through valves and ports, scavenging in two stroke engines and models for the same, supercharging and turbo-charging. Charge motion within the cylinder. General principles of manifold, air filter and silencer design. Application of different flow measurement techniques for assessment of air motion in engines.

Combustion in SI engines, ignition, flame propagation, factors affecting flame structure and speed, cycle by cycle variations, misfire, knock and pre-ignition. Combustion in diesel engines, comparison of different combustion systems, heat release models, fuel spray structure and factors affecting it. Thermodynamic analysis of engine pressure data to yield heat release rates, techniques to analyse combustion, combustion and combustion and emission models for SI and CI engines.

Engine heat transfer and energy balance, correlations for heat transfer coefficient, measurement of instantaneous heat transfer rates and variables affecting heat tranfer in engines.

ME

Text Books/References:

+ *Internal Combustion engine fundamentals by John B Heywood, McGraw Hill Book Company, USA, 1989.*
+ *Introduction of internal combustion engines, Richard Stone, Macmillam, UK, 1992*
+ *Internal Combustion engines and air pollution by Edward F Obert, Harper and Row Publishers, New York, 1973.*

ME 348 CNC Machining (Self-Study) **3 0 0 3**

Basic components of CNC machining system – Machine Control Unit, Part Programming methods, machine tools, automatic tool changing systems, automatic work holding systems, interpolators and sequential controllers – manual part programming and machining of rotational and prismatic components with two and three axes MNC machine tools- Tools presetting and work setting procedures – Computer assisted part programming – Complex surface machining- Tool path generation for rough and finish machining of complex surfaces – Quality aspects in CNC machining of different surfaces.

References:

1. *Yoram Koren, Computer control of manufacturing systems, McGraw Hill, New York 1983*
2. *James Madison, CNC Machining Handbook, Industrial Press,New York, 1996.*

ME402 Combustion **3 0 0 3**

Review of Combustion Thermodynamics, Fuels: Classification and properties, Elementary reaction kinetics, Laminar flame propagation: Flammability, Ignition and Quenching, Turbulence and Turbulent flame propagation. Flame Stabilization, Combustion in swirling flows, Atomization of liquid fuels and droplet combustion. Elements of coal combustion.

ME408 Modelling & Analysis of Heat Transfer Processes **3 0 0 3**

Heat Transfer models - mathematical formulation of heat transfer processes - Exact solutions - Order of magnitude and dimensional analysis - Approximate analytical and numerical solutions.

Introduction to numerical techniques - Finite difference, finite volume and finite element techniques.

Matrix methods for radiation - Multimode problems.

ME410 Quality Control **3 0 0 3**

Statistical quality control. Theory of control charts. Control charts for variables, fraction A defective and defects. Acceptance sampling. Design of single, double and sequential sampling plans. Continuous sampling plans.

ME412 Hydroturbomachines Application Engineering **3 0 0 3**

Selection of Hydroturbomachines (Pumps and Turbines) System economics, pumps application in areas like thermal and nuclear power plants, process industries, water supply and sewage, irrigation and flood control, mining and marine, iron and steel industries etc. Hydroturbine and pump -turbine applications. Various hydropower plant layouts. Operation and maintenance of pumps and turbines.

ME413 Combustion and Propulsion **3 0 0 3**

Combustion in jet engines; Ramjet and Rockets; Performance characteristics of turboprops, turbojets and ramjets; Analysis of jet engine components; Equilibrium running condition; Supersonic combustion and scramjet engines; Liquid and solid fuel rocket engines; Introduction to Electrical and Nuclear rockets.

ME414 Axial Flow Hydroturbomachines **3 0 0 3**

Introduction and definitions, influence of degree of reaction on the blade shapes equation of flow in between the guide vanes and moving vanes -twist of blades in turbines and pumps -design of an axial flow pump, one dimensional and two dimensional analysis, cavitation and rotating stall in axial flow pumps.

ME415 Utilization of Solar Energy **3 0 0 3**

Structure of the sun, Sun-Earth relationships; Solar radiation; Measurements and estimation; Availability and limitations of solar energy; Flat plat collectors; Energy balance; heat capacity effects; selective coating; Solar energy applications; Water heating, cooling, dehumidification, drying, solar stills; Energy storage and solar ponds. Focusing collectors. Thermal power generation.

ME416 Design of Pumps **3 0 0 3**

Classification, fundamental equations and definitions, slip power design of centrifugal impellers -Single and double curvature vanes, mixed flow pumps, axial flow pumps, multi staging, design of guide vanes and return channel, spiral casing, axial thrust, model testing, regulation, cavitation: pump for special duties and maintenance hints.

ME418 Automobile Engineering **3 0 0 3**

Power plants for automotive vehicles, Layout of different kinds of vehicles, Resistance to vehicle motion and need for a gear box, various types of gear boxes including automatic transmission systems, clutches including fluid couplings, torque converters, rear axle and final drive - differential, front axle construction, steering systems, suspension systems, tyres, springs and shock absorbers, brakes and their actuation, recent developments. Vehicle electrical & electronic systems.

ME419 Industrial Heat Transfer Equipment **3 0 0 3**

Design principles of heat and mass transfer equipment – Energy auditing in various industries such as power plants, steel, cement, fertilizers, paper etc. Energy conservation and methods of improving efficiencies in energy utilization – energy recovery from individual, municipal and agricultural wastes – Typical design studies including cost effectiveness.

ME423 Design Practice **1 3 0 3**

Introduction to practical design of equipments, devices and machines. The various aspects of design covering conceptual, manufacturing, strength, rigidity, vibration, wear, lubrication, maintenance, assembly, asthetics and ergonomics etc.

Introduction to systems approach to design.

ME424 Vehicle Mechanism and Dynamics

Automobile Clutches; Gear Boxes; Manual and Automatic Transmissions; Universal joints, Propeller Shafts; Differentials; Rear axle constructions; Brakes and Braking Systems; Front axle and Steering Mechanisms; Suspension systems; Tyres and Wheels.

Forces acting on a road vehicle; Dynamic Characteristics - vehicle performance; braking performance; Anti-skid braking systems; Handling and Ride characteristics of road vehicles.

ME425 Advanced Refrigeration & Airconditioning **3 0 0 3**

Non-conventional refrigeration systems; air cycle, vapour jet, thermoelectric refrigeration - Multistage and cascaded vapour compression refrigeration systems - Dual effect and dual stage vapour absorption refrigeration systems - Vapour compressor and vapour absorption heat pumps - comfort and industrial air conditioning systems - Environmental aspects and alternate refrigerants.

ME426 Cryogenic Systems **3 0 0 3**

Introduction: Historical review, application areas - Properties of cryogenic fluids - Gas - liquefaction system: for gases other than Neon, hydrogen and helium; for neon, hydrogen and helium - cryogenic refrigeration systems; Joule - Thompson, Striling, Gifford - McMahon, Magnetic and Dilution refrigeration systems - Air Separation systems - critical components of Cryogenic systems: Heat Exchangers, Expanders, Compressors, storage dewars and transfer lines - Cryogenic insulation.

ME427 Solar Heating and Cooling **3 1 0 4**

Solar radiation - its measurement and estimation, solar energy collection - different types of collectors, their optical and thermal design procedures, testing and performance evaluation, Energy storage; solar heating systems and economics; solar refrigeration - vapour jet systems; solar absorption and vapour jet systems; solar dehumidification; solar boosted heat pump systems.

ME429 Fans, Blowers and Compressors **3 0 0 3**

Classification -fans, blowers and compressors -centrifugal, axial flow and mixed flow types; Principles of operation; Different design approaches; Flow mechanism through impeller -ideal and actual flows. Concept of slip power; Degree of reaction; Aerodynamic design of impellers -impeller blade design -diffusers and volute casing; 1ormance and regulation -surging and stalling; Constructional details and blade fixing; Mechanical aspects -critical speed, stress calculation -blade vibration; Different applications; Introduction of supersonic compressors.

ME431 Mechanisms and Transmissions **3 0 0 3**

Structure and systematic of planar and spatial mechanisms. Gross motions; linkage design: graphical and analytical methods. Pantographs and cognate linkages. Dwell mechanisms. Cam size and cam calculations. Rolling cams and noncircular gears. Intermittent motion mechanisms. Planetary gearing: types, speeds, efficiency, assembly, Cyclodrives. Change gear train synthesis. Multispeed gear drives. Kinematically flexible couplings.

ME432 Gas Turbine Engineering **3 0 0 3**

Thermodynamics of Gas Turbines: Cycle analysis; Gas Turbine components; Compressor, Combustor, heat exchangers, turbine -description, analytical considerations, performance, cooling of turbine blades.

Compressor -turbine impeller construction, blade-fixing details, sealing -Material selection for components, protective coating for hot turbine parts. Blade vibration, stress in impellers, components -Fabrication technique, Gas turbine turbocharger,

gas turbine power generation, turbo expander, gas turbine in space flight. Closed cycle gas turbines, critical speeds of rotors, Supersonic compressors.

ME434 Steam Turbines and Accessories **3 0 0 3**

Principle of operation; Types of steam turbines -impulse and reaction turbines; Multi stage steam turbines -velocity and pressure compounding; Effect of wet steam; Blade design; Mechanical design aspects -stress calculation and critical speeds of rotors - glands and packing devices -bearings and lubrication. Operating experiences; Construction of turbine parts; Governors and governing; Turbines for special purposes -marine turbines.

ME436 Failure Analysis and Design **3 0 0 3**

Failure - quality loss and robust design. Service failure modes, characterization and interpretation. Deformation modes yielding and creep. Ductile and Brittle fracture - fatigue and fracture mechanics approach to design. Cumulative damage - life prediction. Wear-modes and control. Systematic approach to failure analysis.

ME 439 Metal Cutting and Cutting Tool Design **3 0 0 3**

Principles of metal cutting -mechanics of metal cutting, tool forces, cutting temperature “and tool wear, tool life, economics of metal cutting, machinability assessment, cutting fluids. Geometry of basic tools -design of single point cutting tools, drills; milling cutters and broaches.

ME440 Manufacturing Planning **3 1 0 4**

Part print analysis, Design for production, Value analysis, Processing sequence. Process capability, selection of processing parameters. Manufacturing errors and methods of obtaining the specified dimensions -Blank setting up. Tolerance chart and its applications. Production flow analysis, shop layouts. Inspection Planning. Planning of assembly process. Cost estimation.

ME441 Tooling for Production **3 0 0 3**

Design principles of jigs and Fixtures -location and clamping principles -Types of jigs and Fixtures -Design of jigs and Fixtures for components with simple shapes. Design of press tools for blanking, piercing, bending, drawing, etc. Design of cams for automats.

ME442 Unconventional Manufacturing Techniques **3 1 0 4**

Unconventional Machining Techniques -Electro-chemical, Electro- discharge, Ultrasonic, Laser beam, Electron beam, Water Jet Machining. Principles of Advanced Forming Techniques: High energy rate forming, fine edge blanking. Powder metallurgical methods. Principles of Advanced casting techniques -Fluids and process, High pressure mould process. Principles of advanced welding methods - Ultrasonic welding, diffusion bonding.

ME443 Oil Hydraulic and Pneumatic Systems and Circuits **3 0 0 3**

Hydraulic Systems: Basics and Symbols, Pumps and Motors - Types, Characteristics, efficiencies; Pump Circuits and Power Packs, Filtration, Accumulators, etc.; Directional control, Speed control, Pressure control and related circuits; Fundamental switching circuits, design and analysis.

Pneumatic Systems: Compressed air generation, preparation and distribution; Pneumatic working elements; Pneumatic control valves; Design and construction of simple pneumatic circuits, cylinder sequence control; Emergency control and incorporation of auxiliary conditions.

ME444 Gear Manufacture and Inspection **3 0 0 3**

Introduction -types of gears, applications, quality of gears and their special requirements in manufacture. Gear material selection. Gear blank preparation, Gear manufactures -Gear stamping, rolling, extrusion, wintering, milling, shaping & hobbing. Machines, Machining time estimation. Gear heat treatment methods. Gear finishing process. Gear inspection methods and analysis. Process sheet for gear manufacture.

ME445 Fluid Mechanics of Turbomachines **3 0 0 3**

Cascade mechanics. Thin airfoil theory. Three-dimensional flow in turbomachines. Laws of vortex motion -radial equilibrium theory -actuator disc theory -secondary flows. Boundary layer and loss mechanism in turbomachines -physics of cavitation.

ME446 Control of Production Systems **3 0 0 3**

Nature of Production Control. Functions of Production Planning and Control. Forecasting -Methods of forecasting -Economic indicators, Time series, exponential smoothing etc. Verification and Control of forecasts. Production Planning. Inventory Systems, Sensitivity analysis, Price break models, use of Lagrangian multipliers in models with restrictions. Scheduling: Flow shop and Job shop scheduling, Net works in project management. Line of balance and Line balancing techniques in scheduling work. Assignment methods, paper work -Evaluation of P.P.C.

ME

ME447 Automated Manufacturing **3 0 0 3**

Definition of Automation - Merits and Criticism -Manufacturing plants and operations -Automation strategies, an Overview.

Introduction to Microprocessor and Computer Technology -Data Representation. Software -Mini computers -Micro computers -Programmable controllers.

ME

CAD/CAM -Fundamentals of CAD -Hardware in CAD -Computer Graphics Software and Data Base.

Computer control of Machine Tools and Machining Centres -NC and NC part programming. CNC -DNC -Adaptive Control.

Group Technology -Computer Aided Process Planning -Retrieval Type and Generative Type -Machinability Data Systems -Computer Generated Time Standards.

Robot Applications for automated manufacturing.

Computer Aided Quality Control -Microprocessor-based Measurement Systems - Integration of CAQC with CAD/CAM.

Computer Aided Production Management Systems -Inventory Management -MRP and MRP II -Just in Time Manufacturing -Shop Floor control -Factory Data Collection - Computer Process Monitoring.

Role of Sensors -Vision Systems. Voice Recognition -Artificial Intelligence Technology -Expert Systems.

Flexible Manufacturing Cells and Systems -part storage, transport, handling, identification, processing *etc.* -Flexible Assembly Systems -Automatic factory.

ME448 Advances in Machine Tools **3 0 0 3**

Numerical control in Machine tools. Adaptive control in Production. Programme controlled machines. Special purpose machine tools. Transfer lines. Recent trends in 1 metal removal processes.

ME451 System Design & Optimization in Thermal Engineering **3 0 0 3**

Introduction to thermal design - Regression analysis and Equation fitting - basics of fluid flow and heat transfer required for design of thermal systems - Modeling of thermal equipment (heat exchangers, evaporators, condensers, turbo machines, distillation equipment) - System simulation (successive substitution, Newton Raphson method) - examples: Optimization - Search methods, linear Programming, dynamic programming, geometric programming - Lagrangian multipliers.

Examples applied to thermal systems such as power plants, humidifiers etc.

Basics of Second law analysis in heat and fluid flow, applications in thermal design.

5.2.9 B.Tech. Metallurgical and Materials Engineering

Semester – III

MM 201 Principles of Physical Metallurgy * 4 0 0 4

Iron – carbon diagram; Annealing, normalizing, hardening and tempering of steels; Isothermal and continuous cooling transformation diagrams; Influence of alloying elements on transformation characteristics; Hardenability, Principles of alloying; Introduction to important alloy steels like stainless steels, tool steels, maraging steels, high strength low alloy steels, etc; Surface hardening of steels; Cast irons – types, heat treatment and properties.

Non-ferrous alloys – Classification, important alloy types, and heat treatment of aluminium alloys, titanium alloys, copper base alloys, super alloys, shape memory alloys, etc.

Reference Books:

1. *Introduction to Physical Metallurgy by S.H. Avner - (McGraw Hill International Editions, 1987)*
2. *Engineering Metallurgy, Part I by R.A. Higgins (Edward Arnold, 1993)*
3. *Physical Metallurgy Principles by R.E. Reed Hill and R. Abbaschian - (PWS-Kent, 1991)*
4. *Light Alloys – Metallurgy of the Light Metals by I.J. Polmear - (John Wiley, 1995)*
5. *Non ferrous Metals and Alloys by V. Sedlacek (Materials Science Monographs, Vol. 30, Elsevier Science, 1986)*

MM 203 Metallurgical Thermodynamics 3 1 0 4

Review of laws of thermodynamics; equilibrium; entropy and free energy; statistical thermodynamics; Auxiliary functions; Phase Equilibria; Gibbs phase rule; Reaction equilibria; Solution Thermodynamics; Multicomponent Systems; Electrochemical cells; Thermodynamics of phase diagrams; Applications in extraction, refining of metals and materials processing.

* Subject to approval by Senate

MM 211 Physical Metallurgy Lab 0 0 3 1

Study of a metallurgical microscope. Metallographic preparation of metals and alloys. Hardness testing of metals on Vickers scale. Microscopic examination of steels and non-ferrous metals. Interpretation of microstructures. Heat treatment of steels.

Macroscopic examination of cast wrought and welded structures and also defects and failures in metallic components.

Semester IV

MM202 Mechanical Metallurgy **3 0 0 3**

Elements of elasticity and plasticity, deformation of ideal crystals, crystal defects, dislocation theory, observation of dislocations , dislocations in FCC, BCC and HCP structures, stress fields and energies of dislocations, Forces on and between dislocations. Non-conservative motion, reactions and interaction of dislocations, multiplication of dislocations; dislocation-point defect interactions and dislocation-precipitate interactions. Plastic deformation of engineering single crystals and polycrystals, strain hardening, cold work, recovery and recrystallisation. Effect of grain boundaries, yield point phenomenon, strain aging and dynamic strain aging. Tensile flow properties, effects of strain rate, temperature and state of stress on plastic deformation, ductile-brittle behaviour, tensile and impact fractures.

MM 204 Introduction to Transport Phenomena **3 0 0 3**

Fundamentals of heat conduction, convection, radiation and their combined effect; steady and unsteady heat transfer in metallurgical processes, e.g. continuous casting, spray forming, solidifcation, extrusion etc. Diffusion and its application in solid state materials processing, convective mass transfer in extraction processes, unsteady diffusion in finite and infinite bodies, diffusion and chemical reaction in porous and nonporous solid. Newton's law of viscosity, laminar flow problems related to metallurgy, general equation of continuity and motion, application of Bernoulli's equation in flow measuring devices and flow from ladles.

MM206 Phase Transformations **3 0 0 3**

Diffusion: Fick's laws of diffusion, solution of Fick's second law and its applications, atomic model of diffusion and role of crystal defects, temperature dependence of diffusion coefficient, Kirkendall effect. Thermodynamic considerations: Free energy of alloy phases and free energy-composition curves for binary systems. Nucleation and growth - energy considerations; heterogeneous nucleation, growth kinetics, overall transformation rates. Solidification: Nucleation and growth from liquid phase, stable interface freezing, cellular and dendrite growth, freezing of ingots, nucleation and grain size, segregation, directional solidification, growth of single crystals. Precipitation from solid solution: Homogeneous and heterogeneous nucleation of precipitates, the aging curve, mechanisms of age hardening, examples from Al-Cu and other alloy systems. Martensitic Transformations: General characteristics of martensitic reactions, similarity to deformation twinning, bain distortion, crystallography and kinetics of martensitic transformations, examples from ferrous and non-ferrous alloy systems. Order-disorder Transformation: Examples of ordered structures, long and short-range order, detection of super lattices, influence of ordering on properties.

MM 208 Principles of Extractive Metallurgy **3 0 0 3**

Science and technology of metal extraction with emphasis on specific ferrous and non-ferrous metals. Thermodynamics and kinetic aspects; elements of heat and mass transfer, principles, practice and analysis of unit processes such as calcining, roasting, sintering, smelting, refining and other pyrometallurgical operations with suitable examples. Other processes: hydro - and electro-metallurgical, vacuum, plasma etc.

MM 212 Mechanical Metallurgy Lab **0 0 3 1**

Evaluation of mechanical properties of metallic materials by conducting the following tests: (i) Hardness tests (Vicker, Brinell & Rockwell) (ii) Charpy impact tests (iii) Tension tests, and (iv) Fatigue tests (v) Study of Testing machines : Hydraulic & Servo hydraulic universal testing machines Study of hardness machines Study of impact machines (vi) Fracture mechanics tests.

MM 214 Chemical Metallurgy Lab **0 0 3 1**

Chemical analysis of ferrous and non-ferrous alloys by conventional and instrumental methods. Experiments related to chemical and extractive metallurgy, corrosion and fluid property measurements.

Semester V

MM 301 Physics of Materials **3 0 0 3**

Wiedemann-Franz law, Drude model, elementary quantum mechanics, free electron theory of metals, Fermi-Dirac statistics, density of states, nearly free electron theory, tight-binding approximation, band theory, reciprocal space, electron diffraction in crystals, Brillouin zones, Fermi surface, theory of metallic phases, order-disorder transformations in alloys, classification of semiconductors, electrons and holes, opto-electronic materials, magnetic properties of materials, superconductivity, Meissner effect, BCS theory and high-Tc superconductors.

MM303 Materials Characterisation **4 0 0 4**

Scope of metallographic studies. Abbe's criterion for image formation, resolving power, numerical aperture, empty magnification, construction of simple and

MM

compound microscopes, Important lens defects and their correction, principles of phase contrast, interference and polarized light microscopy. Bright field and dark field contrast, photomicrography, sample preparation, elements of quantitative metallography and image processing. Production and properties of X-ray, absorption of X-rays and filters - diffraction and X-ray - diffraction directions and methods. Power photographs from samples with simple, body centered, face centered and diamond cubic and hexagonal crystal structures. Effect of texture, particle size, micro and macro strain on diffraction lines. Applications - indexing of powder photographs. Precise lattice parameter determination. Chemical analysis by X-ray diffraction and fluorescence. Construction and working principles of transmission electron microscopes. Image formation, resolving power, magnification, depth of focus, elementary treatment of image contrast. Bright field and dark field images, sample preparation techniques. Stereographic projection and applications. Selected area diffraction, reciprocal lattice and Ewald sphere construction, indexing of diffraction patterns. Scanning electron microscope: construction; interaction of electrons with matter, modes of operation, image formation - plane and fractured surfaces. Chemical analysis using electron beam devices.

