DEPARTMENT OF CHEMICAL ENGINEERING

CURRICULUM AND SYLLABUS

B. TECH
Chemical Engineering

2014 REGULATION

KALASALINGAM ACADEMY OF RESEARCH AND EDUCATION
(KALASALINGAM UNIVERSITY)
ANAND NAGAR, KRISHNANKOIL – 626 126

VISION & MISSION

UNIVERSITY VISION	DEPARTMENT VISION
To be a Center of Excellence of International repute in education and research	To be a globally recognized department through excellence in teaching and research
UNIVERSITY MISSION	**DEPARTMENT MISSION**
To produce technically competent, socially committed technocrats and administrators through quality education and research	To provide quality education and training that can prepare graduates with excellent technical and leadership skills, integrity and social responsibility

PROGRAM EDUCATIONAL OBJECTIVES (PEO's)

PEO1: Graduates would engage in advanced studies in engineering, Science and in other related areas.

PEO2: Graduates would be successful as engineers and further develop skills through lifelong learning.

PEO3: Graduates would have effective communication and managerial skills and assume leadership roles in industry and /or in business and contribute to the upliftment of the society.

STUDENT OUTCOME

SO-1: Ability to identify, formulate, and solve engineering problems by applying principles of engineering, science, and mathematics.

SO-2: An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as global, cultural, social , environmental and economic factors.

SO-3: An ability to communicate effectively with a range of audiences.

SO-4: An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

SO-5: An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan task and meet objectives.

SO-6: An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

SO-7: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

PROGRAM OUTCOMES

The student will have

1. An ability to apply knowledge of mathematics, science and chemical engineering in the design and operation of chemical processes
2. An ability to identify, formulate and solve complex problems in the various domains of chemical engineering such as fluid mechanics, heat transfer, mass transfer, mechanical operations and transport phenomena
3. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability
4. An ability to design and conduct experiments, as well as to analyze and interpret data
5. An ability to use the techniques, skills, and modern engineering tools necessary for chemical engineering practice
6. A knowledge of contemporary issues
7. The broad education necessary to understand the impact of chemical engineering solutions in a global, economic, environmental and societal context
8. An understanding of professional and ethical responsibility
9. An ability to work individually and as a member of a team
10. An ability to communicate effectively
11. An ability to function on multidisciplinary teams
12. A recognition of the need for, and an ability to engage in life-long learning

SEMESTER-1

Code No.	Subject	Objectives & Outcomes		L	T	P	C
		PEO's	PO's				
HSS101	English for Technical Communication I	2,3,4	6,7,10	2	0	0	2
MAT103	Mathematics I	1	1,2,4	3	0	0	3
PHY131	Physics I	1,3	1,2,3,4	3	0	0	3
CHY106	Chemistry	1,3	1,3,4	3	0	0	3
MEC101/ CSE102	Engineering Drawing/ Programming Languages	1,2,3,4/1,2,3,4	1,7,11/ 4,7,10,11	1	0	3	2
EEE101/ CIV101	Basic Electrical and Electronics Engineering /Basic Civil and Mechanical Engineering	1,2,3/2,3,4	3,4, 10,11 /6,7,9,10,11	4	0	0	4
MEC181/ CSE181	Work Shop/ Programming Language Laboratory	1/3,4	1,4/7	0	0	3	1
PHY183/ CHY182	Physics Laboratory/ Chemistry Laboratory	1,2,3/1,3	1, 3,4,11/ 1, 2,3	0	0	3	1
	Total			16	0	9	19

SEMESTER-2

Code No.	Subject	Objectives & Outcomes		L	T	P	C
		PEO's	PO's				
HSS102	English for Technical Communication II	2	6,8,9,10,11	2	0	0	2
MAT104	Mathematics II	1	1,4	3	0	0	3
PHY132	Physics II	1,3	1,3,4	3	0	0	3
CIV101/ EEE101	Basic Civil and Mechanical Engineering/Basic Electrical and Electronics Engineering	2,3,4/1,2,3	6,7,9,10,11/3,4, 10,11	4	0	0	4
CHY102	Environmental Sciences	1,2,3,4	3,4,9,12	2	0	0	2
CSE102/ MEC101	Programming Languages/ Engineering Drawing	1,2,3,4/1,2,3,4	4,7,10,11/1,7,11	2	0	0	2
MEC103	Engineering Mechanics	1,3	1,2,3,4	3	0	0	3
CHY182/ PHY183	Chemistry Laboratory/Physics Laboratory	1,3/1,2,3	1, 2,3/ 1, 3,4,11	0	0	3	1
CSE181/ MEC181	Programming Language Laboratory/ Work Shop	3,4/1	7/1,4	0	0	3	1
HSS036	Soft Skills- I	2	6,8,9,10,11	2	0	0	1
	Total			21	0	6	22

SEMESTER-3

Code No.	Subject	Objectives &Outcom		L	T	P	C
		PEO's	PO's				
MAT202	Mathematics III	1	1,4	3	0	0	3
HSS006	Professional Ethics	2	8,9,10,11	3	0	0	3
CHE201	Chemical Process Calculations	1,2,3,4	1,3,5,11	3	1	0	4
CHE202	Inorganic Chemical Technology	1,3,4	1,7	3	0	0	3
CHE203	Mechanical Operations	1,3,4	1,3,4,5	3	0	0	3
CHE204	Fluid Mechanics	1,3,4	1,2,5,7	3	1	0	4
CHE205	Chemical Engineering Thermodynamics I	1,2,3	1,3,4,8,9	3	0	0	3
CHE281	Mechanical Operations Laboratory	1,2,3,4	1,3,4,5,8	0	0	3	2
CHE282	Fluid Mechanics Laboratory	1,3,4	1,3,4,5	0	0	3	2
HSS037	Soft Skills- II	2	6,9,10	2	0	0	1
	Total			23	2	6	28

SEMESTER-4

Code No.	Subject	Objectives & Outcomes		L	T	P	C
		PEO's	PO's				
MAT212	Mathematics IV	1	1,4	3	0	0	3
HSS018	Communication Skills	2	8,9,10,11	3	0	0	3
CHE206	Heat Transfer	1	1,2,4,5	3	1	0	4
CHE207	Material Science and Technology	1,3	3,4,5	3	0	0	3
CHE208	Chemical Engineering Thermodynamics II	1,2,4	1,2,4,5,6	3	0	0	3
CHE209	Technical And Instrumental Methods of Analysis	1,3,4	1,2,5,7	3	1	0	4
CHE210	Organic Chemical Technology	1,3	3,4,5	3	0	0	3
CHE283	Heat Transfer Laboratory	1	2,4,5	0	0	3	2
CHE284	Technical and Instrumental Analysis Laboratory	1,2,3,4	1,2,5,7,9	0	0	3	2
HSS038	Soft Skills-III	2	6,9,10	2	0	0	1
	Total			23	2	6	28

SEMESTER-5

Code No.	Subject	Objectives & Outcomes		L	T	P	C
		PEO's	PO's				
CHEXX	Major Elective I			3	0	0	3
	Minor Elective I			3	0	0	3
CHE301	Process Dynamics and Control	1	1,2,4,5	3	1	0	4
CHE302	Chemical Reaction Engineering I	1,3	1,2,3,4	3	1	0	4
CHE303	Mass Transfer I	1,3	1,2,3,4	3	1	0	4
CHE304	Numerical Methods for Chemical Engineers	1,2,3,4		3	1	0	4
CHE381	Process Dynamics and Control Laboratory	1,3	1,3,4	3	0	0	2
CHE382	Chemical Reaction Engineering Laboratory	1,3	1,2,3,4	0	0	3	2
CHE398	Community Service Project- Phase I			0	0	2	1
	Total			21	4	5	27

SEMESTER-6

Code No.	Subject	Objectives & Outcomes		L	T	P	C
		PEO's	PO's				
	Free Elective I			3	0	0	3
CHEXXX	Major Elective II			3	0	0	3
CHE305	Chemical Reaction Engineering II	1,3	1,2,3,4	3	0	0	3
CHE307	Biochemical Engineering	1,3,4	3,7	3	0	0	3
CHE308	Process Equipment Design	1	4	3	1	0	4
CHE309	Mass Transfer II	1,2,3	1,2,3,4,5,6	3	0	0	3
CHE383	Mass Transfer Laboratory	1	4	0	0	3	2
CHE384	Process Equipment Design and Drawing Laboratory	1	4	0	0	3	2
CHE385	Biochemical Engineering Laboratory	1	4	0	0	3	2
CHE399	Community Service Project- Phase II			0	0	3	2
	Total			18	1	12	27

SEMESTER-7

Code No.	Subject	Objectives &		L	T	P	C
		PEO's	PO's				
CHEXXX	Major Elective III			3	0	0	3
CHEXXX	Major Elective IV			3	0	0	3
HSSXXX	Humanities Elective III			3	0	0	3
CHE418	Transport Phenomena			4	0	0	4
	Free Elective II			3	0	0	3
	Minor Elective II			3	0	0	3
CHE481	Computer Applications in Chemical Engineering Laboratory	1	4	0	0	3	2
	Total			19	0	3	21

SEMESTER-8

Code No.	Subject	Objectives & Outcomes		L	T	P	C
		PEO's	PO's				
CHEXX	Self study Elective			3	0	0	3
CHE499	Project Work and Viva-Voce	1,2,3,4	1,2,3,4,5,6,7,8,9,10,	0	0	24	10
	Total			3	0	24	13

Total Credits (from 1st semester to 8th semester = 185)

MAJOR ELECTIVES

Code No.	Subject	Objectives & Outcomes		L	T	P	C
		PEO's	PO's				
CHE310	Fertilizer Technology	1, 3	2,3,4,5	3	0	0	3
CHE311	Corrosion Science and Engineering	1,3	1,3,4	3	0	0	3
CHE312	Electrochemical Engineering	1, 3	1,3,5	3	0	0	3
CHE313	Polymer Technology	1,2,3	1,2,3,6	3	0	0	3
CHE314	Colloids and Surface Science	1,3	1,3,4,5	3	0	0	3
CHE317	Food Technology	1,3	1,3	3	0	0	3
CHE421	Safety in Chemical Industries	1,3,4	1,7	3	0	0	3
CHE422	Paper and Pulp technology	1,2,3	2,3,4,6	3	0	0	3
CHE320	Energy Technology	1,3,4	2,3,4,7	3	0	0	3
CHE321	New Separation Techniques	1,3	1,3,4,5	3	0	0	3
CHE322	Nanoscience and technology	1,2	4,5,6,8	3	0	0	3
CHE323	Membrane Science and Technology	1,2,3	3,4,5,6	3	0	0	3
CHE324	Optimization for Chemical Engineers	1,2,3	1,3,4,5,6	3	0	0	3
CHE325	Petroleum Refinery Engineering	1,2	1,4,5,8	3	0	0	3
CHE401	Boundary Layer Theory	1	1,2,4	3	0	0	3
CHE402	Multiphase Flow	1	1,4	3	0	0	3
CHE403	Downstream Processing	1,3	1,3,5	3	0	0	3
CHE404	Computational Fluid Dynamics	1,2,3	1,2,3,6	3	0	0	3
CHE405	Computational Heat Transfer	1,2	1,4,5,6	3	0	0	3
CHE406	Computer Aided Process Plant Design	1,3	3,4,5	3	0	0	3
CHE407	Fluidization Engineering	1	2,4,5	3	0	0	3
CHE408	Principles of Heterogeneous	1,2,3	3,5,6	3	0	0	3
CHE409	Multi-component Mass Transfer	1,2	1,4,5	3	0	0	3
CHE410	Finite Element Methods	1,2	2,3,6,12	3	0	0	3
CHE411	Process Modelling and Simulation	1	1,4	3	0	0	3
CHE412	Enzyme Engineering and	1,3	1,2,3,5	3	0	0	3
CHE414	Pharmaceutical Engineering	1,3	1,3,4,5	3	0	0	3
CHE415	Bioreactor Design and Analysis	1,2	1,4,8,11	3	0	0	3
CHE416	Process Engineering Economics	1,2,3,4	1,3,5,7,8,10,1	3	0	0	3
CHE417	Process Instrumentation	1	1,2,4,5	3	0	0	3

MINOR ELECTIVES

Code No.	Subject	Objectives & Outcomes		L	T	P	C
		PEO's	PO's				
CIV320	Air Pollution and Control	1,2,3,4	3,7,8,10	3	0	0	3
CIV369	Environmental Impact Assessment	1,2,3,4	3,7,8,10	3	0	0	3
CIV463	Solid Waste Management	1,2,3	3,4,8,10	3	0	0	3
CIV464	Industrial Wastewater Management	1,2,3	1,3,4,8	3	0	0	3
CSE255	Data Structures	1,3	1,2,3,4	3	0	0	3
ECE304	Microprocessors and its	1,3,4	1,3,5,7,12	3	0	0	3
EEE409	Industrial Automation	1,2	1,5,8	3	0	0	3
EEE410	Neural Network and Fuzzy Logic Control	1	1,2	3	0	0	3
EIE319	Piping and Instrumentation	1,3		3	0	0	3
MEC313	Turbo Machinery	1,3	1,2,3,4,5	3	0	0	3
MEC318	Refrigeration and Air Conditioning	1,3	1,2,3	3	0	0	3
MEC326	Composite Materials Science	1,3	1,2,3	3	0	0	3
MEC405	Vibration Analysis and Noise Monitoring	1,3	2,3,4	3	0	0	3
MEC412	Micro Electro Mechanical Systems	1,3	1,2,3,4	3	0	0	3
MEC417	Work Study	1,2,3,4	6,7,8,9	3	0	0	3
CHE315	Thin Films	1,3	2,3,4	3	0	0	3
CHE316	Biomedical Engineering	1,3	3,4,5	3	0	0	3

HUMANITIES AND SOCIAL SCIENCE

Code No.	Subject	Objectives & Outcomes		L	T	P	C
		PEO's	PO's				
HSS001	Total Quality Management	2,3,4	6,7,8,9,10,11,12	3	0	0	3
HSS002	Engineering Management	2,3,4	6,7,8,9,10,11,12	3	0	0	3
HSS003	Indian Economic Development	2,3,4	6,7,8,9,10,11,12	3	0	0	3
HSS004	Industrial Psychology	2,3,4	6,7,8,9,10,11,12	3	0	0	3
HSS005	Consumer Psychology	2,3,4	6,7,8,9,10,11,12	3	0	0	3
HSS006	Professional Ethics	2,3,4	6,7,8,9,10,11,12	3	0	0	3
HSS007	Operations Management	2,3,4	6,7,8,9,10,11,12	3	0	0	3
HSS008	Introduction to Economics	2,3,4	6,7,8,9,10,11,12	3	0	0	3
HSS009	Applied Economics	2,3,4	6,7,8,9,10,11,12	3	0	0	3
HSS010	International Trade and Finance	2,3,4	6,7,8,9,10,11,12	3	0	0	3
HSS011	Information Systems for Managerial Decision Making	2,3,4	6,7,8,9,10,11,12	3	0	0	3
HSS012	Advertising and Media Services	2,3,4	6,7,8,9,10,11,12	3	0	0	3
HSS013	Cost Analysis and Control	2,3,4	6,7,8,9,10,11,12	3	0	0	3
HSS014	Introduction to Marketing Management	2,3,4	6,7,8,9,10,11,12	3	0	0	3
HSS015	Management Concepts and Techniques	2,3,4	6,7,8,9,10,11,12	3	0	0	3
HSS016	Organizational Psychology	2,3,4	6,7,8,9,10,11,12	3	0	0	3
HSS017	International Economics	2,3,4	6,7,8,9,10,11,12	3	0	0	3
HSS018	Communication Skills	2,3,4	6,7,8,9,10,11,12	3	0	0	3
HSS019	Organizational Psychology	2,3,4	6,7,8,9,10,11,12	3	0	0	3
HSS020	Human Resource Management	2,3,4	6,7,8,9,10,11,12	3	0	0	3
HSS021	Public Finance in Theory and Practice	2,3,4	6,7,8,9,10,11,12	3	0	0	3
HSS022	Banking Theory and Practice	2,3,4	6,7,8,9,10,11,12	3	0	0	3
HSS023	Entrepreneurship Development	2,3,4	6,7,8,9,10,11,12	3	0	0	3

FREE ELECTIVES

Code	Name of the Course	L	T	P	Credit
BCY501	Nano Chemistry	3	0	0	3
BPY502	Laser Physics	3	0	0	3
BCY504	Applied Chemistry	3	0	0	3
BPY504	Radiation Physics	3	0	0	3
BCY505	Instrumental Method Of Analysis	3	0	0	3
BPY506	Nuclear Physics	3	0	0	3
BCY506	Environmental Chemistry	3	0	0	3
BPY507	Space Physics	3	0	0	3
BMA332	Mathematical Modelling	3	0	0	3
BMA331	Combinatronics	3	0	0	3

SEMESTER 1

HSS101	ENGLISH FOR TECHNICAL COMMUNICATION I	L	T	P	C
		2	0	0	2

Course Outcomes:

At the end of the course, students would be able

to CO1: Participate in Non-verbal

communication CO2: Enjoy cloze reading—

skimming and scanning

CO3: Frame simple sentences to express daily activities

CO4: Take notes when reading and listening lectures and media events

CO5: Frame Instructions, Recommendations and Short Speeches

CO6: Remember nuances of Note-making, the template of Notices, Advertisements, Graphs and Charts

CO7: Write Short stories, anecdotes, process description, etc..

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H	M			H		
CO2						H	M			H		M
CO3						H						
CO4						H						
CO5						H	M					
CO6						H						
CO7						H						

FOCUS ON LANGUAGE

Parts of speech - nominal compounds, noun phrases - relative pronoun - adjective - numerical, comparison and contrast, collocation and word combinations - verb - preposition and relative - conjunction- connectives, expressions of purpose and function, cause and effect - articles - adjectives - sentence pattern - tenses - voice - rewriting the sentences in impersonal/abbreviated passive grammatical structures - concord - sentence level verb noun agreement - gerund - rewriting infinitive into gerund - imperative - rewriting imperative into recommendation using should - word formation - varied grammatical function of the same word - affixes - prefix and suffix, number prefix, negative prefix - reported speech - editing strategies - conditional structures - real, unreal, no possibility, zero condition - writing formal definition - abbreviation and acronym - idioms and phrases - varieties of English - British versus American.

LISTENING SKILLS

Comprehension practice - vocabulary development - familiarity to varied types of spoken English and accents - developing ability to understand audio and video media - aiming at overcoming barriers to listening - listening to documentaries, radio news broadcasts, TV news telecasts - active listening in discussions and to lectures - taking notes while listening - extracting information from listening.

SPEAKING SKILLS

Oral practice - role play - interplay - seminar - transcoding visual into oral - participating in short and longer conversation - voice record, replay, correction of intonation, pronunciation and flow of speech - phonemes - vowels, consonants, stress, rhythm, intonation - group discussion - participative

learning - acquiring proficiency, fluency, accuracy in oral communication - speaking practice - developing confidence - extempore speech - learning professional/conversational etiquette.

Vocabulary extension - improving vocabulary - intensive reading - reading strategies - identifying topic sentence - guessing meaning from content - picking out specific information - professional reading - reading practice - predicting the content, critical and analytical reading - reading articles in English newspapers, sports magazines, encyclopedias - reading aloud, use of stress and intonation - reading and comprehending technical materials - cloze reading.

WRITING SKILLS

Discourse cohesion - improving writing skills, avoiding common grammatical errors in academic writing - extending the hints - writing shorter sentences - punctuation - dialogue writing - paragraph writing, problems and solutions, achieving coherence, transition words, sequence words - essays of descriptive and argumentative

- writing instructions, use of imperatives - jumbled sentences into sequential paragraph using linguistic clues - report writing - technical reports, industry visit reports, events reports - writing recommendations - letter writing - formal and informal letters - job application and resume, permission for in-plant training, business correspondence letters, calling for quotation, placing order, lodging complaint, persuasive letters - assignment writing - mini-project - transcoding - transferring of information from text to pictorial/graphical representation and vice versa.

TEXT BOOK

1. Rizvi M Ashraf, Effective Technical Communication, Tata McGraw-Hill, 2005

REFERENCES

1. Daniel Jones, English Pronouncing Dictionary, Universal Book Stall, New Delhi, 17th Edition, 2000
2. Geoffrey Leech, Fan Svartvik, A Communicative Grammar of English, Pearson Education Asia, 1994
3. Hornby, AS, Oxford Advanced Learner's Dictionary of Current English, OUP, 7th Edition, 2005
4. Manivannan G, English for Engineers - A Book on Scientific and Technical Writing, Govi Publications, 2005

MAT103	MATHEMATICS I	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Find the Eigen values of a matrix and to use Cayley-Hamilton theorem for finding the inverse of a matrix

CO2: Explain the concept of curvature and to find envelope of a curve

CO3: Apply partial derivatives to find maxima and minima

CO4: Solve second order linear differential equations with constant coefficients, Cauchy's equation and Legendre's equation

CO5: Understand the geometry of sphere, plane and straight line in the three dimensional space

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M										
CO2	M			M								
CO3	M	M		M								
CO4	M			H								

CO5	M			M								

MATRICES

Review of linear algebra - Matrix operations - Addition, scalar multiplication, multiplication, transpose, ad joint and their properties - Special types of matrices - Null, identity, diagonal, triangular, symmetric, Skew- symmetric, Hermitian, Skew-Hermitian, orthogonal, unitary, normal - Rank - Consistency of a system of linear equations - Solution of the matrix equation Ax = b – Row - Reduced echelonform

EIGEN VALUE PROBLEMS

Eigen value and eigen vector of real matrix - properties of eigen values and eigen vectors - Cayley - Hamilton theorem - Orthogonal transformation of a real symmetric matrix to diagonal form - Reduction of quadratic form to canonical form by orthogonal transformation - Index, signature and nature of quadratic form

DIFFERENTIAL CALCULUS

Review of limits - Continuity and differentiability - Curvature - Cartesian and Parametric co-ordinates - Centre
and radius of curvature - Circle of curvature - Evolutes - Involutes - Envelopes - Partial differentiation - Euler's theorem for homogeneous functions -Total differential - Taylor's expansion (two variables) - Maxima and Minima for functions of two variables - Method of Lagrangian multiplier - Jacobians

THREE DIMENSIONAL ANALYTICAL GEOMETRY

Direction cosines and ratios - Angle between two lines - Equations of a plane - Equations of straight line - Coplanar lines - Shortest distance between two skew lines - Sphere - Tangent plane - Plane section of a sphere- Orthogonal spheres

ORDINARY DIFFERENTIAL EQUATIONS

Solutions of second and higher order linear ODE with constant coefficients - Cauchy's and Legendre's linear equations - Simultaneous first order linear equations with constant coefficients - Method of variation of parameters

TEXT BOOKS

1. Kreyszig, E, Advanced Engineering Mathematics, John Wiley and Sons (Asia) Limited, Singapore , 8^{th} Edn., 2001
2. Arumugam, S., Thangapandi Isaac, A., Somasundaram, A., Engineering Mathematics Volume I, Scitech Publications (India) Pvt. Ltd., Chennai, 2^{nd} Edn., Reprint 2000, 1999

REFERENCES

1. Grewal , B.S., Grewal, J.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 37^{th} Edition., 5^{th} Reprint 2004, 2003
2. Venkataraman, M. K., Engineering Mathematics First Year, The National Publishing Company, Chennai, 2^{nd} Edition., Reprint 2001, 2000

PHY 131	PHYSICS I (Common to all Branches)	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Understand the different types of sound waves and production & application of ultrasonics CO2: Understand the basic concepts, production & applications of different types of laser sources CO3: Know the general ideas about optical fibres and their applications in various fields

CO4: Learn the basic knowledge of crystallography and it's preparation techniques

CO5: Gain the knowledge about the fundamentals, theory of quantum physics

CO6: Gain the knowledge about various mechanical properties & thermal properties of matters

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		M	M								
CO2	H	M	M	H								
CO3	H	H	H	H								
CO4	H	H	H	M								
CO5	H	H	H	M								

ACOUSTICS AND STRUCTURE OF SOLIDS

Classification of sound – reverberation – Sabine's formula – common acoustical defects and remedies –
classification of solids – crystal structures – X-ray diffraction – crystal growth – crystal defects

LASER AND FIBRE OPTICS

Interaction of radiation with matter – quantum mechanical view – three and four Level laser system – Holography – construction and reconstruction of hologram – Engineering and medical applications – introduction of fibre optics – classification of fibre – Engineering and medical applications

QUANTUM PHYSICS

Inadequacy of classical mechanics – Black body radiation – Planck's law – Photo electric effect – Compton effect – Einstein's photoelectric equation – Schrödinger wave equation – particle in one – three dimensional box.

NON-DESTRUCTIVE TESTING

Liquid penetrant – magnetic particle and eddy current methods – X-ray radiography – fluoroscopy – Gamma ray radiography – ultrasonic scanning methods – ultrasonic flaw detector – thermography.

RELATIVITY

Frame of reference – Newtonian relativity – Galilean Transformation equations – Ether hypothesis – Michelson-Morley experiment – special theory of relativity – Lorentz transformation equations – length contraction – time dilation – relativity of simultaneity – addition of velocities – variation of mass with velocity
– mass-energy equivalence – Minkowski's four dimensional space – time continuum.

TEXT BOOKS

1. P.K. Palanisamy, "Engineering Physics", Scitech Publications (India), Pvt Ltd., Chennai, 2009.
2. S.O. Pillai and D.N. Sankar, A text book of Engineering Physics. New Age International Publication, New Delhi, 2008.

REFERENCES

1. Murthy V.S.R., Jena AK, Gupta K.P. and Murthy G.S., Structures and Properties of Engineering
Materials, Tata McGraw – Hill Publishing Company Limited, New Delhi, 2003.
2. Gaur R.K. & Gupta S.L., Engineering Physics, Dhanpat Rai publications (P) Ltd., New Delhi, 2001.
3. Ali Omar. M, Elementary Solid State Physics, Pearson Education (Singapore), Indian Branch, New
Delhi.
4. William F. Smith, Foundations of materials science and Engineering, 3rd Edition, Tata McGraw-Hill, New York, 2003.
5. Rajput B.S Pragati Prakashan, Advanced Quantum Mechanics, New Market, Begum Bridge, Meerut.
6. Hand book of Electronics, Gupta S.L. Kumar V Pragati Prakashan, New Market, Begum Bridge, and
Meerut.
7. Arthur Beiser, Concepts of Modern Physics - Tata McGraw – Hill Publishing Company Limited, New
Delhi, 5th Edition, 2000.

CHY 106	CHEMISTRY	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Know the water quality parameters to assess the quality of water

CO2: Learn the techniques of purification of water

CO3: Gather the knowledge in basic concepts of thermodynamics

CO4: Explain the principles of chemical & electrochemical reactions and prevention of corrosion of materials

CO5: Explain the principles and generation of energy in batteries, solar cells and fuel cells

CO6: Explain the preparation, properties and applications of polymers and nano-materials CO7: Discuss the principles, instrumentations and applications of analytical techniques

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			H	M								
CO2			H									
CO3	M											
CO4			M									
CO5				M								
CO6				M								
CO7	M		M	M								

MACROSCOPIC PROPERTIES OF SYSTEMS IN EQUILIBRIUM

Basic concepts of thermodynamics- Mathematical form of First law and its limitations-Enthalpy-Applications of first law (relation between C_p and C_V only) - Second law of thermodynamics (Clausius and Kelvin statement) - Entropy changes for reversible and isothermal processes - Problems-Entropy of phase transitions- Problems- Free energy and work function, Gibbs-Helmholtz equation-Applications-Problems-Van't Hoff isotherm and isochore-Applications-Problems- Phase equilibria-Application to one component systems, two component systems (eutectic and compound formation).