MM305 Creep, Fatigue & Fracture Mechanics **3 0 0 3**

Creep of solids, temperature - stress - strain relationships, deformation mechanisms at elevated temperature, deformation mechanism maps, parametric relationships, materials for elevated temperature. Cyclic stress-and-strain controlled fatigue, fatigue crack initiation mechanisms, microscopic fracture modes and mechanisms, creep-fatigue interaction, parameters affecting fatigue. Elements of fracture mechanics, stress analysis of cracks, Linear, elastic and elastoplastic fracture mechanics, Griffith theory, plastic zone size, fracture toughness testing, KIC, COD, J-Integral, fracture toughness of engineering alloys, ceramics and polymers, role of microstructure on fracture toughness.

MM 307 Solidification Processing * **3 0 0 3**

Thermodynamics of solidification, Nucleation and growth, Gibbs-Thompson effect, alloy solidification, Math. analysis of redistribution of solute during solidification, constitutional undercooling, Mullins-Sekerka instability criterion, dendritic growth, structure of casting and ingots, heat transfer in solidification, design of risering and gating in castings, types of casting processes.

Reference Books:

1. Solidification processing by M.C. Flemings

2. Fundamentals of solidification by W.Kurz and D. Fisher

3. Principles of metal casting by R.W.Heine and P.C . Rosenthal

MM 309 Environmental Degradation of Materials * **3 0 0 3**

Fundamentals of metallic corrosion, thermodynamic and electrochemical aspects, electrode potentials, mixed potential theory, polarisation and passivation. Forms of corrosion - uniform and localised including environmentally assisted cracking - Corrosion prevention - coatings, cathodic and anodic protection. Corrosion measurement and monitoring. Oxidation of metals, Pilling-Bedworth ratio, oxidation kinetics. Degradation of polymers: swelling and dissolution, bond rupture, weathering. Degradation of composites, and ceramics. Thermal degradation of materials, and radiation damage.

Reference Books :

1. *Corrosion Engineering by M.G. Fontana - (McGraw-Hill, 1986)*
2. *Corrosion by T. Burstein, L.L. Shreier and R.A.Jarman - (Butterworth Heimemann 1994)*
3. *Electrodeposition and Corrosion processes by J.M. West*
4. *The fundamentals of Corrosion by J.C. Scully - (Butterworth Heimemann, 1990)*
5. *Corrosion and Corrosion Control by H.H. Uhlig - (John Wiley, 1985)*

MM311 Metal Casting Laboratory **0 0 3 1**

Experiments in the following areas: moulding methods, testing of mould materials, melting practice for aluminium, copper and ferrous alloys; degassing, grain refinement and modification treatments. Gas content determination. Cast metallurgical studies. Pattern, gating and feeder design. Casting defect analysis.

* Subject to approval by Senate

MM313 Materials Characterisation Lab **0 0 3 1**

Laboratory practice involving specimen preparation for optical and scanning electron microscopy, Interpretation of micrographs , X-ray powder techniques, phase analysis, indexing of powder patterns, transmission electron microscope - specimen preparation, SAD, interpretation of micrographs.

Semester VI

MM302 Iron Making and Steel Making **4 0 0 4**

Principles of ironmaking and steelmaking; Ironmaking through blast furnace route; effect of external constraints such as high top pressure, burden preparation, fuel injection etc on pig iron production with emphasis on Indian conditions. Alternate methods of reduction of iron. Steelmaking: primary process - pneumatic and hearth. Secondary steelmaking. Principles and practice of quality steelmaking, Deoxidation,

inclusions. Conventional and continuous casting. Constitution of ferrous slags, physical chemistry of slag-metal reactions.

MM 304 Metal Forming Technology **3 0 0 3**

Principles of plasticity related to metal forming, selection of cold - warm and hot working conditions, dynamic recovery and recrystallisation. Description and analysis of various metal forming processes. Basic design consideration of machine tools for metal forming.

MM306 Metal Joining Technology **3 0 0 3**

Welding versus other joining/processes; Classification of welding processes, manual metal arc, submerged arc, gas tungsten arc, gas metal arc, plasma arc, and flux-cored arc welding, electron beam, laser and electroslag welding, pressure welding; friction, diffusion and ultrasonic welding, resistance welding, flame and plasma cutting, brazing, soldering & spraying. Welding metallurgy: Thermal cycles in welding, use of iron-carbon, TTT and CCT diagrams, welding of mild and low-alloy steels, carbon equivalent, cold cracking, the hydrogen problem, preheating and post-heating, welding of austenitic stainless steels, cast irons and cast steels, welding metallurgy of Al, Cu and Ti alloys, joining of dissimilar materials.

MM 312 Metal Forming Lab **0 0 3 1**

Measurement of fundamental parameters in metal forming, calibration of load cells, demonstration of metal forming processes, sheet metal forming, measurement of flow curves, bulk forming etc.

MM314 Metal Joining Lab **0 0 3 1**

The course covers description of a general lay out of a fabrication shop. Demonstration of plate preparations for welding by gas cutting and plasma cutting. Demonstration of manual metal arc welding. Submerged arc welding, electroslag welding, TIG, MIG/MAG welding and plasma welding systems with regard to equipment details, operation parameters and execution of the process. Demonstration of resistance welding equipments and operating characteristics.

Semester VII

MM 401 P/M, Refractories and Ceramics * **4 0 0 4**

Metal Powder Manufacturing and Characterisation. Shaping and Densification, Secondary Operations and Applications.

Classification of refractories, Raw Materials, Industrial Refractory Products, Manufacturing Processes, Testing and Evaluations.

Structure of Ceramics and glassy materials, ceramic powder preparations, forming and consolidation processes, applications.

Reference Books:

1. *Powder Metallurgy Science – R.M. German, Metal Powder Industries Federation, New Jersey, 2e, 1994*
2. *Refractories, 4e, F.H. Norton, McGraw Hill Book Company, 1968*
3. *Introduction to Ceramics, W.D. Kingery, H.K. Bowen, D.R. Uhlmann, John Wiley and Sons, New York, 1991*
4. *Principles of Ceramic Processing, James S. Reed, John Wiley & Sons, 2e, 1995.*

MM 411 Project I **2 cr**

MM402 Industrial Training **0 0 6 2**

Semester VIII

IL402 Industrial Lecture (P/F) **0 0 3 1**

MM 412 Project II **9 cr**

List of Electives:

MM210 Non-Destructive Examination **3 0 0 3**

Aims, the basic techniques. Liquid penetrant testing: the method, effect of surface tension. Magnetic Particle Testing: types of magnetization, equipment used, demagnetization. Industrial Radiography: generation of X-rays, isotope sources, properties of X- and gamma rays. Contrast, film characteristics and Image quality indicators, ultrasonic testing: Acoustic impedance, pulse echo, through transmission and resonance techniques. Probes employed. Oblique incidence. Beam characteristics. Flaw size determination. Introduction to acoustic emission: thermal imaging, neutron radiography, leak testing, holographic techniques. Standards and codes.

MM212 Modern Experimental Techniques **3 0 0 3**

Importance of chemical characterisation of materials, scope of applications - failure analysis, studies on defects, precipitates. Thermal characterisation, thermo-

gravimetric analysis (TGA) differential thermal analysis (DTA) differential scanning calorimetry (DSC) techniques, Chemical characterisation by auger electron spectroscopy (AES), electron probe micro analysis (EPMA), X-ray florescent analysis (XRF), X-ray absorption spectrometry (XAS), energy dispersive spectroscopy (EDS), gas chromatography, spectrochemical analysis : Infra Red (IR) and Raman Spectroscopy, secondary ion mass spectroscopy (SIMS), atomic absorption spectrography, calorimeters. Mossbauer effect. Electro-analytical techniques: polarography, electrogravimetry, conductometry, potentiometry. Applications of dilatometric techniques.

MM316 Electronic Materials **3 0 0 3**

Review of electron theory of metals, electrical and thermal conductivity. Theory of electron conduction, temperature dependence of electrical conductivity, Hall effect. Elemental and compound semi conductors and their applications, single crystal, oriented poly crystal and amorphous semiconductors; fabrication of semiconductor materials and devices. Thermoelectric properties of metals and semiconductors, ionic and superionic conductivity in solids. Super conductivity, Super conducting materials, structure and applications. Different types of dielectric materials, piezo, ferro, antiferro and ferri-electric materials, structure and applications.

MM318 Advanced Materials & Processes **3 0 0 3**

Smart materials. Use of advanced materials in electrical, magnetic, structural, space, automotive applications etc. Processing of advanced materials. Nanostructured materials, their characterization, fabrication and applications. Typical processing techniques, such as sol-gel processing, laser processing single crystal growth, high density P/M processing, spray forming, mushy state processing, diffusion processing, etc.

MM320 Surface Modification **3 0 0 3**

Introduction to surface modification. Need for surface modification. Plating and coating processes: hardfacing, anodising, PVD, CVD, thermal spraying, electrodeposition, electroless deposition, hot dipping, surface welding, composite coating. Thermochemical processes: plasma nitriding, boronising, nitriding, carbonitriding, carburising, nitrocarburising, surface alloying, plams spraying. Thermal processes: laser hardening, laser glazing, laser surface alloying, laser cladding, electron beam hardening/surface modification. Implantation and special processes: ion implantation, flexible overlays and steam treating. Typical applications. Recent developments.

MM405 Materials Selection and Design **3 0 0 3**

Historical perspective of materials design, fundamental aspects of structural alloy design, methodology of design of alloys and non-metallic materials; strengthening mechanisms in metallic and non-metallic materials, manufacturing techniques for non-metallic materials. Factors influencing materials selection: mechanical properties, physical properties, manufacturing techniques, cost, potential failure modes of engineered components, etc., Various techniques for optimizing these parameters. Materials selection in various industries: construction, automotive, machinery, nuclear, aerospace, defence, petrochemical, environmental etc. Case studies to illustrate use of above parameters in materials selection.

MM407 Modern Materials **3 0 0 3**

Conducting Polymers and Organic Metals : Conduction in organic materials, polyacetylene, doping effects and copolymerization, applications, superconducting inorganic polymers, (SN), fullerenes and carbon based materials. Magnetic materials: Classification, Magnetic domains and anisotropy effects, soft magnetic materials, permanent magnets, magenetic recording materials, magnetic memories, multilayered materials. Biomaterials : Biofunctionality and biocompatibility, classes of biomedical materials; failure mechanisms; composites as biomedical materials. Intermetallics : Ordering and antiphase domains - effect of heat treatment and non stoichiometry - fabrication methods - multiphases, practical applications.

MM411 Computational Methods in Materials Engineering **3 0 0 3**

Introduction to computers, numerical methods; minimization techniques; overview of computational techniques such as FEM, Monte Carlo, and molecular dynamics; use of computers to solve materials science problems, such as, phase transformations, nucleation and growth, diffusion and heat transfer.

MM413 Sintering Technology **3 0 0 3**

Principal aspects of sintering. Single component and multicomponent sintering. Mechanisms of sintering. Sintering diagram. Microstructural changes. Influence of material characteristics and other processing parameters on sintering processes. Novel sintering processes. Sintering atmospheres and furnaces. Porosity and pore-related properties. Quality control in sintering. Recent developments in sintering processes.

MM415 Defects and Failures in Manufacturing and Service **3 0 0 3**

Crystal defects; point, line and volume defects. Design defects; Geometrical design defects and faculty alloy design macroscopic and microscopic defects produced during manufacture of metals and alloys (castings, welding and metal forming

defects). Impurities in metals and alloys. Defects produced during processing of metals and alloys (heat treatment defects & plating defects etc.). Common causes of failure. Tools and techniques for studying metal failures. Principles of fractorgraphy. Embrittlement of metals and alloys. Service failures. Overloading, fatigue, creep, wear and erosion etc. Environmental degradation: aqueous and hot corrosion, stress corrosion cracking, damages due to hydrogen etc. / safety design and selection of materials. Typical case studies of service failures.

MM417 Magnetic Materials **3 0 0 3**

Introduction - Terms connected with magnetic materials - Classification of magnetic materials. Ferromagnetism - Domain Theory. Spontaneous magnetisation in ferromagnetic materials. Magnetic anisotropy - Magnetostriction; Paramagnetism and Diamagnetism. Magnetically hard and soft materials, Special purpose magnetic materials, Rare earth Magnets. Effect of temperature, heat treatment, direction of grain on magnetic materials. Grain oriented, Magnetic oxides, Amorphous magnets. Silicon iron; Losses in magnetic materials - hysteresis loss, Eddy current loss. Measurement of magnetic properties; application of magnetic materials.

MM419 Metallurgical Plant Design **3 0 0 3**

Course, in a project mode, studies both the technical and economic aspects with the objective of preparing a feasibility report. It covers identification of product/ processes, technology assessment, material selection, process selection, process parameters, design aspects, optimization, specifications, product quality as well as project cost and viability. Energy and environmental aspects would also be taken into account.

MM 559 Mathematical Methods in Materials Engineering * **3 0 0 3**

Vectors, Tensors, Differential Operators (Grad, Div, Curl), Different Co-ordinate systems, Ordinary Differential Equations, Matrices, Spectral theory of Operators, Eigenvalue problems, Infinite Series (Convergence tests), Special Functions, Fourier Series, Non-homogeneous ODE: The Fredholm Alternative, Green's functions. Partial Differential Equations: Characteristics, Classification, Representation of some physical phenomena by PDEs (Vibrating String, Vibrating Membrane, Heat Conduction in castings, Potential Equation, Diffusion Equation), Integral Transform methods (Laplace, Fourier, Hankel). Approximate methods (Perturbation methods, Weighted residuals - Galerkin, etc.), Dimensional Analysis and Scaling, Linear Stability Theory (Case study of planar-cellular transition during solidification).

Reference Books :

1. Mathematical Methods for Physicists by G. Arfken

2. Mathematical Methods in Chemical Engineering by S. Pushpavanam

* Subject to approval by Senate

5.2.10 B.Tech. Naval Architecture & Ocean Engineering

SEMESTER III

AM220 Strength Of Materials **3 1 0 4**

Analysis of stress and strain – Hook's law – Relation between elastic constants – Bending stress and shearing stress distribution in beams Torsion of circular cross section – Transformation of stresses – Principal stresses and principle strains – Mohr's circle – Strain Rosettes – Deflection of beams by successive integration method and moment area method – Thin walled pressure vessels. Elastic instability – Euler formula.

AM253 Foundations of Fluid Mechanics **3 1 0 4**

OE

Fluid continuum – Properties of fluids – Methods of describing fluid motion – Kinematics of fluid streamlines, streak lines, path lines – equation of Continuity, Euler's equations of motion – Navier Strokes equations.

Hydrostatics – Manometry – Fluid force on planes and curved surfaces, submerged and floating bodies – stability of submerged and floating bodies – Aerostatics – variation of pressure, temperature and density with altitude – stability of atmosphere – Relative equilibrium – Fluids subjected to uniform linear acceleration and uniform rotation.

Analysis of fluid motion in integral form – Concept of a system and a control volume – equations of continuity, energy, linear momentum and angular momentum as applied to a control volume in fluid flow and their applications to propellers, cascades and pumps and turbines.

Dimensional analysis, similitude and model testing – Laminar and turbulent flows – Viscous effects – Boundary layer – Separation phenomena – Losses in pipes

and minor features.

Hydrodynamics – Two dimensional ideal fluid motion, stream function and potential functions – Source, sink, vortex and double flows – flow around a circular cylinder with and without circulation – transformation of a circular cylinder to an aerofoil – aerofoil characteristics- Effects of viscosity.

Semester IV

OE 202 Analysis of Structures **3 0 0 3**

Work and energy theorems, Reciprocal theorem, Analysis of indeterminate frames, grillages and trusses, Unit load, moment area, conjugate beam methods, Influence lines, Strain energy of beams, bars and torsion members, Matrix formulation of displacement method for frame, truss,bar and torsion members, Beam on elastic foundation and its stiffness matrix, 3D beam element including shear effects, Transformation, assembly and bandwidth reduction of stiffness matrices, Concept of finite element method.

Beam-column theory, Geometric stiffness matrix, Buckling of bars and frames, Application of FEM to buckling.

Shear flow and torsion of beams with thin walled open sections,Combined torsion and bending, Unsymmetric bending of beams.

2D and 3D theory of elasticity, Equilibrium and compatibility equations in cartesian and polar coordinates, Strain-displacement relations, Plane stress and place strain, Use of stress function in 2D problems, Shear lag and its application, Stress concentration and its application.

Application of matrix methods to problems of marine structures.

OE201 Ship Theory **3 0 0 3**

Lines plan and hull form coefficients - Hull forms of different types of ships and boats - Numerical techniques for ship calculations - Fluid pressure, centre of pressure - Weight estimation, centre of gravity, effect of shifting weights.

Lightship, deadweight, CG, CB - definitions - Conditions for equilibrium.

Metacentre, Hydrostatic particulars - definition and derivations.

Stability at small angles - heel, trim and angle of loll - Free surface effects - Inclining experiment - Stability at large angles - cross curves of stability - dynamic stability levers - Wind heeling moment, maximum allowable KG - Stability of grounded vessels - Submarine stability - Stability criterion for various types of crafts.

Capacity and tonnage calculations - Trim and stability booklet - Freeboard - Flooding of ships, subdivision and damage stability - Launching - Approximate method of calculation for hydrostatic particulars - data and references.

OE210 Computer Aided Ship Design and Drafting CASDD – I **1 0 6 3**

Introduction of computer applications in ship design and calculations – Computation and drawing of hydrostatic particulars and cross curves of stability – Drawing and faring of lines plan from supplied offset data.

Computing techniques and applications for launching, subdivision, damage stability, trim and stability booklet, sounding tables and similar design calculations.

An assignment on computation of one of the above applications. Introduction to computer-aided fairing of hull lines.

AM254 Applied Mechanics Laboratory **0 0 3 1**

Laminar and turbulent flow – Venturi principle – Friction coefficient in pipe flow – Flow visualization – Measuring instruments to measure velocity and pressure in fluid flow – Measurement of pressure distribution over body contour – Experiments designed to cover the above.

Mechanical extensometers – Uniaxial tension – Diffractogauge – Deflection and bending stress in beams – Spring constants – Impact test – Stress concentration – Photoelasticity – Experiments designed to cover the above.

Semester V

OE 206 Ship Resistance & Propulsion **3 0 0 3**

Components of ship resistance, dimensional analysis – Froude's hypothesis and model analysis – Surface roughness – Telfer's method, Hughe's method – theory – Wave resistance, wind resistance – Shallow water and wave effects – Methodical series data – BSRA series 60 - Special types of hull forms.

Screw geometry – Theory of propeller action – momentum and blade element theories – Similitude analysis – Hull propeller interaction – Open water and self-propulsion tests-Cavitation – Design of screw propellers utilizing series data – Strength of propellers and manufacturing process – Powering of ships and sea-trials – Specific types of propulsion systems and applications.

OE 301 Ship Hydrodynamics **3 0 0 3**

Vector and tensor forms of fluid dynamic equations;Role of compressibility; Nondimensional groups (Froude / Reynolds / Cavitation / Euler / Weber / Strouhal numbers); Flow visualization methods; Stokes law of viscosity for shear and normal stresses; Circulation, Strokes theorem (2D & 3D), Kelvin's circulation theorem and Helmoltz's vorticity theorems; Vortex line and tube; Vorticity transport equation;l Potential flow and its boundary conditions, superposition of elementary flows, Rankine half and closed bodies etc., method of images, source or vortex near wall, Kutta-Joukowski theorem and lift; D'Alembert's paradox;Unsteady potential flow past circular cylinder and sphere; Added mass tensor of rigid bodies in unbounded fluid, Its properties and symmetries; Munk moment ; Caviation; Boundary value problem of gravity waves and its solution, dispersion and group velocity; Kelvin waves and wave resistance of thin ships.

Lifting surfaces; Foll section characterizations; Flow around a foil; generation of lift, Kutta condition, Linearised lifting surface theory of thin 2D hydrofoil, thickness and camber problems and their solutions, lift and moment coefficients.

Navier-Stokes equations to Prandtl boundary layer (BL) equations; Dynamic similarity and boundary conditions; Laminar flow, BL thickness, displacement and momentum thicknesses; BL seperation; Vortex shedding by cylinders, vortex induced vibration, Skin friction, BL along a flat plate at zero incidence and its solution, Blasius formlula, Plane Couettle and Poiseuille flows; Impulslvely started plate; Momentum integral equation of BL; Characteristics of turbulent flow; Drag crisis in circular and sphere; Friction due to turbulent BL over flat plate, power law, roughness effect; Rans equations and role of CFD.

Applications of all the above in ship design and analysis.

OE 303 Marine Engineering **3 0 0 3**

Introduction to marine machinery – Types of marine power systems – Engine room layout – Marine diesel engines and their cycles, Fuels Super charging, Ignition and combustion problems – Fuel oil, lubricating oil – Compressed air and cooling water systems.

Turbines, pumps, their types and characteristics, cavitation etc.

Marine boilers, Composite boilers – Exhaust gas and heat exchangers – Economizers, Super heaters.

Auxiliary machineries – Choice of power systems for ships.

Fire fighting, Navigational aids, Steering gear, shafting, stern tubes and transmission system.

TEXT BOOKS

1. *Harrington, R.L. Marine Engineering, SNAME, New York (1992)*
2. *Taylor, D.A., Introduction to Marine Engineering, Butterworths, London (1983)*
3. *Woodward, J.B., Low Speed Marine Diesel, Ocean Engineering, A Wiley series (1981)*
4. *Any standard text books on thermodynamics*

OE 305 Ocean Wave Hydrodynamics **3 0 0 3**

Review of basic Fluid Mechanics: Conservation of mass and momentum, Euler Equation, Bernoullis equation, potential flow, stream function.

Waves: Classification of water waves – Two dimensional wave equation and wave characteristics – wave theories – Small amplitude waves – Introduction to Finite amplitude waves – water particle kinematics – wave energy, power – wave deformation – Reflection, Refraction, Diffraction Breaking of waves – Wave Forecasting Methods – Spectral description of Ocean Waves – Design wave. Directional spectra for waves.

Currents: Classification – Behaviour – Design Criteria, Scour.

Forces: Wave forces – Morison equation – Wave loads on vertical, inclined and horizontal cylinders. Diffraction theory – wave slamming and slapping – wave impact pressures and forces on Coastal Structures.

OE307 Ship Structures **3 0 0 3**

Longitudinal strength-shear force and bending moment-still water and wave loads-deflections-unsymmetrical bending-bending stresses and design of midship section.

Shear flow analysis of multicell sections-Torsional analysis-Warping torsion-Determination of shear and normal stresses-shear lag and effective breadth.

Bending of plates-stiffened, plates-orthotropic, plates-large deflection theories and applications.

Buckling and ultimate strengths of columns, plates and stiffened panels-concept of effective width-ultimate strength of the hull guider.

Finite elements for simple plated structures-use of computer packages for the analysis of ship structures.

OE 309 CASDD II **0 0 6 2**

Design and drawing of midship section using Classification Society rules – Calculation of section modulus satisfying minimum rule requirements for stress values. Computation of longitudinal bending moment, shear force, section modulus and stresses or similar structural problems.

Computation of resistance and power requirement of an assigned ship.

OE

Design of propulsion system – selection of engines, gear boxes, shafting and propeller – Drawing and details of propellers.

Design of rudder, estimation of steering gear torque and power.

OE311 Ocean Engineering Lab. I **0 0 6 2**

Strain Gauges, Vibration Measurements, Data Acquisition, Transducers for Mechanical measurements.

Preparation of models for seakeeping tests : Determination of LCG and VCG ; Determination of mass moments of inertia, along 3 axes ; Determination of natural frequency of roll and damping coefficient.

Determination of GM (inclining experiment) ; Determination of range of stability.

Semester VI

OE302 Ship Design **3 0 0 3**

Consideration of overall ship design requirements – Developments of specifications – Determination of principal particulars – Estimation of lightship weight, steel, outfit and machinery for different types of vessels – Derivation of hydrostatic and stability particulars – Capacity calculations – Freeboard rules and calculations – Design of hull lines from basic ship data – Powering of ships –

Weight equation in ship design – Safety regulation and equipments. Grain carriage and rules – Accommodation layout and rules – Outfit equipments, Economic considerations in design, Optimization techniques. Ultimate strength design of hull girders, design for Fatigue. Limit state design concepts.

Introduction to ship design software.

Cost estimation.

OE304 Vibration of Marine Structures and Acoustics **3 0 0 3**

Analysis of single degree of freedom systems – Time & Frequency domain methods continuous system – Modes of vibration – Natural and forced vibrations – vibration of beams.

Source of vibration – propeller excited, wave-induced and machinery – Random vibrations – Calculation procedure for torsional vibrational of propulsion systems – empirical methods.

OE

Hull girder vibration.

Vibration and sound instrumentation – sound transmission and absorption – Acoustic materials – Origin and nature of machinery noise and their control – Effects of noise on human behaviour – Noise limits and legislations.

OE314 Ocean Engineering Lab. II **0 0 6 2**

Study of waves : Height, length & profile ; water particle kinematics, wave pressure ; wave reflection ; Wave Force Measurement.

Seakeeping tests : Motion measurement and response transfer functions in different headings in regular waves ; Tests in irregular seas.

Resistance and propulsion tests : Resistance of bare hull model ; Resistance with appendages ; Calibration of thrust & torque transducers ; Open water test with propellers.

OE 316 Industrial Training (Summer) **0 0 6 2**

Semester VII

OE401 Offshore Structural Design **3 0 0 3**

Design objectives and methods such as WSD and LRFD – loads on offshore structures – design of tubular members for pure and combines stress resultants – brief introduction to optimal member design. Pile design and soil-structure interaction.

Design principles of topsides – design of plates for large deflections and permanent set – design of lifting structures such as cranes.

Design principles of tubular joints – punching shear and ultimate strength concepts – fracture mechanics and fatigue.

Design for dynamic loads – design of guys and tethers – design of anchor and moorings - design of submarine pipelines.

Design of hazards such as collision and fire.

OE403 Dynamics of Floating Systems and Marine Vehicles 4 0 0 4

Review of Equations of motion for SDOF systems, time and frequency domain solutions.

Oscillations of floating bodies, hydrodynamic derivatives, added mass and moment of inertia, and hydrodynamic damping – Exciting forces and moments due to waves – Strip theory for slender bodies – Symmetric & unsymmetric coupled motions – Effect of forward speed-3D effects.

Dynamic effects. Roll and pitch damping devices – probabilistic approach – Introduction to random response theory – Random response of linear systems under wave loading, directional spectra for waves – probabilistic design criteria – General motion analysis of floating bodies, time and frequency domain approaches.

Manoeuvring – steering and manoeuvring equations, control surfaces and sea trials.

OE 405 Project I 0 0 6 2

Semester VIII

OE402 Industrial Lecture 0 0 3 1

A series of lectures by experts from industries and R &D organizations in areas of ship building and ocean engineering.

OE406 Project II 0 0 30 10

Design - Computations - Model Studies of some specific problems in Naval Architecture/Ocean Engineering.

Electives:

OE 313 Physical Modelling & Instrumentation 3 0 0 3

Dimensional Analysis and Modelling Laws – Model Materials – Model Fabrication Techniques

Hydrodynamics Test Facilities – Towing Tank – Wave Flumes – Model Basin – Cavitation Tunnel – Wave Makers and Asbsorbers – Generation of 2D and 3D waves in the Laboratory – typical Test Facilities.

Measuring Systems for Strain – Displacement – Pressure – Force and Torque – Flow

Measurements of Oceanographic parameters like Wave Height, Current, Tide etc.

Model testing of ships and typical offshore structures – case studies.

Reference books: Chakrabarti S K: Offshore Structure & Modeling, World Scientific, 1994.

Hughes, S A Physical Models and Laboratory Techqnieus in Coastal Engg, World Scientific 1993.

Beckwith, T G Marangoni, R D and Lienhard, J H Mechanical Measurements, Addison Wesley, 1999

Dally J W and Riley, W F Experimental Stress Analysis, Mc Graw Hill 1991

Williams J Oceanographic Instrumentation , Naval Institute Press 1975.

OE430 Ocean Energy 3 0 0 3

Generation of waves – Wave theories – Tidal waves – Energy from oceans – Tides, Waves, Currents, Salinity and thermal gradients with special reference to Indian coast – Energy converters for extraction of ocean energy – Design principles of wave power, tidal power and OTEC systems –Cost–benefit analysis.

OE440 Drilling Vessels And Support Crafts 3 0 0 3

Search for oil in sea – Drilling procedures and operations – Requirements and general specifications for the drilling vessels – Different types of drilling vessels – drill ship, jack – ups and semi submersibles – Layout and general arrangements of typical drill ships – Equipments and weight analysis – Stability requirements – Mooring and dynamic positioning. Submersibles – supply vessels – fire boats and rescue vessels.

OE460 Advanced Ship Hydro-Dynamics 3 0 0 3

Navier – Stokes equation – theory – Hydrodynamic forces and coefficients – Wave resistance – theoretical aspects, Kelvin wave pattern, solution for sphere translating under free surface – Slender body hydrodynamics – Mitchell's integral, strip theory for ship motions.

Boundary layer theory – laminar and turbulent flow – Friction lines and frictional resistance of ships.

Introduction to computational hydrodynamics – various numerical methods for solution of ship hydrodynamics problems.

6.1 Mathematics Elective Courses

No.	Title	L	T	P	C
MA201	Complex Variables and Transform Techniques	3	0	0	3
MA202	Special Functions and Partial Differential Equations	3	0	0	3
MA203	Linear Algebra and Numerical Analysis	3	0	0	3
MA204	Statistics	3	0	0	3
MA205	Probability and Random Processes	3	0	0	3
MA206	Graph and Combinatorics	3	0	0	3
MA207	Linear and Integer Programming	3	0	0	3
MA213	Basic Graph Theory	3	0	0	3

MA201 Complex Variables and Transform Techniques 3 0 0 3

Analytic functions, Line integral, Cauchy's integral theorem and integral formula, Taylor and Laurent series, Residue theorem and applications, Bilinear transformations, Fourier transforms (exp. sin, cos), Laplace transforms inversion Integrals, Convolutions, Applications.

References :

1. *E. Kreyszig : Advanced Engineering Mathematics – Wiley Eastern, 1990.*
2. *R.V. Churchle and Brown: Complex Variables and Applications – McGraw-Hill, 1990.*
3. *I N Sneddon, The Use of Integral transforms, Tata McGraw Hill Pub. Co., New Delhi, 1974.*

MA202 Special Functions and Partial Differential Equations 3 0 0 3

Power series method for solving ODE; Legendre's polynomials and properties; Frobenius method; Bessel functions; Sturm-Llouville problem; Gamma and Beta functions.

First order linear and non-linear PDE's, Classification of linear second order PDE; and reduction to Canonical faorms. Variable separable method, solution of Heat, Wave Laplaace equations (Polar and Cartesian Coordinate) Poisson Integral Formula, Greens function and applications.

References :

1. *Erwin Kreyszig : Advanced Engineering Mathematics – Wiley Eastern Ltd., 1990.*
2. *Ian Sneddon : Elements of Partial Differential Equations – McGraw-Hill, 1960.*

MA203 Linear Algebra and Numerical Analysis 3 0 0 3

Vector spaces, subspaces, basis, dimension, Linear and transformations and their representation by matrices, Linar functionals, interpolation of functions.

Inner product spaces, Orthonormal sets, Gram Schmidtt process and its application to the method of least squares, QR algorithm, Contraction mapping theorem and its application to numerical solutions of nonlinear equations.

Approximation of linear transformation and functionals, numerical integration and differentiation, Numerical solutions of differential and integral equations.

References :

1. *J B Fraleign and R A Beauregard, Linear Algebra, Addison-Wesley Publishing Company, 1995.*
2. *S Kumaresan, Linear Algebra, a geometric Approach, prentice Hall of India, 2000.*
3. *S I Grossman and W R Derric, Advanced Engineering Mathematics, Haaper and Row, 1988.*
4. *S D Conte and C Deboor, Elementary Numerical Analysis: An Algorithmic Approach, McGraw Hill 1980.*

MA204 Statistics 3 0 0 3

Review of Probability and Distributions

Sampling Distributions, Inferences, Concerning means Variances, Proportions, Chi-squares tests.

Non-parametric tests, Analysis of Variance, Correlation and regression.

References:

1. *Richard A Johnson, Miller and Freund's Probability and Statistics for Engineers, 5th Edition, Prentice Hall of India 1996.*
2. *J E Freund and N E Walpole, Mathematics Statistics, 4th Edition, Prentice Hall, 1987.*
3. *P L Meyer, Introductory Probability with Statistical Applications, Amerind Pub Co Pvt Ltd 1970.*

MA205 Probability and Random Processes 3 0 0 3

Axioms of probability, conditioning and independence, Random variables and distribution functions, Standard distributions, Joint distribution, Expectation, moments and moment Generating function, Centre limit theorem.

Elements of Stochastic processes; Second order processes, Poisson and Normal processes, Markov chains. .

References :

1. *K.L. Chung; Elementary Probability Theory with Stochastic Processes – Narosa Publishing House, New Delhi, 1981.*
2. *Papounils, a Probability and Random Variables and Stochastic Processes, McGraww Hill, Kongakusha Ltd. 1984.*
3. *P L Meyer, Introductory Probability and Statistical Applications, American Publishing Company Pvt Ltd. 1990*

MA206 Graphs and Combinatorics 3 0 0 3

Graphs: Basic concepts , trees and their applications, graph search algorithms, Euler and Hamilton graphs, planar graphs, chromatic numbers.

Combinatorics: Basics of counting, pigeon hole principle, inclusion-exclusion principle, recurrence relatins and their solutions, enumeration of trees.

References :

1. *J L Morr, A Kandel and T P Baker, Discrete Mathematics for Computer Scientistics and Mathematics, PHI, 1999*
2. *D B West: Introduction to Graph Theory PHI 1999*
3. *N I Biggs, Discrete Mathematics, Oxford Science Publications, 1985.*

MA 207 Linear and Integer Programming 3 0 0 3

Linear programming; Problem formulation, Graphical method, Simplex procedure, revised Simplex method, Duality, Dual Simplex method, Sensitivity analysis, Transportation and Assignment problem.

Integer Programming, Cutting plane algorithm – Brnach and bound technique Travelling salesman problem.

References :

1. *F.S. Hillier and G.J. Lieberman; introduction to Operations Research McGraw Hill 1990*
2. *H.A. Taha; Operations Research ; An Introduction (5th Ed.) – Prentice Hall of India Pvt. Ltd., 1996.*

3. *A. Ravindran, D.T. Phillips and J.L. Solberg; Operations Research ; Principles and Practice – John Wiley & Sons, 1987.*

MA213 Basic Graph Theory **3 0 0 3**

Fundamentals:Graphs, subgraphs, isomorphism, representation of graphs, degrees and graphic sequences, walks, trails, paths, cycles, connectivity, bipartite graphs

Trees: Characterisations of trees, minimum –spanning –trees, number of trees, cayley's formula

Connectivity: cut-sets, characterization of blocks.

Search algorithms: DS,BFS, shortest path algorithms, identification of cut-vertices and cut-edges.

Eulerian and Hamilton graph; Characterizations, Necessssary / sufficient conditions, Fleury's algorithms.

Coverings, independent sets: Basic relations, matchings in bipartite graphs, Tutte's perfect matching theorem and consequences.

Colorings, Edge-colorings of bipartite graphs, Gupta Vizing's theorem (without proof), greedy algorithm for vertex-colorings, Brook's theorem, clique-number and vertex chromatic number.

Planar graphs: Euler's formula V-E+F=2 and its consequences, Kuratowski's characterization (without proof), DMP planarity algorithm.

Directed graphs: Basics, various connectivities and tournaments.

Books:

J.A. Bondy and U.S.R. Murthy, Graph Theory with Applications, Macmillan, 1976
D.B. West, Introduction to Graph Theory, P.H.I 1999.

6.2 Humanities & Social Sciences

S.No.	Course	Title	Credit
1	HS121	English “O” Level (Pass/Fail)	0
2	HS201	English for Communication	3
3	HS202	History	3
4	HS203	Modern Govt & Comparative Constitutions	3
5	HS204	Indian National Movement & Constitutional Development 1858 - 1950	3
6	HS205	Sci Fiction:An Appreciation	3
7	HS206	German I	3
8	HS207	German II	3
9	HS208	French - I	3
10	HS209	French II	3
11	HS210	Russian I	3
12	HS211	Outlines of Indian Soc. & Cul. in Historical Pers.	3
13	HS212	Sci.,Tech & Medicine in India: A historical pers.	3
14	HS213	Contemporary German Philosophy	3
15	HS214	Literature in Translation	3
16	HS221	English Advance Level	3
17	HS231	Indian Economic Development	3
18	HS232	Economics of Industrial Organizations	3
19	HS233	Economics for a Developing World	3
20	HS234	Introduction to Psychology	3
21	HS235	Consumer Psychology	3
22	HS236	Industrial Psychology	3
23	HS237	Introduction to Sociology	3
24	HS301	Creative Writing	3
25	HS304	Religion and Modern Science	3
26	HS305	Professional Ethics	3
27	HS308	American Studies I	3

HSS

S.No.	Course	Title	Credit
28	HS309	Short Story Classics	3
29	HS313	Introduction to Indian Philosophy	3
30	HS341	Modern Science in India	3
31	HS365	Operations Management I	3
32	HS401	Indian Fiction in English	3
33	HS402	Indian Classics and Cultural Values	3
34	HS403	Literature and Life	3
35	HS404	Better Spoken English	3
36	HS405	Technical Communication and Report Writing	3
37	HS406	Humanities in a Technological Age	3
38	HS407	Introduction to Modern Linguistics	3
39	HS408	Communication & Discourse Strategies	3
40	HS409	Theory and Practice of Rhetoric	3
41	HS410	German III	3
42	HS411	German IV	3
43	HS412	German Studies I	3
44	HS413	German Studies II	3
45	HS415	Introduction to Western Classics	3
46	HS416	Literature & Values	3
47	HS419	German for Scientific Purposes	3
48	HS431	Economics	3
49	HS432	Applied Economics	3
50	HS433	Environmental Resources Economics	3
51	HS434	Industrial Economics	3
52	HS435	Contemporary issues in Development	3
53	HS436	Environmental Psychology	3
54	HS437	Social Psychology	3
55	HS440	Introduction to Modern Western Thought	3

HSS

S.No.	Course	Title	Credit
56	HS441	History of Science & Technology	3
57	HS442	Technology & Development	3
58	HS443	Great Social Thinkers	3
59	HS444	Computers and Society	3
60	HS445	Introduction to European Philosophy	3
61	HS446	Science, Society and Languages	3
62	HS447	Nomistics - The Study of Human Values	3
63	HS448	Values, Technology, Sciences and Society	3
64	HS449	Language, Culture & Society	3
65	HS450	Contemporary India:Sociological Perspective	3
66	HS451	Political Philosophy3	
67	HS477	International Trade & Finance	3

HSS

6.2 Humanities and Social Sciences Courses

HS121 English "O" level (Pass/ Fail **3 0 0 0**

Course Objective	:	Competence in Functional English
Course Content	:	Remedial Grammar Sentence Structure Vocabulary
Discursive Writing	:	Paragraphs, Letters Reading Comprehension
Note making	:	Summarising
Oral practice	:	Pronunciation, Basic Conversation

Texts and References:

1. *A Remedial Grammar of English: Wood, F T Madras : Macmillan India, 1969*
2. *Practical English Grammar: Thomson and Martinet, New Delhi: Oxford University Press, 1986*
3. *Living English Structure : Allen, Stannard W., Hyderabad: Orient Longman, 1997*
4. *A Communicative Grammar of English : Leech, Geoffrey & Jan Svartvik, London: Longman, 2003*

HS201 English for Communication **2 1 0 3**

1. Structure of English	-	Remedial Grammar
2. Reading	-	Comprehension and Analysis
3. Writing	-	Memos, Letters, Reports, Reviews
4. Study Skills	-	Dictionary, Thesaurus, Reference, Note Taking, Listening Comprehension
5. Presentation Skills	-	Oral Presentation, Presentation Aid.

HS202 History **3 0 0 3**

HSS

Part I : Classical Greece — Imperial Rome — Modern European States System – Emergence of USA — French Revolution – Nationalists Movement in Italy and Germany Russian Revolution - The two World wars – Post War Developments.

Part II : Pre – historic Indian Cultural antiquity – Heritage of Vedas and Upanishads – Rise of Hinduism – Revolt against Brahmanism – Jainism and Buddhism — Culture and Civilization at the end of 6th century AD – Mughal and Maratha contribution to Indian development – Rise of British Power – Introduction of English Education – Cultural Renaissance – Indian National Movement(1885-1947)Post Independent – India.

HS203 Modern Governments & Comparative Constitutions **3 0 0 3**

Meanings of political constitutionalism - Constitutional State – its origin and growth – Classification of constitutions – unitary State – Federal State – Flexible Constitution – Rigid Constitution - legislature – (a) Suffrage; and Constituencies

— (b) Second Chamber – (c) Direct popular Checks – The Non-Parliamentary Executive- The judiciary – Rule of Law and Administrative Law – Economic and Political Internationalism.

HS204 Indian National Movement & Constitutional Development 1858 - 1950 **3 0 0 3**

Constitutional development from 1858 and rise of Nationalism – Growth of representative institutions – the Indian Council Act, 1861 – reform of 1892 – the Minto-Morley Reforms. Indian External Congress – Moderates and Extremists – Muslim League and Communal representation – The advent of Mahatma Gandhi – Kilafat Movement – the Government of India Act 1919 and Government of India Act of 1935 – The developments leading to the end of the British Empire and the partition of India. Free India – integration of Indian States – From Dominion to Republic.

HS205 Science Fiction: An Appreciation **3 0 0 3**

This advanced optional course aims at a close analytical study of the impact of science and technology on Man and his several institutions in society as expressed in science fiction. It introduces the students to some samples of science fiction, and through a critical discussion and analysis helps them appreciate the creative link between scientific discoveries and technological inventions and human civilization. Finally, it will further improve the student's ability to analyse scientific concepts in extended discussions and compositions. Special emphasis will be laid on increasing ability and style.

HS206 German – I **2 1 0 3**

HSS

German for science and technology, based on the book 'German for science and Technology' by stecker/Davids, for beginners grammar, noun group; verb, prepositions, pronouns, modal verbs, compound verbs, reading and translating practice. Simple colloquial German.