ELECTRODICS

Electrochemical series and its applications -Reference electrodes (H_2 and calomel electrodes)-Determination of single electrode potential by using reference electrodes - -EMF measurements and its applications- problems- Nernst equation-Problems- Electrochemical energy systems: primary and secondary batteries, fuel cells, solar cell- Chemical structure, electronic behaviours and applications of conducting polymers.-Principles of chemical and electrochemical corrosion - Corrosion control (Sacrificial anode and impressed current methods).

DYNAMICS OF CHEMICAL PROCESSES

Basic concepts- Kinetics of parallel, opposing and consecutive reactions with examples-Temperature dependence of rate of reactions-Problems -Techniques and methods for fast reactions, flow techniques, relaxation methods and flash photolysis - Thermodynamic formulation of reaction rates - Enzyme kinetics (Michaelis-Menten equation).

WATER TECHNOLOGY

Water quality parameters - Definition and expression - Importance and determination of Dissolved oxygen (DO) content in water-Estimation of hardness (EDTA method)- Problems-Determination of alkalinity- Water softening (zeolite) - Demineralisation (Ion- exchangers) and desalination – Boiler feed water-Domestic water treatment.

INSTRUMENTAL METHODS OF ANALYSIS

Fundamental principles, theory, instrumentation and applications of UV-Visible spectroscopy, Gas Chromatography (GC), High Performance Liquid Chromatography (HPLC), Thermogravimetric analysis (TGA), Differential Thermal Analysis (DTA), Scanning Electron Microscopy (SEM), Tranmission Electron Microscopy (TEM), Refractometry and Nephelometry.

TEXT BOOKS

1. Atkins P. W., Physical Chemistry, Sixth Edition, Oxford University Press, 1998.
2. Jain P.C. and Monica J., " Engineering Chemistry ", Dhanpat Rai Publications Co.,(P) Ltd., New Delhi, 14th Edition 2002.
3. Sharma, B.K., "Instrumental Methods of Analysis ", Goel publishing House, 12th Edition, 2001.

REFERENCES

1. Puri B. R., Sharma L. R., and Pathania M.S., "Principles of Physical Chemistry", Vishal Publishing Co., 2008.
2. Kuriakose, J.C. and Rajaram J., "Chemistry in Engineering and Technology ", Vol. I and II, Tata McGraw-Hill Publications Co.Ltd, New Delhi, 1996.

3. Kund and Jain, “Physical Chemistry ", S. Chand and Company, Delhi, 1996.
4. Gordon M.Barrow, “Physical Chemistry ", Sixth Edition, Tata McGraw Hill, 1998.
5. Willard, H.H., Merritt. I.I., Dean J.A., and Settle, F.A., "Instrumental methods of analysis", Sixth Edition, CBS publishers, 1986.
6. Vogel A.I., “Quantitative Inorganic Chemical Analysis ", V. Edition, 1989.
7. 7. Rouessac, F., “Chemical Analysis-Modern instrumental methods and techniques ", Wiley- Publishers, 1999.

CSE 102	PROGRAMMING LANGUAGES (Common to	L	T	P	C
		2	0	0	2

Course Outcomes:

At the end of the course, students would be able to

CO1: Learn the basics of computer programming concepts using C programming language

CO2: Design programs involving decision structures, and loops

CO3: Understand how to include functions and structure as part of the solution

CO4: Utilize pointers & arrays to efficiently solve problems and understand the dynamics of memory

CO5: Understand the file system and operations on files

CO6: Develop algorithms to solve basic programming problems & able to learn hands-on experience in designing and implementing some selected types of team oriented projects

CO7: Understand the UNIX basics and also the concept of Shell Programming

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H						M					
CO2											M	
CO3											M	
CO4											M	
CO5	H											
CO6	M											
CO7	M											

BASIC ELEMENTS OF C & CONTROL STATMENTS

Introduction to C programming – C character set – Identifiers, keywords, data types, constants, variable, declarations, expressions, statements, symbolic constants, Operators and Expressions-Operator precedence and associativity of operators -Input and Output Functions-Library Functions - Header Files - Simple Computational problems. Decision Making: if statement - if-else statement - else-if ladder –Looping statements

–While –do-while- Still more looping-For statement, Nested control statements- switch statement – the break statement - ? : Operator - Continue statement - goto statement – Problems using Control Structures.

USER DEFINED FUNCTION FUNCTIONS & STORAGE CLASSES

Need for User defined functions, a multifunction program- Elements of user defined functions-Definition of Functions- Return values and their Types- Function Calls-Function declaration-Category of functions- Nesting of functions –Recursion- Problems on functions & recursion functions. Storage Classes -Automatic Variables - External Variables – Static and Register Variables.

ARRAYS AND POINTERS

Defining and Processing an Array - Passing Arrays to Functions - Multidimensional Arrays - Arrays and Strings - Enumerated data types-Programs using sorting, searching and merging of arrays. Pointer Fundaments - Pointer Declarations - Passing Pointers to Functions - Arrays and

Pointers - Pointers and One- Dimensional Arrays - Pointers and Multidimensional Arrays - Operations on Pointers-Programs using Pointers with Functions.

DYNAMIC MEMORY MANAGEMENT, STRUCTURES & UNIONS

Dynamic Memory Allocation –Allocating a Block of memory, multiple blocks, releasing used space, altering the size of block. – Defining a Structure - Processing a Structure – User defined Data Types – Nested structure- Structures and Pointers - Passing Structures to Functions - Self Referential Structures- Arrays and &Structures Union.

DATA FILES AND UNIX OS

Opening and Closing a Data File - Creating a Data File – Reading & writing a data file. Processing and Updating of Data Files - Unformatted Data Files - Programs using merging, searching of data file contents. Introduction to Operating System. Shell fundamentals- shell commands – File commands- Directory commands-Miscellaneous commands

TEXT BOOK

1. Byron S. Gottfried, Programming with C, Second Edition, Tata McGraw Hill, 2006

REFERENCES

1. Brian W. Kerninghan and Dennis M.Richie, "The C Programming language", Pearson Education, 2005.
2. Johnsonbaugh R.and Kalin M, "Applications Programming in ANSI C", Third Edition, Pearson Education, 2003.
3. E. Balagurusamy " Programming in ANSI C" fourth edition TMH 2008
4. V.Rajaraman "Computer Basics and C Programming" PHI 2008
5. Stephen Kochan and Patrick Wood, UNIX Shell Programming, Third Edition, Pearson education, 2003

EEE101	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
		4	0	0	4

Course Outcomes:

At the end of the course, students would be able to

CO1: Do the basic estimation of electrical quantities
CO2: Interpret the basic electrical and electronics circuits
CO3: Understand the DC and AC single phase and three phase fundamentals
CO4: Understand the working principle of various Electrical AC and DC machines
CO5: Get the knowledge about various Analog type measuring instruments and house wiring. CO6: Get the knowledge about basic semiconductor devices
CO7: Get the knowledge about the application of basic Electronics devices for domestic and industries

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										M		
CO2										M		
CO3										M	M	
CO4										M	M	
CO5										M	M	
CO6			M							M		
CO7			M	M						M		

MAGNETIC CIRCUITS

Magnetic circuits - definition of MMF, flux and reluctance - reluctance in series and parallel - electromagnetic induction - Fleming's rule - Lenz's Law - Faraday's laws - statically and dynamically

induced EMF - self and mutual inductance - coefficient of coupling - hysteresis - eddy currents - analogy of electric and magnetic circuits - simple problems.

DC CIRCUITS AND AC CIRCUITS

Electrical quantities - resistors - inductors - capacitors - Ohm's Law - Kirchoff's Laws - series and parallel circuits - analysis of DC circuits - mesh, nodal - simple problems.

Sinusoidal functions - phasor representation - RMS Effective values - form and peak factors - RLC circuits - power and power factor - analysis of 3 phase AC circuits - simple problems.

ELECTRICAL MACHINES

Construction and principle of operation of DC machines - generator, motor - single phase transformers - alternators - three phase and single phase induction motors.

MEASURING INSTRUMENTS AND WIRING CIRCUITS

Moving coil and moving iron instruments - dynamometer type wattmeter - induction type energy meter.Domestic wiring - accessories - types - staircase wiring - fluorescent tube circuits - simple layout - earthing.

ELECTRONIC DEVICES

Basic concepts of PN junction diodes - zener diode - bipolar junction transistor - uni polar devices - FET, MOSFET, UJT - thyristor - photoelectric devices.

ELECTRONIC CIRCUITS

Half wave and full wave rectifier - amplifier - oscillator - RC integrator and differentiator circuits - diode clampers and clippers - multivibrators - schmitt trigger.

TEXT BOOKS

1. V.K. Mehta, "Principles of Electrical Engineering and Electronics", S. Chand & Company Ltd, 2008.
2. Kothari D P and Nagrath I J, "Basic Electrical Engineering", Tata McGraw Hill, 1991.
3. Mithal G K, Electronic Devices & Circuits, Khanna Publications, 1997.

REFERENCES

1. T. Thyagarajan, "Fundamentals of Electrical and Electronics engineering", SciTech publications (Ind.)
   Pvt. Ltd., 3rd Edition, October 2000.
2. Muraleedharan K.A, Muthususbramanian R and Salivahanan S, "Basic Electrical, Electronics and
   Computer Engineering" Tata McGraw Hill, 1999.

PHY 183	PHYSICS LABORATORY	L	P	T	C
		0	0	3	1

Course Outcomes:

At the end of the course, students would be able to

CO1: Learn the practical understanding of the mechanical properties such as modulus, moment of inertia, gravitational force, stress, strain, etc

CO2: Understand and apply the optical phenomena like diffraction,

interference, etc CO3: Understand the thermal conductivity and also thermal

behaviour of the specimen CO4: Acquire practical skill to analyze the fluid

state mechanism

CO5: Find thickness of very thin objects

CO6: Learn the knowledge of generating ultrasonic waves and finding the velocity of it in Liquid

CO7: Determine the band gap of semiconductor

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				M								
CO2	H											
CO3	H		M	M								
CO4	H											
CO5											M	
CO6	M											
CO7			M									

List of Experiments:

1. To determine the acceleration due to gravity using Compound Pendulum
2. To determine the Rigidity Modulus of wire using Torsional Pendulum
3. To find thickness of the given two glass plates using single optic lever.
4. To determine the thermal conductivity of a bad conductor
5. To determine the refractive index of the material of the prism.
6. To find the number of rulings per cm length of the given transmission grating.
7. To determine the particle Size Using Laser
8. To determine the coefficient of viscosity of the liquid by Poiseuille's method
9. To determine the young's modulus of given material using Uniform Bending
10. To Determine the thickness of a given material using Air wedge method
11. To determine the focal length of a biconvex lens using Newton's Rings method
12. To determine the velocity of ultrasonic waves in the given medium using ultrasonic Interferometer.

CSE 181	PROGRAMMING LANGUAGE LABORATORY	L	T	P	C
		0	0	3	1

Course Outcomes:

At the end of the course, students would be able to

CO1: Understand problem analysis, algorithm design, and program implementation

CO2: Write modular, efficient and readable C programs

CO3: Design modular programs with structured programming constructs

CO4: Formulate problems and implement algorithms in C and work in a team to develop projects

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H			M								
CO2	M											
CO3	H											
CO4	M											

APPLICATION PACKAGES

1. Word Processing
2. Spreadsheet
3. PowerPoint
4. Database Management

C PROGRAMMING

1. Basics
2. Operators and Expressions
3. I/O formatting
4. Control Statements

ARRAYS AND FUNCTIONS

1. Arrays
2. String Manipulation
3. Functions

POINTERS, STRUCTURES AND FILES

1. Pointers
2. Structures and Unions
3. File Handling

UNIX PROGRAMMING

1. Basic UNIX Commands
2. Basic Shell Programming

SEMESTER II

HSS102	ENGLISH FOR TECHNICAL COMMUNICATION II (Common to all Branches)	L	T	P	C
		2	0	0	2

Course Outcomes:

At the end of the course, students would be able to CO1: Identify the errors in sentence structures CO2: Construct grammatically correct sentences CO3: Frame conversations

CO4: Effectively construct utterances for a Dialogue

CO5: Prepare various components of official communication like Memos, Circulars, Notices and Agendas

CO6: Recall Mechanics of Manuscript Preparation

CO7: Write reviews of a text, that the students read or a movie that they watch

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										M		
CO2						H						
CO3						H						
CO4						H				M	M	
CO5								M		M		
CO6						M			M			
CO7						M		M		M		

GRAMMAR AND VOCABULARY

Grammar and Vocabulary - Introduction to grammatical models - Proper use of tenses, concord, voice, articles, punctuation, and modal auxiliaries.

RECEPTION SKILLS

Listening and Language Development - Improving listening skills - comprehension practice - Comprehend classroom lectures, simple technically oriented passages - Listening to news bulletins, pre-recorded talks, different speech styles, comprehending the essential meaning - Physical and psychological barriers to listening - Steps to overcome the barriers - Practice in note-taking while listening.

SPEAKING TECHNIQUES

Speaking practice - Improving conversing skills - Improving self-expression - Developing confidence and fluency in oral communication - Physical and psychological barriers to speaking - Steps to overcome the barriers - Formal and public speaking practice - Extemporary talk practice - Speech process - fluency and accuracy in speech - Developing persuasive speaking skills - Conversation in a given milieu, social and cultural surroundings - Practice in giving small talks on local topics for

a minute or two - Goal oriented group discussion - Participating in seminars - Independent and effective communication.