HS207 German – II **2 1 0 3**

German for Science and Technology, based on the book 'German for Science and Technology by Stoecker/Davids, continuation of GERMAN-I; grammar; subordinate clauses, compound senses, passive voice, infinitive and participle constructions subjunctive. Further reading and translating practice of technical texts. Continuation of colloquial German.

HS208 French – I **2 1 0 3**

Definite and indefinite articles – Adjectives – agreement with their nouns – Conjugation of verbs; to have, to be affirmative, negative and interrogative forms – possessive adjectives. Contraction of 'of the' 'to the' (Singular and Plural) – demonstrative adjectives – The three groups of verbs – present perfect tense with 'to have' and 'to be' – The partitive article – Future tense – immediate future recent past – Reflexive verbs – Present perfect of reflexive verbs.

HS209 French – II **2 1 0 3**

The imperative mood – Comparison of adjectives – Gender of adjectives – Subject and direct object – Possessive pronouns – subject direct object – Conjucation of verbs – peculiarities of certain verbs – Imperfect tense – Adverbs – Relative pronouns – Demonstrative pronouns – interrogative adjectives and pronouns – Agreement of the participle – Grammatical analysis – Future perfect – past perfect – present participle – Conditional present.

HS210 Russian – I **3 0 0 3**

Russian Writing – Basic information on phonetics and intonation – Reading rules – Grammar – Morphology – The Noun – The Gender of Nouns – The Plural of Nouns – Changing the Noun for Case – Three Types of the Declension of Nouns – The Adjective – Changing the Adjective according to Gender – Changing the Adjective according to Number – Declension of Personal Pronouns – The Reflexive Pronoun – Possessive Pronouns – Negative Pronouns – Indefinite Pronouns – The Numerals – Classification of Numerals – Cardinal Numerals – Ordinal Numerals – The Verb – General Idea of Verb Aspects – The Infinitive – Verbs – Verbs of Motion – The Imperative Mood – The Conditional Mood – The Preposition – The Conjuction – Syntax – Declarative, Interrogative and Exhortative Sentences – Parts of the Sentences – Compound Sentences – Complex Sentences – Oral Topics – About myself – My Institute – The lesson of Russian – My City – Shoppings and India – Education in the USSR and India – Space – The first Indian consmonaut – Science in the USSR and India – Russian and Indian writers – Economy of the USSR and India – Etc.

HSS

HS211 Outlines of Indian Society and Culture in Historical Perspective **3 0 0 3**

Harappan Civilization – Society – economy – Religious and art. The Aryans – Society Religion and Culture during the later Vedic Age - Developments during the later Vedic Age – Social and Religious developments during the Sixth Century B.C. Indian Society during 300 BC -–600 AD (Northern India – Deccan and South India) Society and Culture in the middle ages in India.

HS 212 Science, Technology and Medicine in India :A Historical Perspective Scope and Objectives: **3 0 0 3**

This course is designed to provide a broad historical overview of the growth of science, technology and medicine in India.It aims to explicate to the students the rich scientific and technological heritage of India and the positive response to the abvent of modern science through the colonical agency, resulting in the emergence of a viable modern scientific community in India.

Course Contents:

1. Early Indian approaches to the universe, understandings of the physical world, theories of matter and the quest to transcend existential limitations.
2. Development of science and medicine till the colonial era. Astronomy of the Vedas and Aryabahata, Varmaihira and Bhaskar I, Brahmagupta , the Arab connection, Sawai Jai Singh. Mathematics & Geometry: Shulabha Sutra, the Indian numerals , the decimal notations , calendars and algebra. Medicine and Surgery: Charaka ans Sushruta Samhitas, Physiology, Anatomy , Meteria Medica, Unani & Ayurveda. Physical and Botanical Sciences, Antiquity of Indian Chemistry and Alchemy.
3. Advancements in Technology till pre-colonial times: Metallurgy , Artillary , Gunpowder technology , Persian wheel , textile technology , the charka, bleaching, dyeing, Architecture: Monuments, Bridges, Naval Architecture, Shipbuilding and Agricultural technologies.
4. Advent of colonial science: Early colonial settlement and scientific explorations. The East India company- Surveyors, Botanists and Doctors under the company's Service, The Indian Medical Service, Encounters with Indian medicine, Introduction of stream technologies, Railways, Textiles, Mining, Telegraphs, Canals and Dams.
5. Indian response to modern science, the colonial restrictions and limitation, Science and nationalism and the emergence of the Indian scientific community.

HSS

Suggested Reading:

Books:

Arnold, David, Science, Technology and Medicine in colonial India Cambridge, 1999.

Bose, D.M.S.N.Sen, and B.V.Subarayappa, A Coincise History of science in India, New Delhi.1971

Chattopadhayaya, Debiprasad, Science and Society in Ancient India, Calcutta, 1979.

Headrick, D.R., The Tools of Empire: Technology and European Imperialism in the Nineteenthe century, New York.1981

Jaggi, O.P Histroy of science , Technology and Medicine in India, 15 volumes, Delhi, 1969-84.

Kumar ,Deepak, Science and the Raj, Delhi,1995.

Lourdusamy, J B.,(forthcoming) Science and National Consciousness in Bengal, c 1870-1930, Hydrabad, [Jan 2004].

Macleod, Roy and Deepak Kumar, eds., Technology and Culture, Delhi,1982.

Qaisar, A J The Indian Response to European Technology and culture, Delhi, 1982.

Sen, S.N Cultural Heritage of India, Vol vi ., Calcutta, 1972.

Journals:

Studies in History of Medicine and Science

Bulletin of Indian Institute of History of Medicine

Indian journal of History of Science

Science and culture

Journal of the Asiatic Society of Bengal

HS 213 CONTEMPORARY GERMAN PHILOSOPHY 3 0 0 3

Course Objective:

Centered around an understanding of the philosophical and cultural foundations of German life and thought. Proceeding from an elaboration of the traiditional matrix of German Philosophy (ranging from Leibnitz through Kant to Nietzsche) it seeks to amplify some contemporary movements like Phenomenology and Hermeneutics and their reflexes in post-modern discourse. The course also aims at an understanding and assessment of the impact of German thought on European Civilization.

HSS

Syllabus:

1. Introduction to Philosophical Thinking
2. Western Philosophy: A Brief Analysis
3. Metaphysics and Epistemology
4. The German Philosophical Tradition
5. Twentieth Century Developments in Philosophy – The Linguistic Turn
6. Phenomenology
7. Existentialism
8. Hermeneutics
9. Critical Theory
10. German Thought and its contemporary pan-European reflexes

References:

1. *Paul Gorner:* Twentieth Century German Philosophy, *Oxford University Press, 2000.*
2. *Rudolf Majut: German Thought, from Bithell, Jethro:* Germany: A Companion to German Students*, London, Mathew and Co Ltd., 1962.*
3. *Smith, Barry and Smith. David Woodruff (Editors):* The Cambridge Companion to Husserl*. Cambridge. Cambridge University Press, 1995.*
4. *Silverman, Hugh J:* Philosophy and Non-Philosophy Sine Merleau-Ponty*. New York, Routledge. 1988, Bleicher. Josef*:Contemporary Hermeneutics*. London. Routledge and Kegan Paul: 1980.*

HS214 - Literature in Translation 3 0 0 3

Course Content and Objectives:

This course involves the study and analyses of literatures (from different regions of India and all over the world) translated into English. Studying literature in translation is a way of enriching cultural experience, of understanding the universality of human experience.

It is meant primarily for students not having a command of a particular Indian or foreign language who may nonetheless wish to acquaint themselves with literature from that linguistic context. The course will draw upon a broad spectrum of texts from the Indian subcontinent, Asia, Europe, China, Latin America, Africa and the Middle East. The objective of the course is to broaden students' exposure beyond American and English literature and to refine their literary sensibilities in a multilingual, global context. The course will also expose students to some theoretical and practical aspects of translation. Class activities could involve working on translation as well – both from a regional or foreign language into English as well as the other way around.

HSS

Syllabus:

A) Indian Literatures in Translation (Selections from the following texts):

1. Dept. of English, University of Delhi, *Modern Indian Literature*. New Delhi: OUP, 1999.

2. Hariharan, Githa ed. *Katha Regional Fiction: A Southern Harvest*. New Delhi: Katha, 1993.

3. Ezekiel, Nissim and Meenakshi Mukherjee eds. *Another India: An Anthology of Contemporary Indian Fiction and Poetry*. New Delhi: Penguin, 1990.

B) Literature in Translation from Other Parts of the World (Selections from the following texts):

1. Gray, Stephen. *The Picador Book of African Stories*. London: Picador: 2000.

2. Su Tong, *Raise the Red Lantern: Three Novellas* (trans. from the Chinese by Michael Duke). London: Scribner, 1990.

3. Echevarna, Roberto Gonzalez ed. *The Oxford Book of Latin American Short Stories*. New York: OUP, 1997.

Reference:

1. *Bassnett-McGuire, Susan*. Translation Studies. *London: Methuen, 1980.*
2. *Bassnett-McGuire, Susan and and A. Lefevere, eds.* Translation, History, and Culture. *London: Pinter Publishers, 1990.*
3. *Lefevere, André. Translating Literature: Practice and Theory in a Comparative Literature Context. New York: Modern Language Association of America, 1992.*
4. *Robinson, Douglas. Western Translation Theory From Herodotus to Nietzsche. Manchester, UK: St. Jerome Publishing, 1997.*
5. *Robinson, Douglas. Translation and Empire: Postcolonial Theories Explained. Translation Theories Explained 4. Manchester, UK: St. Jerome Press, 1997.*
6. *Hardwick, Lorna. Translating Words, Translating Cultures. London: Duckworth, 2000.*
7. *Hatim, B. and Mason, Ian. The Translator as Communicator. London: Routledge, 1997.*

HSS

HS 221 English Advanced Level **3 0 0 3**

Course Objectives	:	Acquisition of higher order Language skills: Style , Idiom, Nuance. Literature Appreciation.
Course Content	:	Writing: Essays, Reports, Reading: Select
Literary Texts:Prose, Poetry, Drama, Short Stories, Book Review, Oral Skills	:	Presentations; Discussions

Text and References :

1. *Cambridge Advanced Learners' Dictionary 2005*
2. *Palgrave's Golden Treasury : Ed. Palgrave, Frances Taylor London: Oxford University Press, 1861*
3. *20th Century English Literature, London: Penquin 1992*
4. *The Garden of Forking Paths and Other Stories : Harris, V.C. New Delhi: Oxford University Press, 2002*
5. *Discussion Materials: Film / News Clippings, Plays etc.*

HS231 Indian Economic Development **3 0 0 3**

This course seeks to provide an elementary introduction to India's economic and social development since independence. The topics to be covered are listed below:

1. Impact of British Colonial rule on Indian development
2. The structure of Indian Economy at independence
3. Economic growth and development performance since independence: A macro overview
4. Sectoral performance: Agriculture, Industry, Social sectors, Demography
5. Development strategies: Role of state, market and planning
6. Indian Economy: Issues of importance

HS232 Economics of Industrial Organisations **3 0 0 3**

HSS

Introduction, Basic Economic Concepts, Central Problems of Every Economic Society, Economic Agents and Systems, Elements of Demand and Supply, Forms of Business Organisations and Business Motives, Theory of Production and Costs, Structure of Industry and Its Determinants, Market Structure, Market Share and Concentration, Economics of Scale and Scope, Growth of Firms- vertical integration, diversification, mergers etc., Price and output Behaviour in Imperfect Markets,

Potential Competition, and barriers to Entry, Entry conditions, Contestable markets, Entry deterrence, Product Differentiation, Efficiency, Profitability and Indicators of Performance, Technical change, Government and Industry, Role of Government, Industrial Policy and Reforms in India, Public Enterprises in India, Globalisation and Indian Industry.

HS233 Economics for a Developing World **3 0 0 3**

Principles and Concepts: Economics: its nature and importance for developing countries, Economic systems and Third World economies, Basic concepts and principles, Common characteristics of developing countries, meaning of Development.

Economic problems and policies: Problems of growth: causes, characteristics, lessons and controversies, Poverty and inequality, Population and development, Common property management and economic development, Agriculture and rural development.

Development planning: Theory and Practice: market versus non-market mechanisms, Monetary and fiscal policies, Global interdependence and the new international economic order, Role of international economic order, Role of International Development Agencies.

HS234 Introduction to Psychology **3 0 0 3**

The Role of Psychology in organisational behaviour – Personality and its assessment – Motivation – Group Dynamics – Perception – Attitude and Attitudinal change. (The above syllabus to be taught in an organisational context)

HS235 Consumer Psychology **3 0 0 3**

Consumer Behaviour: Introduction, Market Segmentation and Consumer Research, Consumer Needs and Motivation, Personality and Consumer Behaviour, Consumer Perception, Learning and Consumer Involvement, Nature Formation and Change of Consumer Attitude, Communication and Consumer Behaviour, Group Dynamics and Consumer Behaviour, Family, Social Class and Consumer Behaviour, Influence of Culture on Consumer Behaviour, Sub-Cultural Aspects, Cross-Cultural Consumer Behaviour: An international Perspective, Opinion Leadership Process, Diffusion of Innovation, Consumer Decision –making including Models, Marketing Ethics.

HSS

HS236 Industrial Psychology **3 0 0 3**

Definition, Methods and scope of industrial Psychology – Individual and Situational differences in job performance – Psychology testing – Performance evaluation – motivation and the work environment – Leadership and supervision – Accidents and safety.

HS237 Introduction to Sociology **3 0 0 3**

The course attempts to provide a sociological perspective in understanding human behaviour. Beginning with some elementary concepts in the study of society, the course progresses with units on social Institution; social stratification; social change and concludes with the spin offs of globalisation on the Indian society.

The course primarily would consist of lectures to introduce the topics but complement with presentations by students and discussions. It would also include one term paper by every student.

Syllabus

1. Sociology – Definition – Relevance
2. Some basic concepts: Group; society; culture;
3. Social Institutions: Family; Economy; Education; Religion; Political Institutions.
4. Social processes and Social stratification: Mobility and Inequality.
5. Social change and Globalisation: Integration Vs Isolation.

References

1. *Henslin, James. M;SOCIOLOGY – A Down to Earth Approach; Allyn and Bacon; Boston, London, Singapore – 1997.*
2. *Featherstone, Mike, Scott Lash & Roland Robertson (editors) GLOBAL MODERNITIES, Sage Publications, London, New Delhi, 1995.*
3. *Schaefer. Richard.T & Robert.P.Lamm. SOCIOLOGY, McGraw Hill, Inc. New York, New Delhi, 1992.*
4. *Smelser, Neil.J. SOCIOLOGY, Black Well Publishers, Cambridge, Mssachusetts, USA; 1994.*
5. *Anthony Giddens – Sociology, Polity Press.*

Journals

1. *American Journal of Sociology / British Journal of Sociology.*
2. *Seminar*

HSS

HS 301 Creative Writing **3 0 0 3**

Course Contents:

1. The pleasures of thinking and writing creatively.
2. Exploring the limits of language and literature.

3. The basics of crafting short stories, plays, poetry and short fiction leading to the shaping of a finished creative piece.
4. Developing and plot and character.
5. Point of view
6. Atmosphere and detail in writing
7. Editing skills
8. Insights into the shaping of a creative piece through a reading of a selection of creative work.
9. Essays by creative writers on the process of writing.

Syllabus:

1. Bell, Julia, "Introduction" (Training the Eye) in Julla Bell and Paul Magrs Ed. The Creative Writing course book. London : Macmillan, 2001.
2. Magrs, Paul. "Introduction"(point of view) in Julia Bell and Paul Magrs Ed. The Creative Writing course book. London : Macmillan, 2001.
3. Bradbury, Malcolm, "Character and Characterization " in Julia Bell and Paul Magrs Ed. The Creative Writing course book. London : Macmillan, 2001.
4. Strokes , Ashley, "Plotting a Novel " in Julia Bell and Paul Magrs Ed. The Creative Writing course book. London : Macmillan, 2001.
5. Glaister,Lasley . "Memory: The True Key to Real Imaging" in Julia Bell and Paul Magrs Ed. The Creative Writing course book. London : Macmillan, 2001.
6. Excerpts from Chekhov, Anton .The kiss and other stories. London: Penguin, 1982.
7. Excerpts from Ramanujan, AK Poems of love and war. New York:Columbia Uty., Press.1985.
8. Excerpts from Morrison, Tony. Beloved . New York. New York: Plume, 1987.

Reference:

1.Gill, Richard. Mastering English Literature. London: Macmillan, 1985.
2.Cuddon J.A.A Dictionary of literary terms. Delhi: Clarion 1980.

HSS

HS 304 Religion and Modern Science **3 0 0 3**

Scope and objectives:

This course would seek to create an informed understanding of the relationship between scientific pursuits and religious beliefs. It aims to help the student see beyond the restrictive confrontationist model on the one hand and the segregationist model on the other. It would highlight the overlaps between the spaces of religion and science and the more complex relationship engendered therein. While taking good note of the ways and instances in which religion had been right away a hindrance to science, the students, at the same time, would be trained to see the ways and forms in which religion could

- ⇨ Serve as an inspiration for the pursuit of science
- ⇨ Provide valuable metaphysics
- ⇨ Serve to enrich the script of scientific discovery
- ⇨ Mitigate some of the excesses of modern science

Course Contents:

Science – Its underlying principles, methods and approaches to the universe and life. Religion – Its place and society and its approaches to life and reality. Science verses religion – Confrontationist, Segregationist and interactive models. Historical case studies of some scientists/thinkers approaches to the science - religion problem – Western context: Copernicus, Galileo, Newton, William Buckland, Charles Dharwin, Einstein and Max Weber. Case studies – Indian Context: Mahindralal Sircar, Srinivasa Ramanujam, Keshub Chandra Sen, Jgadis Chandra Bose, Swami Vivekananda, Aurobindo Ghose and J Krishnamurthy.

Suggested Readings:

Books:

Barbour, Ian, Religion in an Age of Science, San Francisco, 1990.
Brooke, Jon Hedley , Science and Religion: Some Historical Perspectives, New York, 1991.
Gosling, David, Science and Religion in India, Madras,1976.
Golsling, David, Science and Religion: From Conflict to conversation, New York 1995.
Jaki, Stanley L., The Record of Science and the ways to God, Chicago, 1978.
Lokeswaranda, Swami, Science and Religion, Calcutta., 1987.
Ranganathananda, Swami, Science and Region, Calcutta, 1997.
Russell, C.A., Cross-Currents : Interactions Between Science and Faith, Leicester , 1985.

HSS

Journals:

At the Central Library:
New Scientist
Science, Technology and Human Values
Social Studies of Science

Technology and Society
At www.sciencedirect.com
Studies in History and Philosophy of Science
Technology in Society
The Social Science Journal

HS 305 Professional Ethics **2 0 0 2**

Course Content:

- Concepts of profession and highlights its difference from occupation or job
- The vital role of ethics in professional
- The importance of ethical codes in professional and the prerequisites of an ethical professional
- The nature of engineering ethics, the value of ethical practices in engineering and the virtues of an ethical engineer.

Texts and References:

Texts:

1. *Velasquez, Manuel G : 2002, Business Ethics: Concepts and Cases, Fifth Edition , New Jersey, Prentice Hall.*
2. *Harris, Charles, E Jr., Michael S.Pritchard, Michael J.Rabins, 1995, Engineering Ethics: Concepts & Cases, Belmont, Wadsworth Publishing Company.*
3. *Supplement Reading Materials(SM)*

References:

1. *Sekhar, R.C :1997, Ethical Chioces in Business Response Books, New Delhi, Sage Publications.*
2. *Kitson, Alan and Campebell, Robert :1996. The Ethical Organization, Great Britain Macmillan Press Ltd.*
3. *Pinkus, Rosa Lyun B., Larry J Shulman, Norman Phummon, Harvey Wolfe: 1997, Engineering Ethics New York, Cambridge Uty., Press.*
4. *Erwann, M David, Willams, Masy B and Guiterrez, Claudio:1990, Computers, Ethics and Society , Oxford, Oxford Uty., Press.*
5. *Langford, Duncan (EDT):2000, Internet Ethics, London, Macmillan Press Ltd. 2000*

HSS

HS 308 American Studies I **3 0 0 3**

Course Content:

This course is introductory study of American history and institutions from the early days of colonial settlement to present times. It highlights the development of the society through the major trends movements such as Slavery-Civil Rights – Black Power; The Depression – Democracy –Equal Opportunity. It examines issues of Race, Religion , Politics and Gender alongside the cultural aspects of American Dream; American Theatre, Film and Music.

The Course will draw upon the literature of America to exemplify and understand through the work of its literary masters, the complexity and challenge of social change in the United States.

Texts and References:

1. *Literary History of the United States:Eds.Spiller et al. Indian edition:Macmilan., 1972.*
2. *Carl N Degler, Out of Our Past :The Forces that Shaped modern America. Wiley Eastern Reprint, 1986.*
3. *A Twenthieth-Centuary American Reader, Eds,. Jack Lane and Maurice O'Sullivan, USIA: Washington D.C .,1999.*
4. *The Niortom Anthology of American Literature , 6th Edn ., Norton and C. Inc.:N.Y.:2003.*
5. *Loren Baritz, Sources of the American Mind: A Collection of Documents and Texts in American Intellectual History. John Wiley & Sons: NY, 1966.*
6. *Nelson Manfred Blake, A History of American Life and Thought, McGraw Hill, 1972.*
7. *Thomas Bailey, The American Pageant: A History of the Republic, Indian Reprint Edition, Sterling, 1974.*

Journals:

1.PMAL: Publications of the Modern Language Association of America

2.IJAS:Indian Journal of American Studies
3.The Atlantic Monthly
4.Southern Review
5.Kenyon Review

HS 309 Short Story Classics **3 0 0 3**

Course Content:

The Short Story as a literary genre has found a place among the great works of the masters of fiction.The craft and technique of the short story has been perfected over time by its proponents around the world. This course traces the history and development of the short story genre, studies shot story theory, examines technique, and analyses the short stories of European, American and Third world writers whose works have achieved classic brilliance. It studies the various categories of the short story of the detective, crime and horror stories, to traditional and regional tales, fairy tales, and the work of modern and contemporary masters.