READING STRATEGIES

Reading comprehension - Vocabulary extension methods - Speed reading practice - technical and non-technical materials - Practice in various reading techniques - skimming, scanning, eye reading - Looking for specific information - Comprehending the given passages, technical information.

WRITTEN COMMUNICATION

Basic grammatical structures - Alphabet of other languages - Paragraph writing - Expressing the idea in writing

- Avoiding and correcting common errors - Effective writing techniques - brevity, clarity, objectivity and simplicity - Discourse writing - definition, description, instruction - Note-making - Proof reading - Mechanics of writing - Writing formal, informal letters, Technical reports - Reference skills - using dictionary better.

TEXT BOOKS

1. Rizvi M Ashraf, Effective Technical Communication, Tata McGraw-Hill, 2005.
2. Rutherfoord Andrea J, Basic Communication Skills for Technology, Pearson Education, 2002.

REFERENCES

1. Deborah C Andrews, Margaret D Bickle, Technical Writing - Principles and Forms, Macmillan, 1978.
2. Manivannan G, English for Engineers - A Book on Scientific and Technical Writing, Govi Publications, 2005.
3. Sarah Freeman, Written Communication in English, Orient Longman, 2000.
4. Thomson A J & AV Martinet, A Practical English Grammar, OUP, 4th Edition, 1986.
5. Tom Hutchinson, Alan Waters, English for Specific Purpose, Cambridge University Press, 1987.

MAT104	MATHEMATICS II (Common to all	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Explain the concept of double integral and triple integral CO2: Explain the concept of Gradient, divergence and curl CO3: Explain the concept of line, volume and surface integrals CO4: Construct conformal mappings between regions

CO5: Evaluate certain real integrals using residue theorem

CO6: Apply differential equations for Physical problems

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M			M								
CO2	M	H										
CO3		H		M								
CO4				M								
CO5	M											
CO6	M			M								

SEQUENCES AND SERIES

Convergence and divergence of infinite series – series of positive terms – comparison, D'Alembert's ratio, Raabe's and Cauchy's root tests – Convergence of alternating series – Leibnitz's test (proof of theorems and tests not included) – elementary notions of absolute and conditional convergence - Power series – Taylor's theorem(one variable)

ANALYTIC FUNCTION AND CONFORMAL MAPPING

Function of a complex variable – Analytic function – Necessary conditions – Cauchy – Riemann equations –
Sufficient conditions (excluding proof) – Properties of analytic function – Harmonic conjugate – Construction
of Analytic functions - Conformal mapping - w = z+a, e^z , sin z, cos z and bilinear transformation az, 1/z, fixed points – cross ratio –

COMPLEX INTEGRATION

Statement and application of Cauchy's integral theorem and integral formula – Taylor and Laurent expansions
– Isolated singularities – Residues - Cauchy's residue theorem - Contour integration over unit circle and semicircular contours (excluding poles on boundaries)- evaluation of real integrals using contour integration

MULTIPLE INTEGRALS

Review of Riemann integrals - Double integration – Cartesian and polar coordinates – change of order of
integration – change of variable between Cartesian and polar – Area as double integral – Triple integration in
Cartesian, cylindrical and spherical polar coordinates – volume as triple
integral

VECTOR CALCULUS

Gradient, Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proof) – Simple applications

TEXT BOOKS

1. Kreyszig, E, Advanced Engineering Mathematics, John Wiley and Sons (Asia) Limited, Singapore, 8th Edition, 2001
2. Arumugam, S., Thangapandi Isaac, A., Somasundaram, A., Engineering Mathematics Volume II, Scitech Publications (India) Pvt. Ltd., Chennai, 1st Edition., Reprint 2000, 1999

REFERENCES

1. Grewal , B.S., Grewal, J.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 37th Edition., 5th Reprint 2004, 2003
2. Venkataraman, M. K., Engineering Mathematics First Year, The National Publishing Company, Chennai, 2nd Edition., Reprint 2001, 2000
3. Venkataraman, M. K., Engineering Mathematics –III A, The National Publishing Company, Chennai, 11th Edition., Reprint 2002, 1998

PHY 132	PHYSICS II (common to all branches)	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Understand the free electron theories, formation of energy bands, energy distribution and also the electron behaviour in solids

CO2: Know and understand the cooper pair electron behaviour, applications of superconducting materials in developing technologies

CO3: Learn the importance of semiconducting materials in engineering fields by projecting the view of energy bands

CO4: Gain the knowledge about various kinds of magnetic materials, their properties and applications in advanced technologies

CO5: Gain the knowledge about dielectric materials, their properties and significant applications in advanced technologies

CO6: Learn how to prepare some new materials like metallic glasses, nano-materials, shape memory alloys, nonlinear materials to improve the technology

CO7: Adapt to new developments of materials in science and technology by characterizing with sophisticated instruments

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		M	M								
CO2			M									
CO3			M									
CO4	M		M	M								
CO5			M									
CO6			M									
CO7			M									

CONDUCTING MATERIALS

Conduction in metals – mobility and conductivity – classical free electron theory - electrical conductivity – thermal conductivity – Wiedemann-Franz law – Lorentz number – drawbacks of classical theory. **SEMICONDUCTING AND SUPERCONDUCTING MATERIALS**

Introduction semi conducting materials – types of semiconducting materials – carrier concentration – Hall
effect – determination of Hall coefficient – superconducting phenomena – properties of superconductors –
Type I and Type II superconductors – high Tc superconductors – application of super conductors.

MAGNETIC MATERIALS

Classical theory of magnetism – quantum theory of paramagnetism – ferromagnetism – ferrites – applications of magnetic materials.

DIELECTRIC MATERIALS AND OPTICAL MATERIALS

Electronic, ionic, orientation and space charge polarization – internal field and deduction of Clausius-Mosotti relation – properties of dielectric materials – classification of insulating materials – optical properties of semiconductor – imperfection of crystals – luminescence – fluorescence – phosphorescence – light emitting diode (LED) – liquid crystal displays (LCD).

NEW ENGINEERING MATERIALS

Metallic glasses as transformer core material – nano phase materials – shape memory alloys – Bio materials (metals & alloys, ceramics) – non-linear materials – second harmonic generation – optical mixing - optical phase Conjugation – solitons and IC packaging materials.

TEXT BOOKS

1. P.K. Palanisamy, "Material Science", Scitech Publications (India), Pvt Ltd., Chennai, 2009.
2. Arumugam, M., Material Science, Anuradha Agencies, Kumbakonam, 3rd Edition, 2003.

REFERENCES

1. Aswani K.G., A Text book of Material Science, S.Chand & Co., Ltd., New Delhi, 2nd Edition, 2001.
2. Raghavan, V., Material Science and engineering, Prentice-Hall of India Pvt. Ltd., India.
3. William F.Smith, Foundations of Materials Science and Engineering, McGraw-Hill, New York, 3rd Edition, 2003.
4. Wahab M.A., Solid State Physics, Narosa Publishing House, New Delhi, 1999.
5. Pillai S.O., Solid State Physics, New Age International Publication, New Delhi, 5th edition, 2003.
6. Ali Omar.M, Elementary Solid State Physics, Pearson Education (Singapore) Pvt. Ltd., Indian Branch, New Delhi, 2002.
7. Murthy V.S.R., Jena AK, Gupta K.P. and Murthy G.S., Structure and Properties of Engineering Materials, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2003.

CIV 101	BASIC CIVIL AND MECHANICAL ENGINEERING	L	T	P	C
		4	0	0	4

Course Outcomes:

At the end of the course, students would be able to

CO1: Describe the scientific terminologies related to construction and mechanical sciences

CO2: Familiarize with different components, equipments and technical standards

CO3: Know the purpose, procedures, and the materials

CO4: Be aware of the uses and standards adopted in industries

CO5: Understand the basic laws pertaining towards the subject

CO6: Understand the procedures for construction of several structures

CO7: Create working models or prototypes of the components

CO8: Gain knowledge in surveying, their types and the equipments used

CO9: Explain the principle, working and application of Engines and Power plants CO10: Understand and apply the concepts of manufacturing and the technology related CO11: Mention some of the applications of the manufacturing processes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									H			
CO2											M	
CO3											M	
CO4									M			
CO5									H	M		
CO6											M	
CO7											M	
CO8							H				M	
CO9											M	
CO10										M	M	
CO11						M					M	

CIVIL ENGINEERING

BUILDINGS

Characteristics of good building materials such as stones, bricks, plywood and ceramic tiles, timber, cement, aggregates and concrete - Basic functions of buildings – Major components of buildings – Foundations - Purpose of a foundation – Bearing capacity of soils – types of foundations. Proper methods of construction of Brick masonry – Stone masonry – Hollow Block masonry. Beams – Lintels – Columns – Flooring – Damp proof course – surface finishes – Doors and windows – Roofing.

TRANSPORTATION ENGINEERING

Principles and Classification of surveying, Chain surveying, Compass surveying and leveling - Importance of roads – Classification of Highways –water bound macadam, bituminous and cement concrete roads –. Railways - Importance of railways – Gauges – Components of a permanent way. Bridges - Components of Culverts – Causeways, Slab Bridge, T-beam and slab bridge, Suspension bridge

MECHANICAL ENGINEERING

BOILERS AND TURBINES

Boilers - boiler mountings and accessories – Cochran boiler, Locomotive boiler, Babcock and Wilcox boiler,

fire and water tube boilers - Steam turbine - single stage impulse turbine, Parson's reaction turbine, difference between impulse and reaction turbines.

POWER PLANTS AND INTERNAL COMBUSTION (IC) ENGINE

Classification of power plants – steam, nuclear, diesel and hydro power plants - Alternate sources of energy - solar, wind, tidal, geothermal, ocean thermal energy conversion. – IC engine - components, working of four and two stroke petrol and diesel engines.

PRODUCTION TECHNOLOGY

Metal casting and forming process –patterns, moulding, melting of cast iron, casting – forging – rolling – extrusion – drawing - Metal joining process - welding – arc welding, gas welding, brazing and soldering - Metal machining – lathe, drilling machine, milling machine, shaping machine, planing machine, introduction to Computer Numerical Control machining.

TEXT BOOK

1. Shanmugam, G,, and Palanichamy, M.S., Basic Civil and Mechanical Engineering, Tata McGraw Hill Publishing Co., New Delhi, 1996.

REFERENCE

1. Khanna, K., Justo C E G, Highway Engineering, Khanna Publishers, Roorkee, 2001
2. Arora S.P. and Bindra S.P., Building Construction, Planning Techniques and Method of Construction, Dhanpat Rai and Sons, New Delhi, 1997.
3. Venugopal K., Basic Mechanical Engineering, Anuradha Publications,
4. Kumbakonam, 2000.
5. Shanmugam G., Basic Mechanical Engineering, Tata McGraw Hill Publishing Co.,New Delhi, 2001.

MEC103	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Understand and apply the fundamental Engineering Mechanics principles and their knowledge of mathematical principles

CO2: Analyze the engineering problems physically and mathematically

CO3: Applying the acquired knowledge in situation to solve the engineering problem

CO4: Understanding of safety and reliability concepts in the designing of a solution for a situation

CO5: justify a design project in a formal report and present design calculations in a neat and organized manner

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H					M				
CO2	H					M		M				
CO3	H			H				M				
CO4	H			M						M		M
CO5										M		M

STATICS OF PARTICLES

Six Fundamental principles and concepts - vector algebra- basics, external and internal forces, concurrent and non-concurrent coplanar forces - resultant and resolution static equilibrium of particles in 2-D and 3-D,

STATIC OF RIGID BODIES

Moment about point and about axis - Varignon's theorem - Static equilibrium of rigid body in 2-D and 3-D, free body diagram, supports and reactions - Problem formulation concept in 2-D and 3-D.

FRICTION

Frictional forces- Types- laws of dry friction- simple contact friction - Sliding block, wedges,ladder friction -
rolling resistance - belt friction - Axle friction, disk friction –
Examples.

PROPERTIES OF SURFACES AND SOLIDS

Centroids of lines - areas, volumes, composite bodies, Centre of gravity- center of mass – Area moment of
Inertia - principal moment of
inertia

DYNAMICS OF PARTICLES

Introduction – Kinematics of particles – Displacements, velocity and acceleration, their relationship - Equations of motions– Rectilinear motions - relative motion – Curvilinear motion –

Kinetics of particles - Newton's second law – Equations of motion – rectangular components – Work Energy equation of particles.

TEXT BOOK

1. Beer, F.P., and Johnson, E.R., Vector Mechanics for Engineers – Statics and Dynamics,Tata McGraw Hill, 2007.

REFEREN CE

1. Merriam, J.L., Engineering Mechanics, Volume I – Statics, and Volume – II, Dynamics2/e, Wiley International, 1998.
2. Irving , H., Shames, Engineering Mechanics, Statics and Dynamics, Prentice Hall ofIndia Pvt. Ltd., 2004.

CHY 102	ENVIRONMENTAL SCIENCES (Common to	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Know the importance of environmental studies and methods of conservation of natural resources
CO2: Describe the structure and function of an ecosystem
CO3: Identify the values and conservation of bio-diversity
CO4: Explain the causes, effects and control measures of various types of pollutions
CO5: Select the appropriate methods for waste management
CO6: Get knowledge about various disaster management methods
CO7: Recall social issues and legal provision

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			H	M								
CO2			H	M								
CO3			H	M								
CO4			H	H								
CO5			H	H								
CO6			H	H					M			
CO7			H	M								H

NATURAL RESOURCES

Definitions – Scope of Environmental Sciences - Forest Resource – Food Resource – Land Resource – Water – Mineral resources - Utilization of Natural Resource, Impact on Environment – Conservation of Natural Resources

ECOSYSTEM AND BIODIVERSITY

Concept – Structure and Function – Energy Flow in Ecosystem – Ecological Succession – Food Chain – Food Web, Ecological Pyramids – Biodiversity, Definition, Values, Threats to Biodiversity, Conservation of Biodiversity

ENVIRONMENTAL POLLUTION

Definition, Causes, Effects and Control Measures of Air, Water and Soil Pollution – Thermal and NuclearPollution

MANAGEMENT OF ENVIRONMENTAL POLLUTION

Solid Waste Management – Treatment Methods adopted for Municipal Sewage and Industrial Effluent –Hazardous and Biomedical Waste Management

TOOLS FOR ENVIRONMENTAL MANAGEMENT

Environment Impact Assessment – Precautionary and Polluter Pay Principle - Constitutional Provision – (Air, Water and Forest) - Waste Minimization Techniques, Cleaner Technology Options, Bioremediation

TEXT BOOK

1. Dhameja, S.K., Environmental engineering and Management, S. K. Kataria & Sons, New Delhi, 1st Edition, 2004

REFERENCES

1. Bharucha Erach, the Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad, 1st Edition, 2001.
2. Miller, T.G. Jr., Environmental Science, Wadsworth Publishing Co. USA, 2nd Edition, 2004
3. Trivedi, R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media., New Delhi, 2nd Edition, 2004
4. Masters, G. M., Introduction to Environmental Engineering & Science, Prentice Hall, New Delhi, 2nd Edition, 1997
5. Henry, J. G., and Heike, G. W., Environmental Science & Engineering, Prentice Hall International Inc., New Jersey, 1st Edition, 2005

MEC101	ENGINEERING DRAWING (Common to all Branches)	L	T	P	C
		1	0	3	2

Course Outcomes:

At the end of the course, students would be able to

CO1: Describe the scientific and empirical foundations for engineering design CO2: Familiarize with different drawing equipments and technical standards CO3: Know the purpose, procedures, materials and conventional symbols used CO4: Be aware of the uses of standard and nominal sizes in industries

CO5: Understand the basic geometrical relationships; parallelism, perpendicularity, angularity, co-linearity and concentricity

CO6: Understand the procedures for construction of geometric figures

CO7: Create and read an engineering drawing using standard views

CO8: Know the principles projection and distinguish the types of projection

CO9: Convert pictorial (3-D) drawings to orthographic (2-D) drawings and vice versa

CO10: Explain the principle and application of sectioning

CO11: Understand and apply the concepts of development of surfaces

CO12: Mention some of the applications of technical drawings

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				H								
CO2										M		
CO3										M	M	
CO4										M	M	
CO5				H								
CO6											M	
CO7							M					
CO8											M	
CO9											M	
CO10											M	
CO11											M	
CO12							M					

INTRODUCTION

Importance of graphics – use of drafting instruments – BIS conventions and specifications – size, layout and folding of drawing sheets – lettering dimensioning and scales - orthographic principles – missing view - free hand sketching in first angle projection from pictorial views.

PROJECTION OF POINTS, STRAIGHT LINES AND PLANES

Projection of points, located in all quadrants - projection of straight lines located in the first quadrant,
determination of true lengths and true inclinations, location of traces - projection of polygonal surface and circular lamina located in first quadrant inclined to one or both reference planes.

PROJECTION OF SOLIDS AND SECTION OF SOLIDS

Projection of solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method – types of section – full section and half section - conventional section lines -
section of simple solids like prisms, pyramids, cylinder and cone in vertical position by cutting planes inclined to any one of the reference planes, obtaining true shape of section

DEVELOPMENT OF SURFACES

Development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders and cones - development of lateral surfaces of combined solids.

ISOMETRIC AND PERSPECTIVE PROJECTION

Principles of isometric projection – isometric view and projections of simple solids, truncated prisms,
pyramids, cylinders and cones - Orthographic to isometric view – Introduction to perspective projection.

TEXT BOOK

1. Basant Aggarwal and C. Aggarwal, Engineering Drawing, Tata McGraw-Hill publishing company,New Delhi , 2008

REFEREN CE

1. Shah, M.B., and Rana, B.C., Engineering Drawing, Pearson Education, New Delhi, 2005.
2. Nataraajan, K.V., A text book of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 2006.
3. Bhatt, N.D., Engineering Drawing, Charotar publishing House, New Delhi, 46th Edition, 2003.
4. Luzadder and Duff, Fundamentals of Engineering Drawing, Prentice Hall of India Pvt Ltd, New Delhi, XI Edition, 2001.
5. Venugopal, K., Engineering Graphics, New Age International (P) Limited, 2002.

MEC181	WORK SHOP	L	T	P	C
		0	0	3	1

Course Outcomes:

At the end of the course, students would be able to

CO1: Make Joints and understand their uses in Wooden Products like Table, Frame, etc…

CO2: Perform metal joining with simple saw process

CO3: Make hollow channels, containers using Sheet metal development

CO4: Join Metal using Welding process (Knowledge only)

CO5: Gain knowledge in Casting and Molding of Metals

CO6: Perform various Machining Techniques like Drilling, Tapping, etc…

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							H					
CO2							H					
CO3							H					
CO4							H					
CO5							H					
CO6							H					

CARPENTRY

Carpentry tools - practice in marking, sawing, planing and chiseling – making simple joints: lap joint, T-joint,
dovetail joint, mortise and tenon joint.

FITTING

Fitting tools - practice in marking, filing, punching, hacksawing - fitting to size and drilling - making of simple mating profiles: V, square, dovetail, half round joints.

SHEET METAL

Study of press, die and tools - sheet metal layout - development of lateral surfaces -simple exercises: blanking, forming, bending and flanging.

DRILLING

Drilling and tapping in drilling machines

Demonstration on:

(i) Welding operations like butt joint and lap joints in Arc welding

(ii) Foundry operations like mould preparation for split pattern

(iii) Smithy operations like the production of hexagonal bolt

(iv) Preparation of plumbing line sketches – basic pipe connections involving the fittings like valves, taps, couplings, unions, reducers, elbows and other components used in household fittings

CHY 182	CHEMISTRY LABORATORY	L	T	P	C
		0	0	3	1

Course Outcomes:

At the end of the course, students would be able to

CO1: Analyze the various water quality parameters

CO2: Investigate the kinetics of a chemical reaction

CO3: Determine the amount of fluoride and iron by spectrophotometric methods

CO4: Estimate the amount of acid and base by electrochemical methods

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			H									
CO2	M											
CO3	H	M										
CO4		H										

List of Experiments:

1. Estimation of hardness of water sample by EDTA method
2. Determination of alkalinity of given water sample
3. Determination of dissolved oxygen in a water sample
4. Determination of rate constant of a reaction (Ester hydrolysis)
5. Estimation of hydrochloric acid by pH titration
6. Estimation of chloride ion in a given water sample
7. Determination of sodium and potassium by flame photometry
8. Estimation of ferrous ion by potentiometric method
9. Estimation of iron by spectrophotometry using 1,10-phenanthroline
10. Determination of strength of mixture of acids using strong base by conductometric titration
11. Estimation of fluoride ion by spectrophotometry
12. Conductometric titration of strong acid with strong base

SEMESTER III

		L	T	P	C
MAT202	**MATHEMATICS III** (Common to Biotechnology, Chemical Engineering, Civil Engineering,	**3**	**0**	**0**	**3**

Course Outcomes:

At the end of the course, students would be able to

CO1: Evaluate integrals and solve boundary value problems using Laplace transform

CO2: Solve standard type of first order partial differential equations and higher order partial differential equations with constant coefficients

CO3: Apply the concept of Fourier series to find the sum of certain series. CO4: Solve difference equations using Z-transform

CO5: Find Fourier, Sine and Cosine transforms of given functions

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M											
CO2		H		M								
CO3	H	M		M								
CO4	M	M		M								
CO5	M	M		M								

LAPLACE TRANSFORM

Definition of Laplace transform - Linearity property - condition for existence of Laplace transform - First and second shifting properties - Laplace transform of derivatives and integrals - Unit step functions - Diarc delta-function - Differentiation and integration of transforms - Convolution theorem - Inversion - Periodic functions - Evaluation of integrals by Laplace transform - Solution of boundary value problems

PARTIAL DIFFERENTIAL EQUATIONS

Formation of PDE - Solution of std types of first order PDE - Lagrange's linear equation - Linear PDE of second and higher order with constant coefficients

FOURIER SERIES

Dirichlet's conditions - General Fourier series - odd and even functions - Half range sine and cosine series - complex form of Fourier series - Parseval's identity - Harmonic analysis

Z – TRANSFORM

Z-transform - elementary properties - Inverse Z-transform - Convolution theorem - formation of difference equation - Solution of difference equation using Z-transform.

FOURIER TRANSFORM

Fourier Integral formula - Fourier Transform - Fourier sine and cosine transforms - Linearity, Scaling, frequency shifting and time shifting properties - Self reciprocity of Fourier Transform - Convolution theorem - Application to boundary value problems

TEXT BOOKS

1. Kreyszig, E., Advanced Engineering Mathematics, John Wiley and Sons (Asia) Limited, Singapore, 8th Edition., 2001
2. Arumugam, S., Thangapandi Isaac, A., Somasundaram, A., Engineering Mathematics Volume II, Scitech

Publications (India) Pvt. Ltd., Chennai, 1st Edn., Reprint 2000, 1999

REFERENCE

1. Grewal, B.S., Grewal, J.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 37th Edition, 5th Reprint 2004, 2003
2. Venkataraman, M. K., Engineering Mathematics –III A, The National Publishing Company, Chennai, 11th Edition., Reprint 2002, 1998
3. Venkataraman, M. K., Engineering Mathematics - III B, The National Publishing Company, Chennai, 13th Edition., Reprint 1999, 1998

CHE201	CHEMICAL PROCESS CALCULATIONS	L	T	P	C
		3	1	0	4

Course Outcomes:

At the end of the course, students would be able to

CO1: Describe the fundamentals of stoichiometry

CO2: Apply material balances on unit operations and processes

CO3: Evaluate humidity with/without the use of psychrometric chart

CO4: Apply simultaneous material and energy balances

CO5: Apply Energy and Material balance to industrial processes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M										
CO2			H									
CO3		M			H							
CO4											H	
CO5					M							M

INTRODUCTION

Units and dimensions and conversions - Mass and volume relations - Stoichiometric and composition relations

- Excess reactants - Degree of completion, conversion, selectivity and yield - Ideal gas law, Dalton's Law, Amagat's Law, average molecular weight of gaseous mixtures - Vapor Pressure, effect of temperature on vapor pressure, vapor pressure plot, vapor pressures of miscible and immiscible liquids and solutions - Raoult's Law, Henry's law

MATERIAL BALANCE

Material balances for systems with and without chemical reactions –Material balance applied to different unit operations - Analysis of systems with by-pass, recycle, and purge - Orsat's analysis of solid, liquid, gaseous fuels - Steady state and unsteady state material balances

HUMIDITY AND SATURATION

Relative and percent saturation - Dew point - Dry and wet bulb temperatures - Use of humidity charts for engineering calculations

ENERGY BALANCE

Heat capacity of gases, liquids and solutions, heat of fusion and vaporization - Steady state energy balance for systems with and without chemical reactions - Calculations and application of heat of reaction, combustion, formation, neutralization, solution - Enthalpy-concentration charts - Calculation of theoretical and actual flame temperatures

APPLICATIONS OF MATERIAL AND ENERGY BALANCES

Applications of material and energy balances to various process industries specially combustion of solids, liquids and gaseous fuels

TEXT BOOKS

1. David M. Himmelblau, Basic Principles and Calculations in Chemical Engineering.
2. Richard M. Felder, Ronald W. Rousseau, Elementary Principles of Chemical Processes, John Wiley and rd
3. Bhatt B.I., and Vora S.M., Stoichiometry, Tata McGraw-Hill Publishing Company, New Delhi, 4th edition, 2004

REFERENCES

1. Nicholas Chopey, Handbook of Chemical Engineering Calculations Process Principles", Mc Graw Hill, 2004
2. Venkataramani, V., and Anantharaman, N., Process Calculations, Prentice Hall of India Limited, New Delhi, 2003

CHE202	INORGANIC CHEMICAL TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, the students would be able to

CO1: List chemical processes, units, and the corresponding equipments

CO2: Explain the manufacturing processes of chloro-alkali chemicals

CO3: Describe the manufacturing processes of fertiliser and agrochemicals

CO4: Enumerate the manufacturing processes of Sulphur and Phosphorus based chemicals

CO5: Explain the manufacturing processes of industrial gases and silicate chemicals

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H			H			M					
CO2	M					H						
CO3				M								
CO4			H									
CO5			M			M						

INTRODUCTION

A study of the following chemical industries in relation to their current status (Indian a n d . Global), production and consumption pattern, manufacturing process, latest technological developments, engineering problems viz., pollution control, material of construction, corrosion, kinetics aspects, energy conservation and economical status, importance of block diagrams and flow charts, unit operations, unit processes, process utilities and economics, industrial safety , outline of plant and equipment design, process control and instrumentation

CHLORO-ALKALI INDUSTRY

Common salt - Caustic - Chlorine - Soda Ash - Sodium bicarbonate - Hydrochloric acid - Byproducts of common salt industry - Value added products – Bleaching powder - Bleaching agents

FERTILISER AND AGRICHEMICAL INDUSTRIES

Ammonia - Nitric Acid - Urea and Other Nitrogen Fertilizers - Mixed Fertilizers - Nitrogenous fertilizers, ammonium Sulphate, ammonium nitrate, urea - Phosphatic fertilizers, single and triple super phosphate, ammonium phosphate, nitro phosphate - Potassic fertilizers, potassium chloride, potassium nitrate, phosphate - Compound fertilizers - Bio- fertilizers - Insecticides - Pesticides - Herbicides - Plant nutrients and regulators

SULFUR AND PHOSPHORUS INDUSTRY

Sulfur and its mining, sulfuric acid, different manufacturing processes - Phosphorus, phosphoric acid and super
phosphates