HSS

Texts and References:

1. *The O.Henry Prize Stories, NY: Doubleday: Annual Collections*
2. *Oxford world classics, OUP, 1999.*
3. *Selected Short Stories, Penquin classics, Viking, 1971.*
4. *Twenty great American Short Stories, ed. Asron R Eiss, 2000.*
5. *Imaging America : A Multicultural Anthology of Short Stories, Brown &Ling. Indian Edn,. 1995*
6. *Laurence Perrine, Story and Structure, NY:Harcourt, 1959.*
7. *T.O Beachcraft, the Modest Art: A Survey of the short story in English, London: OUP, 1968.*

Journals:

Studies in Short Fiction.
Modern Fiction Studies .
Genre
Saturday Review
New York Times Book Review

HS 313 Introduction to Indian Philosophy **3 0 0 3**

Course Content:

- ⇨ India's Philosophical and intellectual traditions, Value of Indian approaches to reality in general and problems of life in particular.
- ⇨ The conceptual continuity between the various traditional philosophical issues and the philosophical riddles that encounter in modern life.

Texts and References:

Texts:

1 *Hiriyana, M Outlines of Indian Philosophy, Motilal Banarsidass Publishers Private Ltd., Delhi., 1994.(T1)*
2 *Supplementary Reading Meterial(SRM)*

References:

1 *Ganapathy, T N :1993, The philosophy of the Tamil Siddhas, New Delhi, Indian Council of philosophical Research. (R1)*
2 *Chattopadhyaya, D P: 1990, Carvaka/ Lokayata:An Anthology of Council of Philosophical Research.(R2)*
3 *Raja, Kunjunni K: 1969, Indian Theories of meaning , Adayar, Chennai, The Adayar Library and Research Centre.(R3)*

HSS

HS 341 Modern Science in India **3 0 0 3**

This course is deal with the advent and growth of modern science in India under the aegis of colonialism and the Indian response to it. It would delineate the many ways in which the entire process was implicated not only in the political axis of colonialism and nationalism but also in the various socio-cultural developments of the period.

Course Structure:

a) What is modern Science? –The Scientific Revolution and the rise of modern science in the [1500-1700].

b) The advent of modern science in India : Early travelers,missionaries, colonial settlements and scientific explorations, The east India Company – surveyors, botanists and doctors under the company's service, The Asiatic Society[1500-1757]

c) Institutionalized colonial Science: The various scientific departments, the Indian medical service, Introduction of new technologies – Railways, Textiles, Mining, Telegraphs, Canals and Dams.[1757-1900]

d) Science education in colonial India: Origins of English and western education, founding of the Universities, the content of science in the curricula, ht esetting up of technical institutes, the restrictions and limitations of colonialism.[1980-1930]

e) The Indian response : Response to English Education, its implications for indigenous society and culture, and the role of social and religious reformers, the taste for modern science, setting up of indigenous societies for the learning and cultivation of modern science.[1830-1930].

f) The first modern Scientists of India :Ramanujam, J C Bose, P C Ray, Meghnad Saha, C V Raman, S N Bose.

Texts:

1. *Arnold, David, Science, Technology and Medicine in Colonial India, Cambridge: Cambridge Uty., Press 2000.*
2. *Headrick, D R ., The Tools of Empire: Technology and European Imperialism in the Nineteenthe Century, New York, 1981.*
3. *Kuma Deepak Eds. Science and Empire: Essays in the Indian context, Delhi: Anamika Prakashan, 1991—, Science and the Raj, 1857-1905. Delhi: Oxford Uty.Press 1995.*
4. *Qaisar , A J., The Indian Response to europeean technology and culture , Delhi: Oxford Uty.Press 1982*
5. *Sangwan S Secience, Technology and colonization: Indian Experience, Delhi: Anamika Prakashan,1990.*

HSS

Additional Readings:

1. *Adas, Michael, Machines as the Measure of Me:Science, Technology and Ideologies of western Dominance., Ithaca: Cornel Uty., Press, 1989.*
2. *Baber, Zaheeer, The Science of Empire : Scientific knowledge, Civilization, and Colonial rule in inia, Albany: State Uty., of New York Press, 1989.*
3. *Biswas A K, Science in India. Calcutta: Firma K L Mukhopadhyay, 1969.*
4. *Butterfield, Herbert, The Origins of Modern Science, 2nd Edn.,NY: Wiley, 1991.*
5. *Dasgupta, Subrato, Jagadis Chandra Bose and the Indian Response to western sceience, Delhi: Oxford Uty., Press.1999.*
6. *Goomatilake , S, Aborted Discovery: Science and creativity in third world, London : Zed Books, 1984.*
7. *Whitehead, A N ., Science and the Modern World, New York, 1925.*
8. *Nandy, Ashis, Alternative Sciences, 2nd edn Delhi: Oxford Uty. Press, 1995[first published 1980].*
9. *Prakesh, Gyan , Another Reason: Science and the Imagination of Modern India.Princeton: Princeton Uty., Press, 1999.*

HS401 Indian Fiction in English **3 0 0 3**

This optional advanced course aims to introduce the student to the latest field in English studies, namely, the Indian Fiction in English which is but a faithful reflection of the subtle and significant changes that have taken place in Indian society as recorded by some of the gifted men and women of India. The student will be trained through a series of discussions and assignments to appreciate the interconnected nature of scientific progress and cultural change and the creative literature of the land. The course also develops the student's skills of group discussion and argumentation on the basis of the selected readings in Indian Fiction en English.

HS402 Indian Classics and Cultural Values **3 0 0 3**

The course aims at a critical introduction to, and appreciation of, the two well – known Indian epics – The Ramayana and The Mahabharata – dating back to about 1500 B.C. Besides promoting a cross-cultural understanding, it seeks to place, through discussion and analysis, the relevance of the classics in the context of tradition and modernity. It will also focus on the Ramayana tradition in Asia and examines the literary style in the prose and poetic forms of the epics in English translation.

HSS

HS403 Literature and Life **3 0 0 3**

The objective of this course is to expose the student to examples of great literature which form a necessary complement to our scientific and industrial pursuits. Literature, through its thematic and symbolic expositions, illustrates its concern with human problems, which are avowedly the priority of science. By focusing attention on mankind's purposes and values, great literature exemplifies the vital link between life and letters. The course material will include the works of representative writers from the fields of English and American literature. However, since the aim of this course is to offer an in depth study of literary works, only a few selected pieces will be handled in the course of a semester. Specific bibliographies of particular authors will be furnished as and when they are dealt with.

HS404 Better Spoken English **2 1 0 3**

1. Air stream Mechanism; 2. Organs of articulation; 3. Articulators strictures and Active and Passive Articulators; 4. Cardinal vowels and English vowels; 5. Sounds and Letters; 6. Consonants of British English and their American Variants; 7. Suprasegmental features i. Stress, ii. Rhythm, iii. Intonation; 8. IPA symbols: Reading Phonetic Texts;and 9. Connected Speech.

HS405 Technical Communication and Report Writing **3 0 0 3**

The growing importance and need of technical communication – Aspects of technical description of machinery, equipment and processes – giving instruction in an industrial situation – Note taking and Note making – Planning the Assignment Defining the problem – Limiting the problem – A time schedule – Consulting source material – Preparing a working bibliography – The outline and the first draft – The use of foot notes – Tables and figures – Referencing – Appendices – Editing and valuating the final product – Meaning and examples, abbreviations commonly used – Correspondence on technical topics: (a) with the general public and (b0 with companies etc – style in technical writing.

HS406 Humanities in a Technological Age **3 0 0 3**

The course identifies the humanities as a source of fundamental human skills much needed in a technological age and seeks to demonstrate the importance of the humanities to education and to society. It is directed specifically towards the engineering profession with specially selected readings that relate the career interests of engineers to the humanities. It develops arguments for the study of humanities by engineers, shows the interconnection between technology and the arts both in the past and in the present, and illustrates that the wide range of problem solving skills required by engineers include those provided by a humanities perspective. A special section on Literature and Technology illustrates technological presence in literary themes and techniques through selected readings from some well known writers in English.

HSS

HS407 Introduction to Modern Linguistics **2 1 0 3**

(a). Origin of Language, (b). Design features of Language, (c). Prechomskyan Linguistics: i. Traditional Grammars ii. Ferdinand de sassure. iii. Bloomfied and Structuralists. (d). Chomsky and Generative Linguistics (e). Implication for the Theory of Language Learning: i. LAD/LAS, Motivation & Exposure ii. Performance and competence, Communicative Competence iii. Active and Passive skills iv. Language universals. (f) Structure of Language (Paradigmatic, Syntagamatic) for the following levels: i. Phonetics, ii. Phonology, iii. Morphology, V. Syntax, v. Semantics, VI. Sociolinguistics (g) Generative Phonology and Generative Syntax: Scope for Natural Language Programming/Processes.

HS408 Communication and Discourse Strategies **3 0 0 3**

Fundamental Basis for Communication Theories: Aspects of Message Contents, Interpersonal Relationships, Self-Disclosure Aspects, and Appellative Aspects.

Examples/Causes of Communication Failure: Message Transmission, Specific Speech habits, Perception/interpretation/Affective Aspects, Projection of the self, Estimate of the self made by the other, Feedback, Paradoxes.

Interactive Relationships: Interpersonal Relationships, Intercultural Relationships, and Professional Relationships.

Special Communication Situations: Attending an interview, managerial level discussions with employees/workers, Conflict prevention and resolution.

HS409 Theory and Practice of Rhetoric **3 0 0 3**

The course aims at developing a vital literary/appropriate to the production of pragmatically situated language. It seeks to proceed from the true function of rhetoric as an integral component of the septem artes liberals and to emphasize its legitimate claim, namely to spell out the conditions for a true inter-disciplinary understanding on the basis of cogent and convincing argumentation. In short, the course seeks to realise the two-fold objective of persuasive competence and performance.

HSS **HS412 German Studies I** **3 0 0 3**

German Studies I : aims at a broad historical survey of this period, and concentrates largely on the socioeconomic and political changes brought about in the wake of the Industrial Revolution taking into account the delayed start of industrialisation in Europe. The impact of these forces on the emergence of Modern German Literature is reflected in the simultaneous existence of different literary movements/crosscurrents. The central concern of this course is; What is the special nature of the inter-relationship between literary and socioeconomic development?

HS413 German Studies II **3 0 0 3**

German Studies II.focuses on the revolution in thinking brought about by the scientific discoveries of the new age. More specifically, the course seeks to emphasize how these revolutionary turnings in European Philosophy have not only compelled German writers to think differently about art but also forced art to take note of itself and to reform itself in new ways. The conditioning of modern literary values that occurred in the eighteenth and nineteenth centuries is sought to be understood with reference to the philosophical matrices which have influenced German literary epochs from the Age of Englishtenment to the Age of Romanticism. The course addresses itself to the fundamental question: How has the revolution in thought effected a change in the production and appreciation of literature?

HS414 French II **2 1 0 3**

The imperative mood – Comparison of adjectives – Gender of adjectives – Subject and direct object – Possessive pronouns – subject direct object - Conjucation of verbs – peculiarities of certain verbs – Imperfect tense – Adverbs – Relative pronouns – Demonstrative pronouns – Interrogative adjectives and pronouns – Agreement of the past participle – Grammatical analysis – Future perfect – Past perfect – Present participle – Conditional present.

HS416 Literature and Values **3 0 0 3**

This course aims to emphasize that literary values will always remain central to the human order. Literature, which has probably had only, a pariah status in the face of the growing importance of science and technology needs to be reengaged. The course purports to underline the role of literature in teaching ideological and cultural values in shaping a new world order. It is hoped that literary insights will serve as a redemptive force to neutralize the effect of those Technological Values, which have created a commercial and mechanistic culture.

The course, which aims to promote liberal, democratic values, will examine man as being essentially a moral entity called upon to confront a predominantly philistine culture. It will also discuss a crucial issue that has surfaced in our political systems – the violation of justice and fundamental human rights in authoritarian set-ups and problems of ethnic minorities in diasporic cultures and the attendant problems of alicination arising from physical and cultural displacement. Gender HSS

issues in a predominantly patriarchal world-order will also be examined. Antiwar values and those of compassion and brotherhood will also be a significant input. Rural values and the significance of myths and arche types in creating order and meaning in our materialistic culture will form an important component of the course.

HS431 Economics **3 0 0 3**

The principal aim of this subject is to provide students with some basic techniques of economic analysis to understand the economic processes with particular reference to the economics of firm and industry. The determination of prices in different markets, structure of the modern industrial economy, economic aspects of individual behaviour factors affecting resource rewards, the role of monetary institutions and the basic concept of National Income accounting will be covered during the semester. Where appropriate, references to the Indian economy will be made.

HS432 Applied Economics **3 0 0 3**

This course is designed to provide an advanced treatment of economic theory with emphasis on applications. We seek to demonstrate, with examples, that economic reasoning has far reaching social implications and could be useful in studying a wide range of real world problems. The topics to be covered will include some of the pressing issues of current interest and will deal broadly with the following:

1) Brief review of Micro Economic concepts 2) Introduction to Welfare Economics 3) The method of Applied Economics 4) The question of Income-Distribution 5) Price Policy 6) Public Utility Pricing 7) Taxation 8) Health Economics 9) Urban Economics 10) Economics of Environment and Pollution 11) Economics of Education 12) Transport Economics

HS433 Environmental and Resource Economics **3 0 0 3**

Environmental and natural resource issues have emerged as one of the most controversial areas of public policy. This course aims a) to provide an exposure to some of these issues, and b) to provide an analytical basis for understanding such issues. The following aspects will be covered in this course: Concepts of private costs and social costs Externalities

HSS

Nature of property rights

Property rights and externalities

Economic Growth in a finite environment

Limits-to-growth debate

Economic theory of natural resources

Institutional mechanisms; Regulation and Incentives

Distributional effects of environmental policies

These aspects will be discussed with respect to specific issues such as air-pollution, extraction and consumption of natural resources, using certain case studies.

HS434 Industrial Economics **3 0 0 3**

The objective of the course is to explore the way in which economic forces operate within the industrial sector. A synthetic review of the economic analysis of industrial behaviour will be presented. The subject will cover the analysis of industries and market, the market structure, conduct and performance of industries. The dimensions of growth, merger, diversification, investment and pricing strategies and the role of government will also be examined. The emphasis will be on the Indian experience.

The themes to be covered are:

1. A Perspective of Industrial Economics
2. The Analysis of Markets
3. Market Structure
4. Goals of Firms/Industry
5. Market Performance
6. Market Performance
7. Vertical Integration
8. Diversification
9. Technical Progress
10. Issues of Public Policy

HSS

HS435 Contemporary Issues in Development **3 0 0 3**

Development in Historical Perspective - The Nature of the contemporary global economy - The implications of global political economy for less developed economies, especially India - Conceptualising Development: Alternative Perspectives -

Human Development Indices - Indian Development: Some key issues including growth, inequality (class, caste, region and gender), poverty and self reliance and environment. (The course will use both lecture and seminar formats. The students will be expected to submit a good term paper)

HS436 Environmental Psychology **3 0 0 3**

Nature and history of Environmental Psychology, Environmental Perception, Environmental Cognition, Environmental Attitudes, Performance in Learning and work Environments, Coping with Environmental Stress, Coping with Crowding, Privacy and Territoriality, Personal Space, Affiliation and Support in the Urban/Rural Environment, Environment and Behaviour: A Unifying Framework.

HS437 Social Psychology **3 0 0 3**

Growth and Field of Social Psychology – Methods of Social Psychology – Development of Social Behaviour – Social Perception – Social Development of Personality – Types and mechanisms of Social Interaction – Social Attitudes: Their Development and Measurement – Group Dynamics – Leadership – Social Propaganda – Formation and change of Public Opinion – prejudice and Social Distance.

HS440 Introduction to Modern Western Thought **3 0 0 3**

The Course aims at introducing the student to a representative collection of reflective essays by modern thinkers whose writings have radically altered man's worldview. They trace the emerging new vision that is based upon the enlargement of knowledge in the fields of the sciences and Humanities. The course purports to be a window on the world of the Western mind for it offers a glimpse of the full inheritance of the Western man rendered in imaginative prose. The essays offer allusions to the significant phases and turning points in the social, cultural and intellectual history of the west thus providing a compliment to the oriental student's understanding of the evolution of man's history from primitive times. It is hoped that through classroom discussions and assignments student's interest in further reading in the field of ideas will be stimulated.

HSS **HS441 History of Science and Technology** **3 0 0 3**

Science and Technology in the Primitive Society – Development of Science and Technology in early civilized societies – Science in classical Greece – The rise and Development of early Indian Science in the transition to feudal society – Contributions of Arab Science and Technology – Europeon Science and the Renaissance movement – Science and the Revolutionary era (Industrial, American and French Revolution) Growth of Specific Sciences in Eighteenth and 19th centuries – Heat and Energy Chemistry and Biology – Twentieth Century Science – Physical Sciences – Organisation of Indian Science – Recent advances in Indian Science.

HS442 Technology and Development **3 0 0 3**

Development of Scientific Thought from Aristotle, Francis Bacon to Modern Times. Significant developments in Technology and their impact on society from prehistoric times to present day. The present technological situation in India. The problems of Rural Development, urban Proliferation and of Technology gap. The course will be given from readings from various renowned authors and will be in the form of an introduction of the ideas and discussion on the same.

HS443 Great Social Thinkers **3 0 0 3**

The aim of this elective course is to introduce students in depth to the writings of two of the great social thinkers who have given a definite shape to the world we live in. Initially it is proposed to take up Adam Smith and Karl Marx for extensive treatment. Topics discussed will include: The social and intellectual milieu of the writer, the content of their work, and their lasting influence.

HS444 Computers and Society **3 0 0 3**

Review of computer Technology: History of Computers, Computer generations, microprocessors and the Personal Computer, Communication networks, Artificial Intelligence, Expert systems and robotics. Pace of development, Pervasiveness, capabilities and limitations of computers. Responding to computers: Post Industrial/Information Society, Impact on the Office, industry, education, medicine and other fields. Implications of videotex, teleconferencing and telecommuting effect on employment and nature of work. Computers and privacy. Computer crime.

HS445 Introduction to European Philosophy **3 0 0 3**

The broad aim of the course is to provide students of engineering discipline an insight into the foundational basis of European thought, particularly in the area of 'theory of knowledge'. The course is structured around the fundamental question of all authentic philosophy: If a man has knowledge, then inquiry is superfluous, and if a man does not have knowledge, then inquiry is impossible. How do we then come by knowledge? How is inquiry possible? What are the doctrinal implications of science? How have philosophers from Plato to Polanyi addressed themselves to these questions? HSS

HS446 Science, Society and Languages **3 0 0 3**

This course open to the students, who have an excellent command over English is optional along with German I, French I and History in First Semester and as such it is an advanced course in English. This advanced and optional course in English aims at helping the student in the creative mastery of English by introducing him to the inter-related nature of science and society in the context of cultural values and language behaviour. The prescribed texts highlight the emergency of a scientific temper and relate it to the social and cultural development. The discussion and analysis aim at improving the following specific language skills: usage in the advanced composition, words and expressions commonly misused, syntax and the problem of meaning the communication of ideas.

HS447 Nomistics – The Study of Human Values **3 0 0 3**

Human collective life as nomistic order; the evolution of nomistic culture through human history in ancient societies like India and Greece; *physis* and *nomos* in ancient Greece and the distinction between *episteme* and *techne*; *paideia* in Plato and Aristotle; Christianity and Science; Modernity and the emergence of "two cultures", the Protestant "work-ethic"; value vs. value-free philosophies; the "transvaluation of values".

HS448 Values, Technology, Sciences and Society **3 0 0 3**

1. Pure sciences, Applied sciences and technology: Attempts at Definition.
2. Physical versus Metaphysical: The Aristotelian vs The Heideggerian Approach to Technology
3. Technology and Change I:
   Ethical, Political, and Social Values – Race, Class, Caste, Gender.
4. Technology and Change II:
   Art, Aesthetics, World Religions.
5. Current Issues and Case Studies: Emerging Ethical Issues in the light of Recent Breakthroughs in Technology.

Mass Communication – Information - Internet technologies – Bio-medical Research- Genetic engineering- Space Technology – Privacy – Intellectual Property Rights.

HSS

HS449 Language, Culture and Society **3 0 0 3**

Objectives of the Course:

To enable learners to understand the nature of interaction between language and social forces and examine the role of language as a cultural resource.

Syllabus

- Culture and society

  Influence of language on society and society on language
- Language and literacy

  Oral and written discourse
- Variation in language

  Social, regional dialects; registers
- Language and Nation

  Bilingualism, multilingualism

  Relevance of link language, linguistic dissension
- Literature as a cultural artefact

  Select works of Indian, African and American writers

References:

1.Barber, Charles. ***The English Language: A Historical Introduction***
2. Downes, William. 1984. ***Language And Society.*** *Fontana Paperbacks.*
3. Duranti Alessandro. ***Linguistic Anthropology.*** *Cambridge University Press.*
4. Ganguly.S.P. and Pramod Talgeri (ed.) ***India 2000- Global Civilization*** *And Cultural Roots.*
5.Gokak.V.K. 1989. ***India And World Culture.*** *Sahitya Akademi.*
6. Hymes, Dell. 1964. ***Language In Culture And Society.*** *Harper&Row.*
7. Pound, Ezra. ***ABC Of Reading.***
8.Trudgill, Peter. 1974. ***Sociolinguistics: An Introduction.*** *Penguin Books.*

HS450 Contemporary India: Sociological Perspective **3 0 0 3**

1. Social Structure : Family and Kinship; Caste; Class; Religion; State
2. Social Inequality : Economic; Culture; Regional; Gender; Ecological
3. Social Change : Social Movements; Government Policies; Development Indicators; Modernisation and Globalisation
4. Social Problems: Deviance and Crime; Population and Poverty; Unemployment and Skill Requirement; Social Exclusion and Affirmative Action.

HSS

HS451 Political Philosophy **3 0 0 3**

All political communities come into being not only for the sake of living, but for the sake of a way of living. Characteristic, then, of any political association is the attendant discourse on achieving the best and avoiding the worst for the community and its members. Political philosophy addresses itself to the concepts underlying political beliefs and practices, such that the clarification of concepts can yield a framework for the critical evaluation of these beliefs and practices.

The course seeks to examine the following aspects: the human sense of justice; the quest for and the pursuit of the Good Life; the theoretical study of political life constituting political theory; political philosophy proceeding from the Classics to pose the problems of the unexamined life and to investigate political life as it ought to be; the search for the right order of public life, the constraints it encounters and the resources it seeks in its bid to tame power and compound the ruler and the ruled into the true frame of a commonweal.

HS477 INTERNATIONAL TRADE AND FINANCE **3 0 0 3**

Course Objective

The objective of this course is to understand basic concepts in international trade and finance and use them to analyse impact of recent global developments on emerging market economies and the developing economies. Suitable illustrations will be given on Indian scenario. Structured class discussions and case discussions will supplement the lecturers. Students will be required to prepare a term paper assigned by the instructor and present the same in the class.

Syllabus:

1. Globalization: An Introduction
2. Trade and Growth
3. Pattern of Trade
4. Adjustments in Production Structure
5. Barriers to trade
6. Imperfect competition and Intra-industry trade
7. World Trade Organization
8. Regional trade agreements
9. Balance of Payments: Liberalizing capital movements and currency convertibility issues.
10. Exchange rate determination and related issues
11. Choice of an exchange rate regime
12. Interactions between domestic financial market and market for foreign exchange
13. Currency crisis (Asian and Latin American crisis etc.)
14. Sovereign Debt (cases of Brazil and Argentina etc.)
15. Foreign Direct Investment.

Reference:

Bhagwati Jagdish (2002), Free Trade Today*, Oxford University Press, New Delhi*
Crabaugh R.J (2004), International Economics, Ninth Edition, South Western College Publishing.
Caves R, J.A.Frankel and R.W.Jones (2002), World Trade and Payments: An Introduction*. Addison Wesley.Salvatore Dominick (2003),* International Economics*, Wiley.*

6.3 Management Studies

Sl.No.	Course No	Course Title	Credit
1.	MS361	Accounting for Managerial Control	3
2.	MS391	Principles of Management	3
3.	MS371	Marketing Management	3
4.	MS351	Fundamentals of Operations Research	3
5.	MS352	Operations Management I	3
6.	MS341	Organisational Behaviour	3
7.	MS342	Industrial Relations	3
8.	MS362	Financial Analysis for Managerial Decisions	3
9.	MS392	Strategic Management	3
10.	MS363	Indian Capital Market and Money Market	3
11.	MS364	Indian Corporate Sector	3
12.	MS353	Advanced Operations Research	3
14.	MS381	Systems Engineering	3
15.	MS355	Project Management	3
16.	MS359	Facilities Planning	3
17.	MS360	Materials Management	3
18.	MS382	Management Information System	3
19.	MS356	Network Models & Management	3
20.	MS372	Advertising & Publicity	3
21.	MS357	Stochastic Models – Advanced Operations Research	3
22.	MS583	Computer Simulation	3
23.	MS358	Industrial Engineering	3
24.	MS692	Management of Financial Marketing & Personnel	3
25.	MS365	Introduction to Portfolio Analysis & Investment Mgmt	3
26.	MS366	International Finance	3

MS361 Accounting for Managerial Control **3 0 0 3**

Preparation and interpretation of Financial statements – Profit and Loss Account: Balance Sheet Ration; Analysis of final statements, and Funds Flow statement. Depreciation Methods – Cost Accounting as a control technique – Material costs, standard costing and variance analysis – Cost-Volume – Profit Relationship. Budgetary control system.

MS391 Principles of Management **3 0 0 3**

Development of Administrative Thought; Normative and Descriptive models of Management; Power, Organisational Politics and Organisational Conflict; Managerial Functions; Planning, Objectives, Decision Making Process, Forecasting and Strategy formation; Organising; Division of Labour, Span of Control, Departmentation, Authority, - Group Dynamics, Bureaucracy and Autocracy – Leading: Motivation, Leadership. Supervision: Communication; Evaluating; Evaluation Process, Cost – Benefit Evaluation, Integrating theory and Practice.

MS371 Marketing Management **3 0 0 3**

Marketing concept – Marketing environment objects, objectives, organisations and operations in consumer and industrial markets – Strategic Marketing – Marketing Mix – Product, Price, Physical distribution, Promotion, Advertisement – Sales force management.

MS351 Fundamentals of Operations Research **3 0 0 3**

Prereq. Knowledge of Calculus, matrix, algebra, elementary probability theory. Development and scope of Operations Research-Examples of O.E. models in

engineering and management. Linear programming. Simplex, transportation and assignment algorithms and their applications. Duality and sensitivity analysis. Principles of Optimality and Dynamic programming models. Deterministic inventory models. Introduction to queueing theory and ts applications.

MS352 Operations Management – 1 **3 0 0 3**

The production systems Concept – Decision making and production function, Production design and Process planning. Types of Production system, Production Planning and Control in Project, flow shop and job shop types of Production system. Methods of Forecasting – Production and inventory systems: Deterministic inventory models, Equipment selection and Facility Layout: Quality control; Acceptance sampling, Statistical Quality control, cost reduction techniques.

MS341 Organizational Behaviour **3 0 0 3**

Organizational Theories: Behavioral Perspectives. Development of Achievement Motivation. Inter Personal Communication and understanding. Development Consciousness and Economic Development A Macro behavioral approach to understand Indian Entrepreneurs.

MS342 Industrial Relations **3 0 0 3**

History of Indian Trade Union Movement – Structure of Relations in India – Labour Welfare and Social Security – Wages and Bonus – The Domain of Standing Orders (Industrial Employment Act,1948) – Collective Bargaining and Settlement of Disputes (Industrial Disputes Act, 1947) – Industrial Relations Bill 1978 – Union – Management Attitude to Industrial Relations in India.

MS362 Financial Analysis for Managerial Decisions **3 0 0 3**

Working Capital Management – Cash. Accounts Receivable – Make or Buy Decisions – Capital Budgeting – Financial Planning – Financial Structure – Dividend Policy.

MS392 Strategic Management **3 0 0 3**

Corporate Strategy- Nature & Scope – process of strategic planning – mission – objectives – goals – strategic formulation methods. Strategy Analysis Environment analysis – analysing resources and strategic capability – value chain analysis. Strategy Alternatives – Generic Strategic alternatives – Diversification – Merger & acquisition, strategic alliances. Strategy evaluation – Strategic Choice – Control. Strategy Implementation – Leadership & Organisation Climate – Planning and Control of Implementation – Strategies for going global – Global Strategy.

MS363 Indian Capital Market and Money Market **3 0 0 3**

Indian financial system - structure. Capital Market - players - stock exchanges - EMH - Issue of securities - new instruments. Regulations governing financial instruments - SEBI guidelines. Portfolio investment - CAPM - optimum portfolio. Money market - players - instruments - factoring - money market mutual funds - government securities.

MS364 Indian Corporate Sector **3 0 0 3**

Types of organization - Sole Proprietorship, Partnership firm, Joint Stock Company - Public and private, Public Sector Organisation, Cooperatives - SSIs, Formation procedures of enterprises. Government control over business - Industrial Policy, MRTP. Foreign Trade - Export and Import Policy- FEMA - Foreign Investment - Prevention of Money Laundering Act. Indian financial system - regulatory framework governing business - RBI guidelines, SCRA, SEBI - Credit Rating Agencies. Government Policies pertaining to finance, marketing and personnel.

MS353 Advanced Operations Research **3 0 0 3**

Review of linear programming. Intern programming. Introduction to Game theory. Probabilities inventory models. Priority queues. Morkov chains and applications.

MS381 Systems Engineering **3 0 0 3**

Systems: Definition, hierarchy and classification. Systems approach and its development. Relationship with other approaches to problem solving. Systems modelling. Selected tools and techniques. Basic ideas and applications of Graph Theory, Fuzzy Sets Theory, Catastrophe Theory and Multivariate analysis. General Systems Theory, Cybernatics and Information Theory. Case studies.

MS355 Project Management **3 0 0 3**

Financial analysis and Investment decisions for projects. Network planning. CPM and PERT models. Resource leveling and crashing. Simulation of Networks. Criticality index. PERT Cost and time of Balance. Project Control. Computer packages for Project Management. Organisation for project management.

MS359 Facilities Planning **3 0 0 3**

Plant location – Theories and problems. Plant Layout. Techniques for facility planning. Assembly line balancing. Stores layout principles of material handling. Maintenance and replacement.

MS360 Materials Management **3 0 0 3**

Static and dynamic inventory models under risk and uncertainty. Multiple reorders and discounts. Multi-echelon inventory systems. Material Requirements planning. Rating and selection of vendors, Value Analysis and Standardization.

MS382 Management Information System **3 0 0 3**

Role of MIS in an organization. Systems approach to MIS. Information system for functional operations. Assessing information needs. Design of integrated MIS Choice of hardware and software. Implementation and evaluation of MIS. Project, etc.

MS356 Network Models in Management **3 0 0 3**

Systems modeling using networks. Elements of graph theory, Network optimization, Review of algorithms, Network flows, Network models in plant layout, project management, Group dynamics, etc.

MS372 Advertising and Publicity **3 0 0 3**

Persuasion Process – Communication Methods –Phetoric Models –Propaganda Models etc. –Audience Characteristics -Message structure – Communication credibility – Advertising – Advertisement Budget – Advertisements effectiveness – Publicity etc. Media selection – Sales promotion – General promotions.

MS357 Stochastic Models – Advanced Operations Research **3 0 0 3**

The course introduces the student to stochastic modeling and the theory of queues. The class is appropriate for advanced undergraduates or first-year graduate students intending to pursue an advanced degree program in operations research or operations management.

Pre-requisite: An introductory course in Probability and Statistics.

Introduction to stochastic processes, random variables and conditional expectation; The Poisson Process; Renewal theory; Maaarkov renewal and regenerative processes; Birth-death queuing systems in equilibrium e.g. M/M/1, M/M/1/M; Bulk arrivals and servie queues; The M/G/1 queue-derivation of average waiting time; G/M/m queues; Elementary queuing networks (open, closed networks); Introduction to Browniaan Motion; Stochastic Calculus and the Lto Integral

Reference texts:

Queuing Systems – Vol I (Theory) – Leonard Kleinrock – Wiley Interscience, 1975 1st Edition;

Stochastic Differential Equations - Oksendal – Springer Verlag 1998 V Edition; Stochastic Processes Karlin and Taylor John Wiley, 1981.

A second course in Stochastic Processes – Samuel Karlin and Howard Taylor 1981.

MS383 Computer Simulation **3 0 0 3**

Introduction to digital simulation -System Models. Monte Carlo simulation - Generation and use of random numbers -Fixed time -increment and variable time-increment simulation.

Experiment design for simulation experiments -Verification, validation and stopping rules -Simulation Models for queueing systems, inventory control, scheduling etc. Introduction to simulation languages, Project.

MS358 Industrial Engineering **3 0 0 3**

Quality Control, Maintenance of Plant and Machinery Social and economic impacts of productivity measurement. Work systems design Methods Engineering principles of techniques. Work measurement. Predetermined motion time systems. Introduction to human factors in engineering design and man-machine systems. Effects of environment of human performance. Production Planning and control: Types of Production systems and functions of PPC, Gantt charts, Flow shop and Job shop scheduling, Priority Dispatching rules. Project scheduling with PERT/CPM, Crashing and resource leveling. Plant Location and Plant Layout, Social and economic factors for Plant Location, Types of Layout, Design of Plant Layout, Materials handling, Statistical.

MS692 Management of Financial Marketing & Personnel **3 0 0 3**

(i) Finance function: Structure of Income Statement and balance sheet ; Financial Ratios. Scope and goal of finance function. Capital budgeting decision; Techniques of capital. Budgeting – accounting rate of return, playback period. Method and discounted – cash flow methods . Capital structure decision: Major financial instruments to raise corporate capital; Debt. Equity mix. Concept of working capital.

(ii)Marketing Function: Introduction to marketing management Consumer Market and Buyer behaviour Industrial Market and buyer behaviour

The Assembling of Mix: a) Product Decision b) Price Decision c) Promotion Decision and d) Place decision. Megamarketing strategy – strategies for entering into blocked markets.

(iii) Personnel Function : Management of people – Organization and Administration Manpower planning and staffing Work motivation performance Appraisal wage and Salary Administration-Employee Benefits and welfare measures. Trade Unions –Industrial relations Negotiation and collective bargaining Worker's participation in management.

MS365 Introduction to Portfolio Analysis and Investment Management **3 0 0 3**

Economic Theory of choice under certainty.

Utility Theory: Investor behaviour under uncertainty. The Expected Utility maximum measures of risk aversion, empirical evidence, introduction to mean, variance analysis. Efficient portfolios of two or more assets. The efficient frontier techniques for calculation. Computer exercise. Case discussion. Index models of security returns. Simple techniques for calculating the efficient frontier. The capital asset pricing model (Contd.)case discussion. Empirical Testing of asset pricing models efficient capital markets/valuation models. The term structure of interest rates. Models for security analysis evaluation of portfolio review.

MS366 International Finance **3 0 0 3**

Aim – The aim of this course is to provide an understanding of the fundamental concepts and managerial issues pertaining to international finance.

International Finance – overview – International Financial Institutions/Development Banks – World Bank – IBRD – IDA – IFC – MIGA – International Monetary Fund – Special Drawing Rights – Asian Development Bank – Internationalisation process

The Foreign Exchange Market – SWIFT – Arbitrage – Spot market – Forward market – Cross rates of exchange – Bid – Ask spreads – Balance of payments – Foreign exchange rates – Theories of Foreign Exchange Rate.

Foreign exchange exposure and management – Management of translation exposure – Methods – Management of transaction exposure – Management of economic exposure – Methods – Strategies.

Financial Management of the Multinational Firm – Foreign direct investment – Cost of capital and capital structure of the multinational firm – Multinational capital budgeting – Multinational cash management – Country Risk Analysis – International Taxation.

Financing Foreign Operations – Eurocurrency markets – Instruments – Interest rate swaps – Currency swaps and its pricing – Depository receipts – GDR and ADR – Euro and its implications for India.

References:

1. *Buckley, A., Multinational Finance, Prentice Hall, New Jersy, 1992.*
2. *Levich., R.M., International Financial Markets: Prices and Policies, McGrew Hill, Newyork, 2001.*
3. *Vij, M., Multinational Financial Management, Excel Books, New Delhi, 2001.*
4. *Shaprio, A.C., Multinational Financial Management, Prentice hall of India, New Delhi, 1996.*
5. *Apte, P.G, International Financial Management, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1999.*
6. *Jain, P.K., et.al, International Financial Management, Macmillan, New Delhi, 1998.*
7. *Eun, C.s. and Resnick, B.G., International Financial Management, Irwin McGraw Hill, Singapore, 2001.*

Operators – Simple Genetic Algorithm (SGA) and variable length Genetic Algorithm (VGA). Simulated annealing. Applications to discrete size, Configuration and shape optimization problems.

Artificial Intelligence and Artificial Neural Networks based approaches for structural optimization problems.

CE773 Advanced Finite Element Analysis **3 0 0 3**

Analysis of plates – Shear deformation – Reissner-Mindlin theory – Reduced / Selection integration techniques.

Analysis of shells – Degenerated shell elements – four and eight nodded elements – Reduced / Selective integration techniques.

Introduction to continuum mechanics – Vector, tensor and matrix notations. Analysis of stress – Cauchy stress, Second Piola Kirchhoff stress. Deformation and strain – Description of motion, strain-displacement relations – Green Lagrange strain, Eulerian or Almansi's strain.

Geometric Nonlinear Analysis – total and Updated lagrangian formulations – 3D and 2D truss elements, 3D and 2D beam elements. Plane Stress / strain, axisymmetric element – Plate / Shell element.

Material Nonlinear Analysis – constitutive modelling, Elasto-plastic problems – yield criteria – concepts of hardening. Stress updates – solution algorithms. Application to one-and-two dimensional problems.

Solution Techniques for non-linear analysis – Newton-Raphson and modified Newton-Raphson methods. Post buckling analysis of structures – Displacement incrementation methods, Riks / Wempner and Crisfield methods. Programming and applications to nonlinear analysis.

Finite element modeling – Discretization Error estimates – adaptive meshing – Adaptive Finite element analysis. Package programs – Pre – and Post Processing.

MNS

ID601 Constitutive Modelling in Continuum Mechanics **3 0 0 3**

3. MACHINERY, NOISE AND VIBRATION : AMM3

AM310 Vibration Concepts and Applications **3 0 0 3**

Single Degree of Freedom Systems : Free and Forced Vibration, Damping Concepts, Vibration Isolation, Impulse Response and Frequency Response Functions, Transducers; **2 Degree of Freedom Systems :** Free and Forced Vibration, Vibration Absorber Design; **Multi Degree of Freedom Systems:** Matrix formulation of Eigen value problem and solution techniques, Mode superposition principle for forced response, Component Mode synthesis, Engineering Case studies; **Continuous Systems:** Bending / Torsional / Axial Vibration of beam Structure.

References:

1. *W.T. Thomson, Theory of Vibration and Applications. Prentice Hall, new Delhi, 1992.*
2. *V. Ramamurti, Mechanical Vibration Practice with basic theory, Narosa Publishing Co., New Delhi, 2000.*
3. *J.S. Rao and K. Gupta, Introductory Course on Theory and practice of Mechanical Vibration, Wiley Eastern, New Delhi, 1987.*
4. *L. Meirovitch, Elements of Vibration Analysis, McGraw-Hill Book Co., New York, 1986.*

AM574 Engineering Acoustics **3 0 0 3**

Derivation and solution of Wave Equations – Plane and spherical waves – terminology in acoustics like energy density, intensity, loudness, pitch etc.

Sources of sound : Monopole, dipole and quadrapole theories – Acoustic impedance.

Wave propagation in lobes and horns – Classification of noise, noise analysis, noise instrumentation – Acoustic chambers – Sound radiation of vibrating structures like beams and plates – Structural response to acoustic excitation – Acoustic fatigue.

AM566 Signal Processing in Mechanical Systems **3 0 0 3**

Prereq. COT

MNS

Introduction : Physical data description, data acquisition and processing techniques, various transforms. Discrete Time Signals and Fourier Analysis; Sampling considerations, digital Fourier analysis, FFT algorithms, specialized signal processing, hardware and software (available within the Department). Random Processes: Probability and random variables, distributions and statistical errors, regression analysis, spectral density and correlation functions and their properties. System Identification Techniques: Single input/output system, multi-

input / output systems, coherence functions, cepstral analysis, Hilbert transforms, nonlinear systems, computer aided testing and diagnostics, applications.

AM576 Vehicular Vibration **3 0 0 3**

Human response to shock and vibration, Ride comfort criteria Road vehicles : Vibration of automobiles, trucks, commercial vehicles and tractor-trailer system – passive and active suspensions – Optimum design for ride comfort and road holding.

Rail vehicles : Mathematical modelling of rail vehicles, vertical and lateral vibration, hunting instability – Track-train interaction problems.

Aircraft vibration : Landing gear response to runway roughness, flutter and buffeting.

Ship-hull vibration.

AM578 Noise Control **3 0 0 3**

Biological aspect of noise – noise reduction and control – Techniques applied in practice – Noise generated from individual machine components such as bearings, gears, motors, fans, blowers, propellers and fluid pipes – Design of mufflers – Engine and vehicular noise with special reference to automobiles, aircraft etc. – Legal aspects of noise and environmental control of noise pollution.

AM589 Applied Finite Element **3 0 0 3**

Introduction to finite element – Discretisation concepts – Triangular, rectangular, in plane and bending elements – Axisymmetric analysis – Computer oriented application to mechanical engineering problems – Mini project.

AM569 Modal Analysis of Mechanical Systems **3 0 0 3**

MNS

Introduction – natural frequencies and normal modes of multidegree of freedom symmetric undamped mechanical systems.

Vibration response using modal analysis – Modal damping, proportional damping, complex natural frequencies and complex natural modes in damped mechanical systems – Response representation, non-symmetric systems – Response of single mass rotors on fluids bearings using modal analysis.

Modal testing, signal analysis – Modal parameter extraction methods – Eigenvector modification technique – Multiple input methods – Eigen vector modification technique – Multiple input methods – Component mode synthesis – Ibrahim time domain approach.