INDUSTRIAL GASES AND SILICATE INDUSTRY

Industrial gases: Oxygen - Nitrogen - Hydrogen - L.P.G Silicate industry: Portland cement - Glasses - Ceramics

TEXT BOOKS

1. George T. Austin, Shreve's Chemical Process Industries, McGraw-Hill International Editions, Singapore, 5th Edition, 1998
2. Gopala Rao M. and Marshall Sittig, Dryden's Outlines of Chemical Technology, East-West Press, New Delhi, 3rd Edition,1997

REFERENCES

1. Kent, J.A.(ed), Riegel's Hand Book of Industrial Chemistry, Kluwer Academic Press, New York, 10th Edition, 2003
2. M. Farhat Ali and Bassam El Ali, Handbook of Industrial Chemistry, Mc Graw Hill, New York, 2004
3. Pandey, G. N., Text book of Chemical Technology, Vol. II, Vikas Publishing House, New Delhi, 2nd Edition, 1994

CHE203	MECHANICAL OPERATIONS	L	T	P	C
		3	0	0	3

COURSE OUTCOME:

At the end of the course the students would be able to

CO1: Characterize particles and perform size reduction and size analysis of particles

CO2: Identify conveyors & storage vessels for particular applications

CO3: Explain the principle, construction and operation of various classification equipments

CO4: Apply the principles of agitation and mixing

CO5: Evaluate the parameters of filtration

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H			H								
CO2	H		H		M							
CO3			H	H	H							
CO4					H		M					
CO5		H	H	M								

PARTICULATE SOLIDS & COMMINUTION

Introduction to unit operations and their role in Chemical Engineering industries - Types of Mechanical Operations - Characteristics of particulate solids - Sampling techniques - Specifications - Screen analysis - Particle size distribution, particle size measurement - Surface area measurements - Relevant equations and problems

Principles of size reduction - Specific properties of solids for size reduction - Energy required for size reduction - Crushing and grinding efficiency - Laws of crushing - Classification of crushing and grinding equipment - Construction and working principle of mostly used equipments - Size enlargement - Scope and applications - Size enlargement techniques

CONVEYING

Conveying of bulk solids: Classification of conveyors - Selection of conveyors - Storage of solids in bulk protected and unprotected piles - Bins - Silos - Hoppers - Mass flow and funnel flow bins - Flow assisting devices - Feeders - Weighing of bulk solids - Batch and continuous weighing techniques

CLASSIFICATION

Classification of separation methods for different type of mixtures like solid-solid, solid-gas - solid-liquid - Screening - Classification of screening equipments - Mechanical classification and classifiers - Rare and dense medium separation - Magnetic separation - Electrostatic separation - Floatation and Elutriation - Phase separation - Centrifugal separation - Electrostatic precipitators - Impingement separators - Gas solids separation - Gravity settling - Cyclone separators - Bag filters scrubbers

MIXING AND BLENDING

Mixing of solids, blending, kneading - Power for agitation - Correlations for power consumption

FILTRATION

Filtration - Batch and continuous filtration, compressible and incompressible filter cakes - Calculations for specific cake resistance, filter medium resistance - Industrial filters - Centrifugal filtration

TEXT BOOKS

1. Mccabe, W. L., Smith, J. C., and Harriott, P., Unit Operations of Chemical Engineering, McGraw Hill, New York, 6th Edition,2004
2. Geankoplis, C. J., Transport Processes and Separation Process Principles (Includes Unit Operations), Prentice Hall of India, New Delhi, 4th Edition, 2003

REFERENCES

1. Coulson J.M., Richardson J.F., Backhurst J.R. and Harker J.M., Coulson and Richardson's Chemical Engineering, Volume I, Butterworth Heinemann, Oxford, 5th Edition, 2002
2. Coulson J.M., Richardson J.F., Backhurst J.R. and Harker J.M., Coulson and Richardson's Chemical Engineering, Volume II, Butterworth Heinemann, Oxford, 5th Edition, 2002

CHE 204	FLUID MECHANICS	L	T	P	C
		3	1	0	4

Course Outcome:

At the end of the course, the student would able to

CO1: Explain the basic principles of fluid statistics

CO2: Analyze fluid flow problems with the application of the momentum and energy equations. CO3: Analyze pipe flows

CO4: Describe the basic principles of packed and fluidized beds

CO5: Analyze fluid machinery

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H							M				
CO2	M						H		M			

CO3	H				H							
CO4		H			M							
CO5		H					H					

FLUID STATICS

Properties of fluids and concept of pressure - Introduction - Nature of fluids - Physical properties of fluids - Types of fluids - Fluid statics - Pressure, density, height relationships - Pressure Measurement - Units and Dimensions - Dimensional analysis - Similarity, forces arising out of physical similarity - Dimensionless numbers

MOMENTUM BALANCE

Momentum balance and their applications - Kinematics of fluid flow, stream line, stream tube, velocity potential - Newtonian and non- Newtonian fluids, Time dependent fluids - Reynolds number, experiment and significance - Momentum balance - Forces acting on stream tubes - Potential flow - Bernoulli's equation, correction for fluid friction, correction for pump work

PIPE FLOW

Flow of incompressible fluids through ducts - Flow of incompressible fluids in pipes, laminar and turbulent flow through closed conduits, velocity profile and friction factor for smooth and rough pipes - Head loss due to friction in pipes, fitting etc - Introduction to compressible flow - Isentropic flow through convergent and divergent nozzles, sonic velocity

FLOW PAST IMMERSED OBJECTS

Flow of fluids through solids - Form drag - Skin drag - Drag coefficient - Flow around solids and packed beds, Friction factor for packed beds, Ergun's Equation - Motion of particles through fluids - Motion under gravitational and centrifugal fields -Terminal settling velocity - Fluidization , mechanism, types, general properties and applications

TRANSPORTATION AND METERING OF FLUIDS

Transportation and metering - Measurement of fluid flow, orifice meter, venturi meter, pilot tube, rotameter, weirs and notches, wet gas meter and dry gas meter, hot wire and hot film anemometers - Transportation of fluids, fluid moving machinery performance, selection and specification - Air lift and diaphragm pump, Positive displacement pumps, rotary pumps - Reciprocating pumps - Centrifugal pumps and characteristics **TEXT BOOKS**

1. Noel de Nevers, Fluid Mechanics for Chemical Engineers, McGraw-Hill , New York, International Edition, 2004
2. Streeter, V.L., Wylie, E.B., Fluid Mechanics, McGraw-Hill, New York, 9th Edition, 2003

REFERENCES

1. White, F.M., Fluid Mechanics, McGraw-Hill, New York, 5th Edition, 2003
2. Fox, R., Mc Donald, A. T., Pritchard, P. J., Introduction to Fluid Mechanics, John Wiley and Sons, Singapore, 6th Edition, 2004
3. Coulson J.M., Richardson J.F., Backhurst J.R. and Harker J.M., Coulson and Richardson's Chemical Engineering, Volume I, Butter worth Heinemann, Oxford, 5th Edition, 2002

CHE205	CHEMICAL ENGINEERING THERMODYNAMICS I	L	T	P	C
		3	0	0	3

Course Outcome:

At the end of the course, the student would able to

CO1: Spot and create simple level engineering troubles linked to thermodynamics and energy transformation in an abstract type as well as in provisions of mathematical/physical models

CO2: Gauge the properties of ideal and real mixtures based on thermodynamic ethics

CO3: Establish changes in the properties of fluids undergoing changes in temperature and volume

CO4: Explain the effects of Compression at different work environment

CO5: Resolve thermodynamic competence of different energy associated processes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H		M								
CO2	H	M						H				
CO3			H	H				M				
CO4				H				M	H			
CO5					H							

THERMODYNAMIC LAWS

First law of Thermodynamic - Thermodynamic state and state functions- Enthalpy - Reversible processes - Statements of first law for flow and non-flow systems - Heat effects in phase change - Standard heat of reaction, formation, combustion, effect of temperature on standard heat of reaction - Heat effects of industrial reactions - Second law of thermodynamics - Entropy, entropy change

THERMODYNAMIC PROPERTIES OF FLUIDS

Various thermodynamic relations and application - Equations of State, ideal gas law, cubic equations of state, Van der Waals' equation, Redlich-Kwong, Soave-Redlich-Kwong, Peng-Robinson and Benedict- Web-Rubin equations - Fugacity and fugacity coefficients of real gases

THERMODYNAMIC PROPERTY RELATIONS

Maxwell Relations - Jacobian Method - Relation between heat capacities - Joule-Thompson coefficient - Clapeyron equation - Postulational thermodynamics - Thermodynamic potential - Criteria for equilibrium - Euler relation - Thermodynamic analyses of industrial processes - Introduction to the third law of thermodynamics

COMPRESSION OF FLUIDS

Thermodynamic aspects of compression process - Classification of compression processes - Basic equation for change of state of gases - Work expression for different situations, effect of clearance volume - Multistage compression - Convergent divergent flow, ejectors

GAS CYCLES

Carnot cycle - Stirlings' Cycle, Joule Cycle, Otto Cycle, Diesel Cycle, Dual combustion Cycle - Properties of steam, dryness fraction, latent heat, total heat of wet steam, super heated steam, Use of steam tables, volume of wet steam, volume of superheated steam - External work of evaporation - Internal energy - Entropy of vapor, expansion of vapor - Rankine cycle - Modified Rankine cycle

TEXT BOOKS

1. Nag, P.E., Engineering Thermodynamics, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 3rd Edition, 2005

2. Smith, J.M., Van Ness, H.C., Abbott, M. M., Introduction to Chemical EngineeringThermodynamics , Mc Graw Hill, New York, 6th Edition, 2001

REFERENCES

1. Sandler, S.I., Chemical, Biochemical and Engineering Thermodynamics, John Wiley and Sons, Singapore, 4th Edition,2006.
2. Kyle, B.G., Chemical and Process Thermodynamics, Prentice Hall of India Pvt.Ltd., New Delhi, 3rd Edition, 1999.
3. Koretsky, M. D., Engineering and Chemical Thermodynamics, John Wiley and Sons, Singapore, 2004.

CHE281	MECHANICAL OPERATIONS LABORATORY	L	T	P	C
		0	0	3	2

Course Outcome:

At the end of the course the students would be able to

CO1: Characterize particles and perform size analysis

CO2: Evaluate the power consumption for Particle size reduction and size enlargement. CO3: Evaluate the constants for crushing

CO4: Design and operate filtration equipments

CO5: Analyze Solid liquid separation in industrial equipment based on settling, density and centrifugal force.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H			H				H	M			
CO2	H		H					H	M			
CO3			H		H			H	M			
CO4					H		M	H	M			
CO5		H		M				H	M			

List of experiments

1. Studies in an agitated vessel.
2. Drag studies
3. Particle size distribution
4. Screening Efficiency
5. Determination of specific surface area by air elutriation
6. Determination of area of a thickener by batch sedimentation test.
7. Size reduction using Jaw Crusher and Verification of crushing laws.
8. Size reduction using Ball Mill and determination of specific surface area.
9. Drop weight crushing and verification of crushing laws.
10. Determination of specific cake resistance and filter medium resistance for leaf filtration
11. Determination of specific cake resistance and filter medium resistance for rotary vacuum filtration
12. Determination of specific cake resistance and filter medium resistance for filtration in a plate and frame filter press.

CHE282	FLUID MECHANICS LABORATORY	L	T	P	C
		0	0	3	2

Course Outcome:

At the end of the course the students would be able to

CO1: Determine the friction factor of pipe

CO2: Determine the friction factor of pipe fittings

CO3: Calibrate flow meters

CO4: Analyze the pperformance of centrifugal pumps and reciprocating pumps

CO5: Determine minimum fluidization velocity in a fluidized bed

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H				H							
CO2			H			H						
CO3	M								M			
CO4				H								
CO5	H			H								M

List of experiments

1. Experiment to determine pipe friction
2. Experiment to determine friction for flow in helical coil
3. Experiment to determine friction for flow in an annulus
4. Flow through fittings/valves
5. Flow through non-circular conduits
6. Calibration of a rotameter
7. Determination of coefficient of discharge of an orifice meter
8. Determination of coefficient of discharge venturi meter
9. Flow through open orifice/weirs and notches
10. Performance curves for a centrifugal pump
11. Performance curves for a Reciprocating pump
12. Experiment to determine friction in Packed Bed
13. Determination of minimum fluidization velocity in a fluidized bed

SEMESTER IV

MAT212	MATHEMATICS IV	L	T	P	C
		3	0	0	3

Course Outcome(s)

At the end of the course, students should be able to

CO1: Characterize phenomena which evolve with respect to time in probabilistic manner

CO2: Solve engineering problems with more than one random variable and functions of random variables

CO3: Analyze the response of random inputs to linear time invariant systems

CO4: Acquire knowledge on spectral density which describes the average frequency content of a random process

CO5: Analyze the interpole values, numerical integration for ordinary differentiate equations

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M										
CO2	H	M										
CO3	H	M										
CO4	H	M										
CO5	H	M										

PROBABILITY, RANDOM VARIABLES AND STANDARD DISTRIBUTIONS

Probability - Random variables - Binomial, Poisson, Geometric, Uniform, Normal, Exponential distributions - Moment generating functions and their properties - Functions of Random variables

TESTING OF HYPOTHESIS

Sampling distributions - Testing of hypothesis for mean, variance, proportions and difference using Normal, t, Chi-square and F- distributions - Test of independence of attributes and goodness of fit

DESIGN OF EXPERIMENTS

Design of Experiments - Analysis of variance - one way classification - CRD - Two-way classification - RBD - Latin square

LINEAR PROGRAMMING

Formulation of LPP - Graphical solution - simplex algorithm - Artificial variable - Big M method - Two phase method. Duality, dual computations

BESSEL FUNCTION AND LEGENDRE POLYNOMIALS

Series solutions - Bessel's equation - Bessel Functions - Legendre's equation - Legendre Polynomials - Rodrigue's formula - Recurrence relations - Generating Functions and orthogonal property for Bessel functions of the first kind - Legendre Polynomials

TEXT BOOKS

1. Gupta, S.C, and Kapur, J.N., Fundamentals of Mathematical Statistics, Sultan Chand, New Delhi, 11th Edition, 2006
2. Ross, S., A first Course in Probability, Pearson Education, Delhi, 5th Edition, 2002

3. Taha, H.A., Operations Research, Prentice Hall of India, New Delhi, 6

4. Narayanan, S., Manicavachagom Pillay, T.K., Ramanaiah, G., Advanced Mathematics for Engineering Students Volume II, S. Viswanathan (Printers and Publishers) Pvt. Ltd., Chennai, 2nd Edition, Reprint 2002.