Application of experimental modal analysis in aircraft turbomachinery structures.

AM582 Random Vibration **3 0 0 3**

Probability Theory : Random variables, Probability distribution and density functions – Expected values, mean, variance, conditional probability, characteristic and log characteristic functions, chebychev inequality, Functions of random variables.

Random Process : Concepts of staionarity and ergodicity – Evolutionary nonstationary process – Auto and cross correlation and covariance functions – mean square limit, differentiability and integrability – Spectral Decomposition, power spectral and cross spectral density functions – Wiener Khintchine relations – properties of Gaussian, Poisson and Markov processes – Fokker – Planck Equation – Broad band and narrow band random processes – white noise.

Random Vibration : Response of linear single and multidegree of freedom system to stationary and evolutionary nonstationary random excitation – Response of continuous systems – Normal mode method – Nonlinear random vibration, Markov vector equivalent linearisation and perturbation methods – level crossing, peak and envelope statistics – First excursion and fatigue failures – Application to mechanical, aero, civil and ocean engineering systems.

AM599 Computer Aided Design **3 0 0 3**

A basic course in computer programming.

Introduction – finite element method, finite difference method.

Static problems : Definitions, general approach, matrix inversion, Gausian elimination method, Crout's procedure, Cholesky's method, Potters methods, sparse matrix, vriable bandwidth.

MNS

Eigen-value problems : Definition, properties of eigenvalues and eigen-vectors, typical problem formulations, Sturm sequence, Jacobi, Givens and Householder transformations, forward and Inverse Iteration Schemes, Gram Schmidt deflation, Simultaneous iteration method, subspace iteration, Lanczos method, Component Mode Synthesis.

Cyclic symmetric structures : Static analysis under cyclic symmetric loading,

Eigenvalue problem, static analysis under generalized loading.

Transient analysis : direct integration method, mode super-position, condition for stability.

Case studies.

AM681 Chaotic vibrations **3 0 0 3**

Introduction : Examples of Nonlinear dynamical systems in mechanical and electromechanical systems – Discrete and continuous, Duffing and Van-der Pol Oscillators. Review of approximate Techniques.

Geometric concepts in Nonlinear Dynamical system analysis – Phase plane-fixed points-limit cycles, Nonlinear maps Poincare'map. Types of bifurcation and Chaos-period doubling quasiperiodic and intermittency routes to chaos-crises. Measures of chaos – Autocorrelation, power spectrum, Lyapunov exponents – Fractals and dimensions – Basins of attraction.

Computational aspects – Numerical integration – Cell mapping – Galerkin-Harmonic balancing – Shooting method – Parameter continuation and path following – Applications to mechanical systems – Gear with backlash, Clutch springs – bearings – Buckled beams etc.

4. ENVIRONMENTAL SCIENCE & TECHNOLOGY CHM1

CH322 Basic Environmental Engineering **3 0 0 3**

Air Pollution : Sources of air pollutants, their effects of human, plants and animals. Particulate pollutants their monitoring and control. Gaseous pollutants – their monitoring and control.

Water pollution : Sources of water pollutants, their effect on environment, primary treatment of wastewaters, secondary treatment using aerobic and anaerobic methods. Control of pollution from typical industrial wastewaters.

Solid waste management : Characteristics of domestic garbage and its treatment using thermal and biological methods – Management techniques – Water and Air quality standards.

Ocean Pollution : Function of the Ocean environment, marine pollution clean up methods, pollution by ports and offshore oil industry.

Text and References:

1. *Buonicore A.J. and Theodore L., Industrial control equipment for particulate pollutants, CRP Press.*
2. *Buonicore A.J. and Theodore L., Industrial control equipment for gaseous pollutants, Vol. I & II, CRP Press.*
3. *Metcalf and Eddy., Wastewater Engineering : treatment, disposal and reuse, Tata McGraw-Hill Co., 3rd Edn., 1996.*
4. *George Tschabanoglous, Solid Wastes, McGraw Hill Co.*
5. *Rao M.N. & Rao H.V.N. Air Pollution, Tata McGraw Hill Co.*
6. *Frankel, E.G. Ocean Environmental Management, Prentice Hall, 1995.*
7. *Erickson, P.A. Environmental Impact Assessment, Academic Press, 1979.*

CH423 Basic Ecology and Environmental Impact Assessment **3 0 0 3**

Introduction to environment and ecology – Ecosystems – principles concepts, components and function – Atmospheric, aquatic and terrestrial ecosystems, Biogeo chemical cycles and limiting factor concepts – Impacts of natural and human activities on ecosystems. Environmental policies, acts and standards.

Sustainable development and environmental impact assessment – Institutional frame work and procedures for EIA – Methods for impact identification-matrices. Networks and Check lists, Environmental settings, indices and indicators.

Prediction and assessment of the impacts on air, water, land, noise and biological environments, Assessment of impacts of the cultural, socioeconomic and ecosensitive environments.

Mitigation measures, economic evaluation, Public participation and design making – Preparation of Environmental statement.

Text and References:

1. *Ecology-Rugene P.Odum, Oxford, IBH Publishing Co. 1975 Concepts of ecology – Edward J. Kennedy, Prentice Hall of India Pvt. Ltd., 1989.*
2. *Ecology-Principles and applications – J.L. Chapman and M.J. Reins, Cambridge Century Press, 1992.*
3. *Environmental Impact Assessment; Lorry W. Carter McGraw Hill, New York, 1996.*

CE459 Water and Wastewater Treatment **3 0 0 3**

Importance of protected water supply schemes. Sources of surface and ground waters. Characteristics of raw water and their detrimental effects on human and

livestock. Permissible standards for drinking water. Principles of municipal water treatment, coagulation, filtration and disinfection. Special treatments like deflouridation, iron and manganese removal. Surveillance of quality of water during disturbution.

Sources and quantification of municipal wastewters. Chracteristics of domestic wastewater and their effects on ecological aspects of receiving waters. Permissible effluent standards and stream reaeration. Fundamentals of micro biology. Principles of Biological treatment units. Study of unit operations of typical conventional biological treatment units. Low-cost wastewater treatment systems applicable for sub-tropical regions.

Text and References:

1. *Modi P.N., Environmental Engineering, Vol.I Water supply Engineering, Standard Book House Publication, New Delhi.*
2. *Gilbert M. Masters, Introduction to Environmental Engineering and Science, Prentice Publication, New Delhi.*
3. *Chatterjee, A.K. Water Supply and Wastewater Disposal, Khanna Publication, New Delhi.*
4. *Rao M.N. and Dutta A.K., Waste water treatment, 2nd Edn., Oxford & IBH Publishing Co.*
5. *Soli J. Archivala, Wastewater treatment for pollution control, Tata McGraw Hill Publication.*

---

7. ADVANCED GERMAN HSM2

HS 302 Advanced Structural Study of German 3 0 0 3

Course content:

The course Advanced Structural Study of German shall deepen and refine the student's knowledge of the German language and his/her communicative abilities, expanding the elementary linguistic ability acquired in the courses German I & II. It shall introduce more advanced grammar topics such as the tense forms (past perfect, future and future perfect tense), passive voice and subjunctive forms of verbs, compound sentences (coordinate and subordinate clauses, relative clauses etc.) and so on. The primary aim of this course is to give the student a comprehensive overview of the syntax of the German language, covering all major grammatical elements.

Bibliography

1. Moment mal! 1,2 & 3. Lehrbuch fuer Deutsch als Fremdsprache. Langenscheidt, Berlin and Munich, 1996.
2. Passwort Deutsch 1 & 2. (Indian Licence Edition) German Book Centre, Chennai, 2003.
3. Deutsche Sprachlehre fuer Auslaender. Grundstufe in einem Band. (Schulz/ Griesbach). Hueber (Special Indian Edition), Munich, 1983 (1967).
4. šbungsgrammatik DaF f•r Fortgeschrittene. (Neue Rechtschreibung) šbungsbuch by Karin Hall, Barbara Scheiner. Hueber, Munich, 2001.
5. Sprachkurs Deutsch 1, 2 and 3. Diesterweg, Frankfurt am Main, 1988.

HS303 Advanced Communication in German 3 0 0 3

Advanced Communication in German shall aim at imparting the skills required to read, understand and discuss texts (oral as well as written) in connected discourse. The student should learn to apply the acquired knowledge of the German language to understand others and be understood not only in day to day real life situations, but also in situations dealing with topics of personal or specific interest. The course shall expose the student to texts from diverse fields of interest like science and technology, culture (including literary texts like poems, short-stories and plays and extracts from important contributions to philosophy and history), business, politics and so on. The student shall learn to understand a text, summarize its content, answer text-related questions and contribute to the text's discourse by expressing his/her own views orally as well as in written form. The course shall also impart the skills required to produce specific kinds of texts like personal and business letters, curriculum vitae, short essays and arguments in German language.

Bibliography

1. Moment mal! 1,2 & 3. Lehrbuch fuer Deutsch als Fremdsprache. Langenscheidt, Berlin and Munich, 1996.
2. Passwort Deutsch 1 & 2. (Indian Licence Edition) German Book Centre, Chennai, 2003.
3. Deutsche Sprachlehre fuer Auslaender. Grundstufe in einem Band. (Schulz/ Griesbach). Hueber (Special Indian Edition), Munich, 1983 (1967).
4. šbungsgrammatik DaF f•r Fortgeschrittene. (Neue Rechtschreibung) šbungsbuch by Karin Hall, Barbara Scheiner. Hueber, Munich, 2001.

MNS

MNS

5. Kurze Deutsche Grammatik fuer Auslaender. By Helbig and Buscha (Sixth edition), Enzyklopaedie, Leipzeig.

6. Handbuch Fremdsprachenunterricht, edited by Bausch/Christ/Krumm. Francke, Tubingen and Basel, 1995.

HS 416 German for Scientific Purposes **3 0 0 3**

This course has been designed primarily with the work/research environment in mind, which IIT graduates working/studying in Germany may encounter. The objective is to train the student in the syntax as well as terminology of scientific/ technical German and impart knowledge of effective translation techniques and develop translation skills in German and English. Texts shall include readings from scientific journals, technical descriptions and user manuals, internet terminology and so on. Pre-requisite for this minor stream elective is the successful completion of the courses Advanced Structural Study of German and Advanced Communication in German .

8. TRENDS IN BUSINESS AND FINANCE: MSM1

HS371 Marketing Management **3 0 0 3**

Marketing concept – Marketing environment objects, objectives, organisations and operations in consumer and industrial markets – Strategic Marketing – Marketing Mix – Product, Price, Physical distribution, Promotion, Advertisement – Sales force management.

CS504 Mini Project **0 0 0 2**

CS648 E-Commerce **3 1 0 4**

Internet Fundamentals; Internet communication goals; Intemet vs. direct marketing media; making oneself easy to find; Seizing the Netsurfer's attention; Tailoring the offers on Internet.

Technologies that enable Internet based commerce; JAVA, JAVA++, WEB, HTTP; Some Popular Search Engines.

Electronic payment system; Security and E-Commerce.

Reference:

1. Launching Business on the WEB -2nd Edition, David Cook and Deborah Sellers, Prentice Hall Inc., E.E.E. 1996.

2. Web sites.

HS381 System Engineering **3 0 0 3**

Systems: Definition, hierarchy and classification. Systems approach and its development. Relationship with other approaches to problem solving. Systems modelling. Selected tools and techniques. Basic ideas and applications of Graph Theory, Fuzzy Sets Theory, Catastrophe Theory and Multivariate analysis. General Systems Theory, Cybernatics and Information Theory. Case studies.

HS366 International Finance **3 0 0 3**

Aim – The aim of this course is to provide an understanding of the fundamental concepts and managerial issues pertaining to international finance.

International Finance – overview – International Financial Institutions/Development Banks – World Bank – IBRD – IDA – IFC – MIGA – International Monetary Fund – Special Drawing Rights – Asian Development Bank – Internationalisation process

The Foreign Exchange Market – SWIFT – Arbitrage – Spot market – Forward market – Cross rates of exchange – Bid – Ask spreads – Balance of payments – Foreign exchange rates – Theories of Foreign Exchange Rate.

Foreign exchange exposure and management – Management of translation exposure – Methods – Management of transaction exposure – Management of economic exposure – Methods – Strategies.

Financial Management of the Multinational Firm – Foreign direct investment – Cost of capital and capital structure of the multinational firm – Multinational capital budgeting – Multinational cash management – Country Risk Analysis – International Taxation.

Financing Foreign Operations – Eurocurrency markets – Instruments – Interest rate swaps – Currency swaps and its pricing – Depository receipts – GDR and ADR – Euro and its implications for India.

References:

1. Buckley, A., Multinational Finance, Prentice Hall, New Jersy, 1992.
2. *Levich., R.M., International Financial Markets: Prices and Policies, McGrew Hill, Newyork, 2001.*
3. *Vij, M., Multinational Financial Management, Excel Books, New Delhi, 2001.*
4. *Shaprio, A.C., Multinational Financial Management, Prentice hall of India, New Delhi, 1996.*

MNS

MNS

5. *Apte, P.G., International Financial Management, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1999.*
6. *Jain, P.K., et.al, International Financial Management, Macmillan, New Delhi, 1998.*
7. *Eun, C.s. and Resnick, B.G., International Financial Management, Irwin McGraw Hill, Singapore, 2001.*

HS372 Advertising & Publicity **3 0 0 3**

9. INDUSTRIAL ENGINEERING: MSM 2

HS351 Fundamentals of Operations Research **3 0 0 3**

Prereq. Knowledge of Calculus, matrix, algebra, elementary probability theory. Development and scope of Operations Research-Examples of O.E. models in engineering and management. Linear programming. Simplex, transportation and assignment algorithms and their applications. Duality and sensitivity analysis. Principles of Optimality and Dynamic programming models. Deterministic inventory models. Introduction to queueing theory and ts applications.

HS352 Operations Management – 1 **3 0 0 3**

The production systems Concept – Decision making and production function, Production design and Process planning. Types of Production system, Production Planning and Control in Project, flow shop and job shop types of Production system. Methods of Forecasting – Production and inventory systems: Deterministic inventory models, Equipment selection and Facility Layout: Quality control; Acceptance sampling, Statistical Quality control, cost reduction techniques.

HS383 Computer Simulation **3 0 0 3**

Introduction to digital simulation -System Models. Monte Carlo simulation - Generation and use of random numbers -Fixed time -increment and variable time-increment simulation.

Experiment design for simulation experiments -Verification, validation and stopping rules -Simulation Models for queueing systems, inventory control, scheduling etc. Introduction to simulation languages, Project.

HS381 Systems Engineering **3 0 0 3**

Systems: Definition, hierarchy and classification. Systems approach and its development. Relationship with other approaches to problem solving. Systems modelling. Selected tools and techniques. Basic ideas and applications of Graph Theory, Fuzzy Sets Theory, Catastrophe Theory and Multivariate analysis. General Systems Theory, Cybernatics and Information Theory. Case studies.

HS355 Project Management **3 0 0 3**

Financial analysis and Investment decisions for projects. Network planning. CPM and PERT models. Resource leveling and crashing. Simulation of Networks. Criticality index. PERT Cost and time of Balance. Project Control. Computer packages for Project Management. Organisation for project management.

HS359 Facilities Planning **3 0 0 3**

Plant location – Theories and problems. Plant Layout. Techniques for facility planning. Assembly line balancing. Stores layout principles of material handling. Maintenance and replacement.

HS360 Materials Management **3 0 0 3**

Static and dynamic inventory models under risk and uncertainty. Multiple reorders and discounts. Multi-echelon inventory systems. Material Requirements planning. Rating and selection of vendors, Value Analysis and Standardization.

HS358 Industrial Engineering **3 0 0 3**

Quality Control, Maintenance of Plant and Machinery Social and economic impacts of productivity measurement. Work systems design Methods Engineering principles of techniques. Work measurement. Predetermined motion time systems. Introduction to human factors in engineering design and man-machine systems. Effects of environment of human performance. Production Planning and control: Types of Production systems and functions of PPC, Gantt charts, Flow shop and Job shop scheduling, Priority Dispatching rules. Project scheduling with PERT/CPM, Crashing and resource leveling. Plant Location and Plant Layout, Social and economic factors for Plant Location, Types of Layout, Design of Plant Layout, Materials handling, Statistical.

10. OPERATIONS RESEARCH : MSM3

HS351 Fundamentals of Operations Research **3 0 0 3**

Prereq. Knowledge of Calculus, matrix, algebra, elementary probability theory. Development and scope of Operations Research-Examples of O.E. models in

MNS

engineering and management. Linear programming. Simplex, transportation and assignment algorithms and their applications. Duality and sensitivity analysis. Principles of Optimality and Dynamic programming models. Deterministic inventory models. Introduction to queueing theory and ts applications.

HS353 Advanced Operations Research **3 0 0 3**

Review of linear programming. Intern programming. Introduction to Game theory. Probabilities inventory models. Priority queues. Morkov chains and applications.

HS383 Computer Simulation **3 0 0 3**

Introduction to digital simulation -System Models. Monte Carlo simulation - Generation and use of random numbers -Fixed time -increment and variable time-increment simulation.

Experiment design for simulation experiments -Verification, validation and stopping rules -Simulation Models for queueing systems, inventory control, scheduling etc. Introduction to simulation languages, Project.

HS356 Network Models in Management **3 0 0 3**

Systems modeling using networks. Elements of graph theory, Network optimization, Review of algorithms, Network flows, Network models in plant layout, project management, Group dynamics, etc.

MA639 Queues and Inventories **3 0 0 3**

Stochastic processes governing queues and inventories M/M/s queueing systems, steady state, Finite queues and their steady state behaviour, machine interaction problems, M/G/k and GI/M/s queueing system, cost estimates, Application to telephone trunking, Warehouse and workshop facilities, Inventory systems optimal policy, S-s inventory systems, Various models of inventories, application to large warehouse facilities, Optimal policies.

MNS

11. FINANCIAL MANAGEMENT : MSM4

HS361 Accounting for Managerial Control **3 0 0 3**

Preparation and interpretation of Financial statements – Profit and Loss Account: Balance Sheet Ration; Analysis of final statements, and Funds Flow statement. Depreciation Methods – Cost Accounting as a control technique – Material costs, standard costing and variance analysis – Cost-Volume – Profit Relationship. Budgetary control system.

HS391 Principles of Management **3 0 0 3**

Development of Administrative Thought; Normative and Descriptive models of Management; Power, Organisational Politics and Organisational Conflict; Managerial Functions; Planning, Objectives, Decision Making Process, Forecasting and Strategy formation; Organising; Division of Labour, Span of Control, Departmentation, Authority, - Group Dynamics, Bureaucracy and Autocracy – Leading: Motivation, Leadership. Supervision: Communication; Evaluating; Evaluation Process, Cost – Benefit Evaluation, Integrating theory and Practice.

HS391 Financial Analysis for Managerial Decisions **3 0 0 3**

Working Capital Management – Cash. Accounts Receivable – Make or Buy Decisions – Capital Budgeting – Financial Planning – Financial Structure – Dividend Policy.

HS362 Strategic Management **3 0 0 3**

Corporate Strategy- Nature & Scope – process of strategic planning – mission – objectives – goals – strategic formulation methods. Strategy Analysis Environment analysis – analysing resources and strategic capability – value chain analysis. Strategy Alternatives – Generic Strategic alternatives – Diversification – Merger & acquisition, strategic alliances. Strategy evaluation – Strategic Choice – Control. Strategy Implementation – Leadership & Organisation Climate – Planning and Control of Implementation – Strategies for going global – Global Strategy.

HS392 Indian Capital Market and Money Market **3 0 0 3**

Indian financial system - structure. Capital Market - players - stock exchanges - EMH - Issue of securities - new instruments. Regulations governing financial instruments - SEBI guidelines. Portfolio investment - CAPM - optimum portfolio. Money market - players - instruments - factoring - money market mutual funds - government securities.

MNS

HS363 International Finance **3 0 0 3**

Aim – The aim of this course is to provide an understanding of the fundamental concepts and managerial issues pertaining to international finance.

International Finance – overview – International Financial Institutions/Development Banks – World Bank – IBRD – IDA – IFC – MIGA – International Monetary Fund – Special Drawing Rights – Asian Development Bank – Internationalisation process

The Foreign Exchange Market – SWIFT – Arbitrage – Spot market – Forward market – Cross rates of exchange – Bid – Ask spreads – Balance of payments – Foreign exchange rates – Theories of Foreign Exchange Rate.

Foreign exchange exposure and management – Management of translation exposure – Methods – Management of transaction exposure – Management of economic exposure – Methods – Strategies.

Financial Management of the Multinational Firm – Foreign direct investment – Cost of capital and capital structure of the multinational firm – Multinational capital budgeting – Multinational cash management – Country Risk Analysis – International Taxation.

Financing Foreign Operations – Eurocurrency markets – Instruments – Interest rate swaps – Currency swaps and its pricing – Depository receipts – GDR and ADR – Euro and its implications for India.

References:

1. *Buckley, A., Multinational Finance, Prentice Hall, New Jersy, 1992.*
2. *Levich., R.M., International Financial Markets: Prices and Policies, McGrew Hill, Newyork, 2001.*
3. *Vij, M., Multinational Financial Management, Excel Books, New Delhi, 2001.*
4. *Shaprio, A.C., Multinational Financial Management, Prentice hall of India, New Delhi, 1996.*
5. *Apte, P.G., International Financial Management, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1999.*
6. *Jain, P.K., et.al, International Financial Management, Macmillan, New Delhi, 1998.*
7. *Eun, C.s. and Resnick, B.G., International Financial Management, Irwin McGraw Hill, Singapore, 2001.*

MNS

MP365: SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT 2 0 0 2

The course introduces security research technique as well as security valuation methods. The lectures, projects and cases require use of computer based technical tools.

1. Money market securities – CDs – CPs – Eurodollars – REPO – bankers acceptances – government bills.
2. Corporate bonds – types – characteristics – determinants of discount rates.
3. Shares – types – characteristics – determination of issue price.
4. Security market indexes.
5. Risk and factors influencing security risk – short positions – hedging – abridge.
6. Bond portfolio management – bond values – durations – yield spreads – bond portfolio immunization.
7. Portfolio management – share valuation –earnings approach – valve vs price – technical analysis – fundamental analysis – portfolio return – efficient frontiers – optimum portfolio.
8. Portfolio performance evaluation – mutual funds – Sharpe's performance measure – Treynor's performance measure – Jensen's performance measure – comparison of performance measures.

References

9. *Fisher, Donald, and Ronald Jordon, Security analysis and Portfolio Management, John Wiley, New York, 1990.*
10. *Francis, J.C., and W.Taylor, Theory and Problems of Investments, McGraw Hill, New York, 1992.*
11. *Jones, Charles P., Investments: Analysis and Management, John Wiley, New York, 1990.*
12. *Francis, J.C., and Stephen H.Archer, Portfolio Analysis, Prentice Hall, New Jersey, 1990.*
13. *Reilly, Frank., and Keith C. Brown, Investment Analysis and Portfolio Management, Harcount College Publsihers, 1999.*

Cottle, Sidney, et.al, Security Analysis, McGraw Hill, New York, 1988.

MNS

12.MATHEMATICS FOR COMPUTER SCIENCE : MAM1

MA490 Computability 3 0 0 3

Chomsky Grammars and Languages – Finite state automation – Deterministic and Non-deterministic automata – Regular expressions.

Context free languages and Pushdown automata, Turing Machines, church's thesis, Universal Turing Machines, Computability, Halting Problem, Decidability.

Time and Tape Complexity of Turing Machines, Other Complexity models, RAM algorithms Worst case and Average case Complexities, Big 'O' notation, NP and P, NP Completeness.

References:

1. *J.E. Hopcroft and J.D. Ullman, Introduction to Automata theory Languages and Computation, Narosa Publishing House, 1986.*
2. *Peter Linz, Introduction to Formal Languages and Automata, Narosa Publishing House, 1990.*
3. *H.R. Lewis and C.H. Papdimitrion, Elements of the theory of Computation, Prentice Hall of India, New Delhi, 1996.*
4. *J.L. Balcazar, J. Diaz, J. Gabaroo, Structural Complexity, Vol. I & II, Springer-Verlag, 1988.*
5. *Rani Siromoney, Formal Languages and Automata, The Christian Literature Society, Madras, 1979.*
6. *L. Mishra, N. Chandrasekaran, Theory of Computer Science (Automata, languages and Computation) Prentice-Hall of India, New Delhi, 1993.*

MA619 LOGIC AND APPLICATIONS **3 0 0 3**

Course Content :

Propositional Logic (PL): Syntax of PL, Consequences, Normal Form, Calculations, Analytic Tableaux.

First Order Logic (FL): Syntax of FL, Semantics of FL, Consequences, Standard Forms, Herbrand Interpretations, Calculations, Analytic Tableaux.

Program Verification: Partial Correctness, Toral Correctness, Hoare Logic, Predicate Transformer wp.

Books :

1. ***R.C. Backhouse**, Program Construction and Verification, Prentice Hall International, Englewood Cliffs NJ. (1986).*
2. ***M. Fitting**, First Order Logic and automated Theorem Proving, Springer Verlag, New York, (1990).*
3. ***D. Gries**, The Science of Programming, Springer Verlag, New York, (1981).*
4. ***A. Singh**, Logics for Computer Science, Prentice Hall of India, New Delhi, (2003).*

DCC approved date: 12th April, 2004

MA616 FUZZY SET THEORY AND ITS APPLICATIONS **3 0 0 3**

Course Content :

Fuzzy sets, Extension Principle of Fuzzy sets, Operations on Fuzzy sets, Fuzzy numbers, Arithmetic operations on fuzzy numbers, Fuzzy logic, Fuzzy decision making, Multiperson decision making, Multicriteria decision making, Multistage decision making, Fuzzy ranking methods, Fuzzy linear Programming.

Books :

1. ***H.J. Zimmermann**, Fuzzy Set Theory and its Applications, Allied Publishers, Indian Reprint, (1996).*
2. ***George J. Klir, Bo Yuan**, Fuzzy Sets and Fuzzy Logic, Theory and Applications, Prentice-Hall of India, (1997).*

DCC approved date: 12th April, 2004

MA621 COMBINATORIAL OPTIMIZATION **3 0 0 3**

Course Content

Review of Mathematical Programming- Integer programming – Branch and Bound techniques – Travelling salesman problem.

Computational complexity – Ellipsoidal and Karmarkar algorithms – Primal-dual algorithms.

Network problems: Shortest path algorithms – minimum spaning trees – matching algorithms – Chinese postman problem – Flows in networks and algorithms.

Books

1. ***L.R. Foulds**, Combinatorial Optimization for under graduates, Spinger Verlag, (1984).*
2. ***M. Grotschel, L Lovasz** and **A. Schrijver**, Geometric algorithms and Combinatorial optimization, Springer Verlag, (1988).*
3. ***B. Korte** and **J. Vygen**, Combinatorial Optimization, Spinger, (2002).*
4. ***C.H. Papadimitriou** and **K. Steiglitz**, Combinatorial Optimization, Algorithms and Complexity, Prentice Hall, (1982).*

DCC approved date: 12th April, 2004-

MA623 GRAPH THEORY **3 0 0 3**

Course Content :

MNS

MNS

Graphs and subgraphs – Connectivity and trees - Euler circuits – Menger's Theorem – Matchings – Tutte's l-factor theorem – Hamilton paths and cycles – Vertex and edge – colourings – Planar graphs - Flows in digraphs.

Graph algorithms – DFS, BFS, Shortest path algorithms – Minimum spanning trees - planarity algorithm.

Books

1. ***J.A Bondy and U.S.R. Murty****: Graph theory with applications, Macmillan (1976).*
2. ***D.B. West****: Introduction to graph theory, P.H.I. (1999).*

DCC approved date: 12th April, 2004

MA624 ALGORITHMIC GRAPH THEORY **3 0 0 3**

Course Content :

Introduction to algorithms, algorithmic complexity through Turing machines, P, NP-complete, NP-hard problems, Cook's Theorem : SAT is NP-complete.

NP-completeness of vertex cover, Independence number, Hamilton problem – k-vertex colouring problem.

Implementation of graph algorithms: Adjacency and incidence matrices, adjacency list, DFS, BFS.

Polynomial algorithms: Components – blocks – strong components in diagraphs – Eulerian circuits – vertex connectivity – edge connectivity.

Greedy algorithms: k-colourings – matchings.

Flows in networks, Max-flow - Min-cut theorem and algorithm.

Books :

1. ***A.Gibbons****, Algorithmic Graph Theory, CUP (1985).*
2. ***S. Even****, Graph Algorithms Computer Science Press, (1979).*
3. ***M.R. Garey and D.S. Johnson****, Computers and Interactability, Freeman, (1979).*

DCC approved date: 12th April, 2004

MA631 OPERATIONS RESEARCH **3 0 0 3**

Course Content :

Linear programming – Simplex algorithm – Transportation and assignment problems.

Duality – Dual simplex method – Sensitivity analysis.

Deterministic inventory models – EOQ formula.

The Birth and death processes – Steady s

tate solution of Poisson queues – Single and multiple servers.

Books :

1. **Taha H.A.,** Operations Research: An Introduction, Prentice Hall of India Pvt. Ltd., 7th Edition (2003).

2. **F.S. Hiller and G.J. Lieberman**; Introduction to Operations Research, Mc Graw-Hill, Fifth Edition, (1990).

3. **Ravindran A., Phillips D.T. & Solberg J.,** Operations Research: Principles and Practice, John Wiley & Sons, 2nd Edition (1987).

4. **Kanti Swaroop, P.K. Gupta and Man Mohan,** Operations Research, Ninth Edition, Sultan Chand & Sons,(2001).

DCC approved date: 12th April, 2004

MNS

MNS

MNS

IITM July ’06

MNS

IITM July ’06

MNS

13. MATERIALS TECHNOLOGY : MMM1

MT331 Introduction to Materials Science **3 0 0 3**

Introduction, materials classification, modern material needs, atomic structure, electrons atoms, bonding forces, crystal structures, crystallographic directions and planes, polycrystalline and non-crystalline solids, means of determining crystal structure (x-ray and electron diffraction), point defects, impurities, basics of dislocations and interfaces. Diffusion mechanisms, role of diffusion materials processing, phase equilibria, phase rule, binary phase diagrams, case study of Fe-Fe diagram, kinetics of phase transformations, nucleation and growth. Mechanical properties of metal elastic deformation, dislocations and plastic deformation, strengthening mechanisms, recover recrystallication and grain growth. Failure, fracture, fatigue and creep Environmental degradation of materials.

References:

1. *Materials Science and Engineering by V. Raghavan, (Prentice Hall of India, 1998).*
2. *Elements of materials Science and Engineering by Lawrence H. van Vlack, (Addison-Wesley, 1989).*
3. *Materials Science and Engineering by William D. Callister, (John Wiley & Sons, 1991.*
4. *Introduction to Materials Science and Engineering by James F. Schacklford, (MacMillen 1992).*

MM332 Techniques in Materials Characterisation **3 0 0 3**

Importance of characterization of materials – Chemical, mechanical metallographic and crystallographic characterization and their relevance.

Chemical characterization: Scope and applications, important and widely practiced instrumental methods of chemical analysis like AES, XRF, EDAX, EPMA etc, their working principles, limitations and merits.

Metallographic Studies: Importance of microstructure and morphology in materials technology. Scope of metallographic studies. Principles and techniques of optical metallographic-bright field and dark field image contrast; phase contrast, interference and polarized light microscopy; limitations of optical microscope. Scanning and transmission electron microscopy. Interpretation of electron micrographs.

Crystallographic characterization : Concept of phases and microconstituents. Role of diffraction studies in materials technology. Basics of x-ray and electron diffraction. Phase analysis using x-ray and electrons. Selected area diffraction (SAD) patterns and their interpretation.

Non-destructive examination.

References:

1. Instrumental methods of chemical analysis by B.K. Sharma, (Goel Publishers)
2. *Instrumental methods of Analysis by H.A. Willard, L.L. Merti & J.A. Dean, (CBS Publishers)*
3. *L.e. Murr; electron and Ion Microscopy and Micro Analysis – Principles and Applications – Marcel Dekk.*
4. *Elements of x-ray diffraction B.D. Cullity, (Addison Wesley)*
5. *Metals Hand Book 9th Edition, ASM Vol.10, Materials Characterization.*

MM333 Non-Metallic Materials **3 0 0 3**

Ceramic Materials: Ceramic structures, silicates, glasses, electromagnetic behaviour, mechanical and thermal properties, processing methods.

Molecular Phases : giant molecules, linear polymers, molecular irregularities, plastics, elastomers, adhesives, speciality polymers, conducting polymers, fullerenes and nanotubes.

Biomedical materials: Biofunctionality and biocompatibility, adoption of materials for medical and dental applications, need for composites.

Intermetallics : Classification, defects ordering and antiphase domains, non-stiochiometry, fabrication methods and applications.

References:

1. *Materials Science and Engineering : An introduction by W.D. Callister, Jr.-(John Wiley & sons, Inc.1996)*
2. *Elements of Materials Science and Engineering by L.H. Van Vlack, (Indian Book House Private Limited, Bombay, 1975)*
3. *Introduction to materials Science by V. Raghavan – (Prentice Hall, 1998).*

MM334 Materials Processing Techniques **3 0 0 3**

MNS

MNS

Metal Casting: Casting of ingots, introduction to moulding processes, gating and riser design, solidification, growth of single crystals.

Metal forming: Classification of metal forming processes, role of temperature and friction in metal working, deformation zone geometry, workability, unit operations in metal forming like rolling, extrusion, sheet metal forming, etc.

Welding: Classification of welding processes, their typical industrial applications, weldability, weld defects.

Powder Processing: Hot and cold isostatic processing, sintering, applications.

Novel Processing Techniques: Laser processing, etc.

References:

1. *Mechanical Metallurgy by George E. Dieter – (McGraw-Hill International Editions, 3rd Edn. 1986).*
2. *Principles of Metal Casting by R.W. Heine, C.R. Loper and P.C. Rosnethal – (Tata McGraw-Hill, 21st reprint, 1997).*
3. *Welding Metallurgy by Sindo Kou (John Wiley, 1987).*

---

14. PHYSICS FOR MODERN TECHNOLOGY : PHM1

PH350 Quantum Mechanics for Engineers 3 0 0 3

Wave-particle duality and the uncertainty principle. Two-slit experiment.

Wavefunction for a particle - physical interpretation, probability density, current, equation of continuity, normalization. Time-dependent Schrodinger equation for a free particel and particle in a potential.

Stationary states. Time-independent Schrodinger equation. Postulates of quantum mechanics. Expectation values of physical observables.

MNS

One-dimensional problems : energy eigenvalues and wavefunctions for a particle in a box, linear harmonic oscillator. Sware well potential. Kronig-Penney model, energy bands.

Reflection and transmission in potential barriers.

Motion in a central potential. Orbital angular momentum. Hydrogen atom - energy levels, degeneracy.

Electron spin. Pauli matrices. Application to magnetic resonance.

Charged particle in uniform constant magnetic field: Landau levels, wavefunctions. Elements of the Quantum Hall Effect.

Time-independent perturbation theory: non-degenerate and degenerate cases. Application to Zeeman and Stark effects.

Time-dependent perturbation theory: transition probabilities, Fermi's Golden Rule. Decay of excited states of atoms in the dipole approximation.

Identical particles and spin. Fermions and bosons. Free electron gas. Photon gas (blackbody radiation).

Semi-classical theory of radiation. Spontaneous and stimulated emission, Einstein's A and B coefficients. Population inversion, Maxwell-Bloch equations laser action.

References :

1. *E. Merzbacher, Quantum Mechanics, 2nd Edition, Wiley International Edition (1970).*
2. *P.M. Mathews and K. Venkatesan, A Textbook of Quantum Mechanics, Tata Mc-Graw Hill (1991).*
3. *J.J. Sakurai, Modern Quantum Mechanics, Revised Edition, Addison-Wesley, International Student Edition (1999).*

PH622 Semiconductor Physics 3 0 0 3

Semiconductor types: crystalline and amorphous, inorganic and organic, elemental and compound. Preparation and characteristics.

Band structural aspects. Effect of temperature and electric field on the bank structure. Frank Keldysh effect. Localized states of impurities: theoretical models and experimental probes (Capacitive and spectroscopic techniques). Optical properties: allowed and forbiddem and phonon-assisted transitions and their spectral shapes. Burstein Moss effect. Excitons: free and bound excitons.

MNS

Statistical thermodynamics of crriers. Fermi level in intrinsic and doped materials. Nonstoichiometric semiconductors: role of structural defects. Heavy doping and degeneracy. Electrical conductivity. Hall effect: two-bank model. Mobility of carriers. Mechanisms of scattering. Measurement of mobility. Recombination processes. Boltzman equation for electron transport. Equilibrium and nonequilibrium processes. Effective masses and their measurement. Cyclkotron resonance. Thermoelectric power. Magnetoresistivity. Hot electron effects. Microwave generation.

Metal-semiconductor contacts. Schottky barrier. P-N junctions: theory of carrier transport in p-n juctions. Characteristics of practical junctions and deviations from ideality. Capacitance effects: Space charge and diffusion capacitances. Impurity profiling through capacitance measurements. Tunnel diode and applications.

Photoconductivity. Role of traps and recombination. Photovoltaic devices fro solar cells and radiation detection. Luminescence. Light emitting diodes and laser action in p-n junction diodes.

Surfaces states. Band bending and effect on bulk properties. Thin film structures. Low-dimensional semiconductors: Quantum wells. Multiple quantum well structures, quantum dot structures. Methods of preparation, special characteristics and devices based on quantum wells. Quantum Hall effect. High electron mobility transistor.

References:

1. *R.A. Smith, Semiconductors, Academic Publishers, Calcutta (1989).*
2. *R.F. Pierret, Advanced Semiconductor Fundamentals, Vo.II Addison_Wesley (1989).*
3. *A.B. Lev, Semiconductors and Electron Devices, Prentice Hall (1987).*
4. *M. Shur, Physics of Semiconductor Devices, Prentice Hall (1990).*
5. *S.M. Sze, Physics of Semiconductor Devices, Wiley Eastern, 2nd Edition (1991).*
6. *G.C. Jain and W.B. Berry, Transport Properties of Solids and Energy Conversion, Tata McGraw-Hill (1972).*
7. *W.C. Dunlop, an Introduction to Semiconductors, Wiley (1957).*
8. *W. Shockley, Electrons and Holes in Semiconductors, D. Van Nostrand (1950).*

PH635 Laser Theory **3 0 0 3**

MNS

Thermal radiation : factors influencing coherence.
Radiation in Vacuum : intensity, energy density and pressure of radiation. Rdiation in a cavity : Modes of oscillation, blackbody radiation.
Radiation and Matter : mass and atomic absorption coefficients, Enistein coefficients, photo excitation cross-section, lifetimes of excited states, amplification of radiation, spectral line shapes, and line broadening mechanisms, grain profiles, threshold condition, gain saturation.
Optical Resonators : Fresnel number, time constant and Q factor of an optical cavity. Geometric theory : plane and spherical mirror resonator configurations, general conditions of stability, matrix treatment. Wave theory "confocal multimode resonators and fields, non confocal resonators, circular mirrors, spherical annular mirrors, unstable resonators, mode degeneracy, ring resonators.
Gain and saturation effects : Theory of gain saturation. Gain narrowing. Effect of gain saturation on modes. Power output, single mode operation, mirror transition and power optimization. Hole burning effects. Lab dip. Mode pulling, frequency bandwidth of laser output.
q-modulation : High inversion fast switching case. Arbitrary inversion fast switching case, giant pulse dynamics.
Mode locking : Generation and measurement of ultrashort optical pulses, dynamics of mode locking, efficiencies of mode locking. Cavity dumping. Pulse amplification : Limitations of peak power. Pulse shortening. Amplified spontaneous emission and mirror-less lasers.

References:

1. *A. Maitland and M.H. Dunn, Laser Physics, North Holland (1970).*
2. *A. Yariv, Quantum Electronics, John Wiley (1975).*
3. *M. Sargent III, Mrlan O Scully, and W.E. Lamb, Laser Physics, Addison-Wesley (1974).*
4. *W.V. Smith and P.P. Sorokin, The Laser, Mcgraw-Hill (1966)*
5. *J.T. Verdeyen, Laser Electronics, prentice Hall (1981).*
6. *A. Yari, Optical Electronics, Holt Rinehart & Winston (1976).*
7. *Laser Theory, Encylopedia of Physics, Vol.25/20, Springer (1984).*
8. *D.C.O. Shea, W.R. Callen and W.T. Rhodes, Introduction to Lasers and Their Applications, Addison Wesley (1978).*
9. *O.Svelto, Principles of Lasers, Plenum (1976).*

PH642 Superconductivity and its Applications **3 0 0 3**

Fundamental phenomena : Perfect Conductivity and Meissner effect. Thermodynamic critical field. Electrodynamics : London equations and penetration depth. Superconductor as a macroscopic quantum state. Flux quantisation. Pippard's non-local electrodynamics and coherence length.

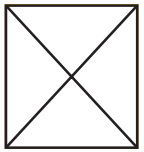
Thermodynamics of the superconducting phase transition. Ginsburg – Landu theory. Type I and Type II Superconductors. Surface nucleation and H_{c22}. Nature of mixed state – Flux flow and critical density. Superconductors and fullerenes.

Microscopic (BCS) theory. Cooper pairs and the attractive interaction. BCS ground state and exitations from the ground state. Energy gap and its temperture dependence. Tunneling experiments.

Josephson effects. SQUID devices. Superconducting magnet design.

References:

1. *M. Tinkham, Introduction to superconductivity, McGraw-Hill (1975).*
2. *D.R. Tilley and J. Tilley, Superfluidity and Superfluidity and Superconductivity, 3rd Edition, Hilger, Bristol (1990).*
3. *R.D. Parks (Ed.O, Superconductivity, Vols. 1 and 2, Marcel-Dekker (1969).*



INDIAN INSTITUTE OF TECHNOLOGY MADRAS

OUR VISION

To be an academic institution in dynamic equilibrium with its social, ecological and economic environment striving continuously for excellence in education, research and technological service to the nation.

OUR MISSION

- To create and sustain a community of learning in which students acquire knowledge and learn to apply it professionally with due consideration for ethical, ecological and economic issues
- To pursue research and disseminate research findings
- To provide knowledge-based technological services to satisfy the needs of society and the industry
- To help in building national capabilities in science, technology, humanities, management, education and research

QUALITY POLICY

To pursue global standards of excellence in all our endeavours namely, teaching, research, consultancy and continuing education and to remain accountable in our core and support functions through processes of self-evaluation and continuous improvement

CORE VALUES

MNS

- In pursuit of its mission IITM will
- Develop human resources to serve the nation
- Recognize teaching as a unifying activity
- Nurture Integrity, creativity and academic freedom
- Retain a willingness to experiment with new paradigms.

July, 2004

M.S. Ananth
Director