CHE206	HEAT TRANSFER	L	T	P	C
		3	1	0	4

Course Outcome:

At the end of the course the students would be able to CO1: Recognize the basic doctrine of heat transmits CO2: Recognize and work out conduction effort

CO3: Recognize and work out convection effort and analyze heat exchangers

CO4: Recognize and work out radiation effort

CO5: Propose and analyze the recital of evaporators

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H		M									
CO2	H	H		H	M							
CO3	H	H		H	M							
CO4	H	H		H	M							
CO5					H				H	M	M	

MODES OF HEAT TRANSFER

Introduction - Modes of heat transfer - Fourier's law - Newton's law - Stefan-Boltzmann's law - Thermal conductance and resistance - Temperature field and temperature gradient - Combined mechanism of heat transfer.

CONDUCTION HEAT TRANSFER

Conduction - Heat transfer by conduction - General heat conduction equation - Thermal diffusivity and equivalent thermal conductivity - Linear one-dimensional steady state conduction through plane, cylinders, spheres and composite walls - Heat conduction with internal heat generation - Systems with variable thermal conductivity - Critical radius of insulation - Heat conduction with extended surfaces.

CONVECTION HEAT TRANSFER

Convection - Heat flow mechanism by convection - Individual and overall heat transfer coefficient - Log-mean temperature difference - Forced convection inside tubes and ducts, Dittus-Boelter equation - Reynolds's analogy - Natural convection - Condensation of single and mixed vapors - Heat transfer to boiling liquids - Types of heat exchange equipment and design of heat exchangers, shell-and-tube heat exchangers, double-pipe heat exchanger - Illustrative examples Number of transfer units and effectiveness of heat exchangers - Condensers and reboilers - Boiling, condensation, evaporation.

RADIATION HEAT TRANSFER

Radiation -Thermal radiation - Spectrum of electromagnetic radiation - Monochromatic Emissive Power of black body - Planck's Distribution Law - Kirchoff's Law - Total Emissive Power, problems on Stefan- Boltzmann's law and Wien's displacement law - Configuration factor determination, typical examples.

EVAPORATION

Evaporation - Mechanism of vaporization - Single and multiple effect evaporators - Types of evaporators with accessories - Design calculations for evaporators and optimum number of effects - Thermo- compression evaporator.

TEXT BOOKS

1. Holman, J. P., Heat Transfer, 9th Edition, Mc Graw Hill, Singapore, 2002
2. Donald Q. Kern, Process Heat Transfer, Tata McGraw Hill, New Delhi, 1997

REFERENCES

1. Incropera, F. P.,Dewitt, D. P., Bergman, T. L., Lavine, A. S., Introduction to Heat Transfer, John Wiley and Sons, Singapore, 5th Edition, 2006.
2. Bejan A., Convective Heat Transfer, John Wiley and Sons, Singapore, 3rd Edition, 2005.
3. Kreith, F. And Bohn, M. S., Principles of Heat Transfer , Brookes/Cole, California, 5th Edition, 2001.
4. Necati Ozisik, M., Heat Transfer - A basic Approach, McGraw Hill , New York 2002.

CHE207	MATERIAL SCIENCE AND TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course the students would be able to

CO1: Explain the properties of material and corrosion prevention

CO2: Describe the principles of heat treatment

CO3: Analyse ferrous metals

CO4: Explain about Non-ferrous and other materials of construction

CO5: Analyze crystal structures and apply non-destructive testing

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		H				M					
CO2					M		M					
CO3				M	H						M	
CO4			M									
CO5							M				M	H

PHASE DIAGRAMS

Factors affecting the selection of materials for constructional purpose in chemical industries - Metallic and Non-metallic materials of construction, ferrous and non-ferrous metals - Cold and hot working of metals and their effects on mechanical properties - Binary equilibria involving solid solution - Eutectic and peritectic system - Cu-Ni - Cu- Zn - Fe-C diagrams - Corrosion, various types, mechanism, method of prevention and control

HEAT TREATMENT

Mechanical properties of various materials - General principle of heat treatment - TTT curves, annealing, normalizing, hardening, tempering and age hardening

FERROUS METALS

Cast Iron, gray and white cast iron malleable, mechanite and nodular cast iron - Plain Carbon Steel, classification properties and applications - Alloy Steels, stainless steels, ferritic, austenitic and martensitic, mechanism of development of corrosion resistance in austenitic stainless steel, application of stainless steel in chemical industries, alloy tool steel, ultra high strength steels

NON-FERROUS METALS

Copper - Brasses - Bronzes - Aluminium - Their mechanical properties, workability and applications, corrosion resistance - Non-metallic materials of construction – Ceramics, various types specially glasses and refractories, properties and applications – Polymers, comparison of properties of various polymers and their relationship with chain structure, applications in chemical industries.

CRYSTALLOGRAPHY AND NON DESTRUCTIVE TESTING

Space lattice, unit cell, Bravais space lattices, lattice planes, Miller indices - Calculation of number of atoms per unit cell, atomic radius coordination number, packing factor for simple cubic, BCC, FCC, HCP and diamond structures - NDT methods, liquid penetrant method, ultrasonic flaw detector, X-ray radiography, fluoroscopy - Thermography

TEXT BOOKS

1. Callister, W. D., Materials Science and Engineering: An Introduction, John Wiley and Sons, Singapore, 7th Edition, 2005
2. Smith, W.F, Hashemi, J., Foundations of Material Science and Engineering, Mc Hraw Hill, New York,2005

REFERENCES

1. Budinski, K. G., Dubinsky, M. K., Engineering Materials, Prentice-Hall of India Private Limited, New Delhi, 4th Indian Reprint, 2002
2. Raghavan, V., Materials Science and Engineering, Prentice Hall of India Pvt., Ltd., New Delhi, 1999
3. Murthy, V. S. R., Structure and Properties of Engineering materials, Tata Mc Graw Hill Book Company, New Delhi, 1st Edition, 2003
4. Allen, S. M., Thomas, E. L., The Structure of Materials, John Wiley and Sons, 1999

CHE208	CHEMICAL ENGINEERING THERMODYNAMICS II	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course the students would be able to

CO1: Explain the partial molar properties of solutions

CO2: Ability to distinguish ideal and non-ideal solution based on thermodynamic properties

CO3: Apply phase equilibrium

CO4: Analyze phase equilibria in chemical reactors

CO5: Analyze the performance of refrigeration

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H		M									
CO2	M			M								
CO3			M									
CO4				H								
CO5												M

PARTIAL MOLAR PROPERTIES

Partial molar properties - Ideal and non-ideal solutions - Standard states, definition and choice - Gibbs-Duhem equation - Excess properties of mixtures - Mixing Rules - Departure functions for real gas mixtures - Fugacity and fugacity coefficients of real gas mixtures

SOLUTION THERMODYNAMICS

Ideal and non-ideal solutions - Dilute Solutions, thermodynamic properties of solutions, Lewis-Randall rule, Raoult's Law, Henry's Law , Colligative properties, excess properties - Activity and activity coefficient, estimation of activity coefficients using Redlich-Kister, Margules, Van Laar, Wilson, NRTL, UNIQUAC and UNIFAC models - Azeotropy, minimum boiling azeotrope and maximum boiling azeotrope.

PHASE EQUILIBRIA

Criteria for equilibrium between phases in multi component non-reacting systems in terms of chemical potential and fugacity - Application of phase rule - Vapor-liquid equilibrium - Phase diagrams for homogeneous systems and for systems with a miscibility gap - Effect of temperature and pressure on azeotrope composition - Liquid- liquid equilibrium, ternary liquid-liquid equilibrium

FREE ENERGY AND CHEMICAL EQUILIBRIUM

Definition of standard state, standard free energy change and reaction equilibrium constant, evaluation of reaction equilibrium constant - Prediction of free energy data - Equilibria in chemical reactors, calculation of equilibrium compositions for homogeneous chemical reactors, thermodynamic analysis of simultaneous reactions

REFRIGERATION

Principles of refrigeration, methods of producing refrigeration, liquefaction process, co-efficient of performance, evaluation of the performance of vapor compression and gas refrigeration cycles

TEXTBOOKS

1. De Nevers, Noel, Physical and Chemical Equilibrium for Chemical Engineers, John Wiley and Sons, Singapore, 2nd Edition, 2002
2. Smith, J.M., Van Ness, H.C., Abbott, M. M., Introduction to Chemical Engineering Thermodynamics , Mc Graw Hill, New York, 6th Edition, 2001

REFERENCES

1. Prausnitz, Lichtenthaler and de Azevedo, Molecular Thermodynamics of Fluid Phase Equilibria, Prentice Hall, 1999
2. Sandler, S.I., Chemical, Biochemical and Engineering Thermodynamics, John Wiley and Sons, Singapore, 4th Edition, 2006
3. Kyle, B.G., Chemical and Process Thermodynamics, Prentice Hall of India Pvt.Ltd., New Delhi, 3rd Edition, 1999

CHE209	TECHNICAL AND INSTRUMENTAL	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, the students would be able to

CO1: Analyze the properties of electromagnetic radiation and measure them

CO2: Apply the principles and instrumentation of quantitative spectroscopy

CO3: Apply the Principles, Instrumentation and Applications of Atomic Absorption Spectrophotometry

CO4: Apply Thermogravimetric analysis and analyze thermograms

CO5: Explain the Principles of chromatography

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H				H							
CO2			H			H						
CO3			H			H						
CO4					H						H	
CO5					H			M				

ELECTROMAGNETIC RADIATION

Various ranges - Dual properties - Various energy levels, interaction of photons with matter - absorbance and transmittance and their relationship, permitted energy levels for the electrons of an atom and simple molecules

- Classification of instrumental methods based on physical properties.

QUANTITATIVE SPECTROSCOPY

Beer-Lambert's Law, limitations, deviations (real, chemical, instrumental) - Duboscq colorimetry - Estimation of inorganic ions such as Fe - Ni and estimation of Nitrite using Beer-Lambert's Law

Various electronic transitions in organic and inorganic compounds effected by UV - Visible and infra red

radiations, various energy level diagrams of saturated, unsaturated and carbonyl compounds, excitation by UV and visible radiations - Woodward-Fischer rules for the calculation of absorption maxima (dienes and carbonyl compounds) - Effects of auxochromes and effects of conjugation on the absorption maxima - Instrumentation for UV - visible and IR spectroscopies - Multicomponent analysis - Photometric titration (Experimental setup and various types of titrations) – Applications.

ATOMIC ABSORPTION SPECTROPHOTOMETRY

Principle - Instrumentation and Applications - Various interferences observed in AAS (Chemical radiation and excitation), principle - Instrumentation and Applications of refractometry and polarimetry

THERMOGRAVIMETRY

Instrumentation - Factors affecting the shapes of thermograms, applications, thermograms of some important

compounds ($CuSO_4.5H_2$- $CaC_2O_4.2H_2O$ etc) - Differential thermal analysis, principle, instrumentation and applications - Differences between DSC and DTA. Applications of DSC (Inorganic and Polymer samples)

CHROMATOGRAPHY

Classification of chromatographic methods - Column - Thin layer - Paper - Gas - High Performance Liquid Chromatographic methods (Principle - mode of separation and Technique), Separation of organic compounds by various chromatographic compounds

TEXT BOOKS

1. Willard, H.H., Merritt. I.I., Dean J.A., and Settle, F.A., Instrumental methods of analysis, CBS

publishers, New Delhi,6^{th} Edition, 1986.

2. Skoog, D . A . and West D.M., Fundamentals of Analytical Chemistry, Saunders-college

Publishing, 1982

REFERENCE

1. Rouessac, F., Rouessac A., Chemical Analysis-Modern instrumental methods and techniques, John

Wiley and Sons, Singapore, 2nd Edition, 2005

2. Banwell, G.C., Fundamentals of molecular spectroscopy, Tata Mc Graw Hill, New Delhi, 1992

3. Robert de Levie, Principles of Quantitative Chemical Analysis, I Edition, Tata McGraw Hill, New Delhi,

1998

CHE210	ORGANIC CHEMICAL TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, the students would be able to

CO1: Explain the processing of natural products

CO2: Describe about microbial processes and edible oil refining process

CO3: Elaborate the processes for producing petrochemicals

CO4: Characterize polymers and elaborate its production processes

CO5: Describe the production processes of fibres

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M										
CO2	M			M								
CO3			M									
CO4				H								
CO5												M

NATURAL PRODUCTS PROCESSING

Production of pulp, paper and rayon, Manufacture of sugar, starch and starch derivatives, gasification of coal and chemicals from coal

FERMENTATION PROCESSES

Industrial microbial processes and edible Oils - Fermentation processes for the production of ethyl alcohol, citric acid and antibiotics - Refining of edible oils and fats, fatty acids - Soaps and detergents **PETROLEUM REFINING AND PETROCHEMICAL PRECURSORS**

Petroleum refining to produce naphtha, fuel hydrocarbons and lubricants - Processes for the

production of petrochemical precursors, ethylene, propylene, butadiene, acetylene, synthetic gas, benzene, toluene and Xylene - Cracking, catalytic reforming and separation of products

POLYMERS

Polymer based industries and their characteristics, Plastics, production of thermoplastic and thermosetting resins such as polyethylene, polypropylene, phenolic resins and epoxy resins - Polymers and their applications in engineering practice

SYNTHETIC FIBRES

Fiber forming and electrometric polymers - Synthetic fibers, polyamides, polyesters and acrylics from monomers - Processes for the production of natural and synthetic rubbers.

TEXT BOOKS

1. George T. Austin, Shreve's Chemical Process Industries, McGraw-Hill International Editions, Singapore, 5th Edition,1998
2. Gopala Rao M. and Marshall Sittig, Dryden's Outlines of Chemical Technology, East-West Press, New Delhi, 3rd Edition,1997

REFERENCES

1. Kent, J.A. (ed), Riegel's Hand Book of Industrial Chemistry, Kluwer Academic Press, New York, 10th Edition, 2003
2. M. Farhat Ali and Bassam El Ali, Handbook of Industrial Chemistry, Mc Graw Hill, New York, 2004
3. Pandey, G. N., Text book of Chemical Technology, Vol. II, Vikas Publishing House, New Delhi, 2nd Edition, 1994

CHE283	HEAT TRANSFER LABORATORY	L	T	P	C
		0	0	3	2

Course Outcomes:

At the end of the course, the students would be able to

CO1: Apply Fourier's law of heat conduction

CO2: Analyze the modes of heat transfer

CO3: Apply heat transfer to various unit operations

CO4: Analyze heat exchangers

CO5: Analyze evaporators

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M										
CO2	M			M								
CO3			M									
CO4				H								
CO5							M					

LIST OF EXPERIMENTS

1. Thermal Conductivity of metal rod
2. Thermal Conductivity of an insulating powder
3. Convective heat transfer - Forced and free convection
4. Transient heat conduction
5. Agitated vessel heat transfer
6. Heat Transfer in Jacketed Kettle
7. Plate Heat Exchanger
8. Double pipe Heat Exchanger
9. Shell and Tube Heat exchanger

10. Vertical and Horizontal Condensers
11. Evaporator
12. Radiation Heat Transfer

CHE284	TECHNICAL AND INSTRUMENTAL ANALYSIS LABORATORY	L	T	P	C
		0	0	3	2

Course Outcomes:

At the end of the course, the students would be able to

CO1: Analyze organic chemicals CO2: Analyze inorganic chemicals CO3: Analyze ores and alloys

CO4: Apply spectophotometric techniques

CO5: Apply Chromatographic techniques

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H						H	M				M
CO2	H						H	M				M
CO3	H						H	M				M
CO4	H						H	M				M
CO5	H						H	M				M

LIST OF EXPERIMENTS

Analysis of

1. Water
2. Oil
3. Soap
4. Cement
5. Sugar
6. Bleaching Powder
7. Fertilizer
8. Drugs and Vegetables.
9. Tannins.
10. Ores and Alloys
11. Cellulose

Analysis of products by

1. Spectrophotometer
2. Polarimetry
3. Nephelometry
4. Flame Photometry
5. pH meter
6. Gas Chromatography

SEMESTER V

CHE301	PROCESS DYNAMICS AND CONTROL	L	T	P	C
		3	1	0	4

Course Outcomes:

At the end of the course, the student would be able to

CO1: Analyze open-loop systems

CO2: Analyze and apply the knowledge of linear closed loop systems

CO3: Develop working knowledge of control system by frequency response CO4: Analyze Frequency response and apply it to advanced control systems CO5: Develop working and design knowledge of Digital controllers

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M										
CO2	M			M								
CO3			M									
CO4				H								
CO5							M					

OPEN LOOP SYSTEMS

Laplace Transforms - Standard functions, Open loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics

CLOSED LOOP SYSTEMS

Closed loop control systems, development of block diagram for feed-back control systems, servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transportation lag, transient response of closed-loop control systems, Routh- Hurwitz and Root-locus stability of a control system

FREQUENCY RESPONSE

Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, Principle of Nyquist diagram, stability criterion, tuning of controller settings

ADVANCED CONTROL SYSTEMS

Introduction to advanced control systems, cascade control, feed forward control, model predictive control, control of distillation Column and heat exchanger. Adaptive controller, Supervisory controller and Ratio controller

DIGITAL CONTROLLERS

Introduction to Computer control loops, Digital computer, computer process Interface, digital to analog and analog to digital converters, sampling continuous signal, Hardware components of a DDC loop, New control Design problems

TEXT BOOKS

1. Coughnowr, D. R., Process Systems Analysis and Control, Mc Graw Hill, New York, 2nd Edition,
1991

2. George Stephanopolous, Chemical Process Control, Prentice-Hall of India Pvt-Ltd., New Delhi,
1990

REFERENCES

1. Doeblin Ernest, Measurement Systems, Mc Graw Hill, New York , 2005
2. C. A. Smith and A. B. Corripio, Principles and Practice of Automatic Process Control, John Wiley and Sons, New York, 2nd Edition, 1997.
3. Luyben, M. L., Luyben, W. L., Essentials of Process Control, Mc Graw Hill, New York, 1997.
4. Eckman, D.P., Industrial Instrumentation, John Wiley and Sons, Singapore, 1990
5. Harriot, P., Process Control, Tata McGraw Hill, New Delhi, 1984

CHE302	CHEMICAL REACTION ENGINEERING I	L	T	P	C
		3	1	0	4

Course Outcomes:

At the end of the course the students would be able to

CO1: Explain the concepts of reactor design and reaction kinetics

CO2: Interpret reactor data

CO3: Identify ideal reactors and explain various aspects of design for single reactions

CO4: Explain various aspects of design for multiple reactions

CO5: analyze effects of temperature and pressure on conversion

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H			H								
CO2		H		H								
CO3			H	H				M				
CO4			H	H				M				
CO5			H	H				M			M	

REACTION KINETICS

Chemical kinetics - Classification of reactions, variables affecting rate of reaction, definition of reaction rate

- Kinetics of homogeneous reactions - Concentration dependant terms of rate equation – Elementary and non- elementary reactions, kinetic view of equilibrium for elementary reactions - Molecularity and order of reaction, representation of reaction rates - Testing kinetics models - Temperature dependency of rate - Rate of reaction predicted by theories

INTERPRETATION OF REACTOR DATA AND RATE EQUATION

Interpretations of reactor data - Constant volume batch reactor – Integral methods of analysis - Autocatalytic reactions - First and second order reversible reactions - Differential method of analysis - Variable volume batch reactor - Temperature and reaction rate - Search for rate equation

IDEAL REACTORS

Ideal Reactors - Reactor design, batch reactor, semi batch reactor, single ideal reactors - Performance equations for batch, plug, mixed reactor - Design for simple reactions - Size comparison of single reactors, general graphical comparison - Multiple reactor systems - Mixed flow reactor of different type in series - Reactors of different types in series - Recycle reactor - Autocatalytic reactions

MULTIPLE REACTIONS

Design of reactor for multiple reactions - Reaction in series and parallel - Qualitative and quantitative treatment about product distribution - Successive irreversible reactions of different orders - Semi-parallel reactions, kinetics of series-parallel reactions

HEAT EFFECTS

Heat Effects -Temperature and pressure effects on single and multiple reactions - Stability - Multiplicity of steady states - Limit cycles - Oscillating cycles and parameter sensitivity

TEXT BOOKS

1. Levenspiel, O., Chemical Reaction Engineering, John Wiley and Sons, New York, 3rd Edition, 1999
2. Froment G. F., Bischoff, K. B., Chemical Reactor Analysis and Design, John Wiley and Sons, New York, 2nd Edition, 1999
3. Fogler, H. S., Elements of Chemical Reaction Engineering, 4th edition, Prentice Hall of India Private limited, 2006

REFERENCES

1. Davis Mark, E., E., Davis Robert, J., J., Fundamentals of Chemical Reaction Engineering, Mc Graw Hill, New York, 2003
2. Bruce, N., Handbook of Chemical Reactor Design Optimization and Scaleup, Mc Graw Hill, New York, 2002

CHE303	MASS TRANSFER I	L	T	P	C
		3	1	0	4

Course Outcomes:

At the end of the course the students would be able to

CO1: Solve diffusion and diffusion related problems

CO2: Estimate mass transfer coefficients for gas –liquid contacting systems

CO3: Explain the concepts of designing the absorption column

CO4: Solve design problems related to adsorption

CO5: Apply design calculations of cooling tower

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M									
CO2		H		H	M							
CO3		H	H	H	M							
CO4		H	H	H	M							
CO5			H	H	M							

DIFFUSION

Molecular and eddy diffusion in gases and liquids - Steady state diffusion under stagnant and laminar flow conditions - Diffusivity measurement and prediction - Multicomponent diffusion - Diffusion in solids and its applications

MASS TRANSFER COEFFICIENTS

Concept of mass transfer coefficients - Mass transfer under laminar and turbulent flow past solids - Boundary layers - Mass transfer at fluids surfaces correlation of mass transfer coefficients - j_D - Theories of mass transfer and their applications - Interphase mass transfer and over all mass transfer

coefficients in binary and multicomponent systems - Application to gas-liquid and liquid-liquid systems - Analogies in Mass Transfer, Reynolds, Chilton-Colburn - Prandtl, Von Karman Analogy.

ABSORPTION

Equilibrium and operating line concept in absorption calculations - Types of contactors - Design of packed and plate type absorbers - Operating characteristics of stagewise and differential contactors, concepts of NTU - HTU and overall volumetric mass transfer coefficients - Multicomponent absorption, mechanism and model of absorption with chemical reaction - Thermal effects in absorption process.

ADSORPTION

Theories of adsorption of gases and liquids - Industrial adsorbents - Adsorption equipment for batch and continuous operation - Design calculation of ion-exchange resins, principle of ion-exchange, industrial equipment

PSYCHROMETRY

Basic concepts - psychrometric chart construction - Humidification and dehumidification operations, design calculations - Cooling tower principle and operation, types of equipment, design calculations

TEXT BOOKS

1. Treybal, R.E., Mass Transfer Operations , McGraw Hill Book, New York, 3rd Edition, 1989
2. Maddox, R., Hines, A., Mass Transfer: Fundamentals and Applications, Prentice Hall, New York, 1985

REFERENCES

1. Geankoplis, C. J., Transport Processes and Separation Process Principles (Includes Unit Operations), Prentice Hall of India, New Delhi, 4th Edition, 2003
2. Roman Zarzytci, Andrzai Chacuk, Absorption: Fundamentals and Application, Pergamon, Press, 1993
3. Strigle (jr), R.F., Packed Tower Design and Applications, Gulf Publishing, Company, USA, 2nd Edition, 1994
4. Wankat, P. C., Equilibrium staged Separations, Prentice Hall, New York, 1989

CHE304	NUMERICAL METHODS FOR CHEMICAL ENGINEERS	L	T	P	C
		3	1	0	4

Course Outcome

CO1: Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems

CO2: Apply numerical methods to obtain approximate solutions to mathematical problems

CO3: Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations

CO4: Analyze and evaluate the accuracy of common numerical methods

CO5: Develop Finite difference solution for one dimensional heat equation

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H				M							
CO2	H		M		M							
CO3	H		M									
CO4	H											
CO5	M		M	H	H		M					H

SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS

Review of open end methods, bracketed end methods - The intermediate theorem (excluding proof) -Iterative method, False position method, Newton - Raphson method for single variable and for simultaneous equations with two variables - Solutions of a linear system by Gaussian, Gauss-Jordan, Jacobi and Gauss - Seidel methods - Eigen value of a matrix by Power Method

INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION

Newton forward and backward difference formulae - Newton's divided difference formulae - Lagrange's polynomials - Numerical differentiation with interpolation polynomials - Numerical integration by Trapezoidal and Simpson's (both 1/3rd and 3/8th) rules

FINITE ELEMENT METHODS

Line segment element - triangular element - rectangular element - quadrilateral element - tetrahedron element - hexahedron element - curved boundary element - Numerical integration over finite elements - Ritz finite element method - Least square finite element method - Galerkin finite element method - convergence analysis

INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS

Single step Methods - Taylor Series, Euler and Modified Euler, Runge - Kutta method of order four for first and second order differential equations - Multistep Method-Milne predictor and corrector method

BOUNDARY VALUE PROBLEMS FOR PDE

Finite difference solution for the second order ordinary differential equations - Finite difference solution for one dimensional heat equation (both implicit and explicit), One-dimensional wave equation and two- dimensional Laplace and Poisson equations

TEXT BOOKS

1. Kreyszig, E, Advanced Engineering Mathematics, John Wiley and Sons (Asia) Limited, Singapore , 8th Edition, 2001
2. Arumugam, S., Thangapandi Isaac, A., Somasundaram, A., Numerical Methods, Scitech Publications (India) Pvt. Ltd., Chennai, 2nd Edition, Reprint 2006
3. Gerald, C.F., Wheatley, P.O., Applied Numerical Analysis, Pearson Education Asia, New Delhi, 6th Edition, Reprint 2002

REFERENCES

1. Jain, M.K., Iyengar, S.R.K., Jain, R.K., Numerical Methods for Scientific and Engineering Computation, New Age International (P) Ltd., New Delhi, 4th Edition, 2003
2. Francis Scheid, Theory and Problems of Numerical Analysis, Schaum's Outline Series, Singapore, 2nd Edition, 1989

CHE381	PROCESS DYNAMICS AND CONTROL LABORATORY	L	T	P	C
		0	0	3	2

Course Outcomes:

At the end of the course, the student would be able to

CO1: Apply control system in processes

CO2: Analyze the control system in processes

CO3: Verify level systems

CO4: Analyze set point and load changes in processes

CO5: Optimize controller settings

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M										
CO2	M			M								
CO3			M									
CO4				H								
CO5							M					

List of Experiments

1. ON-OFF control of thermal process
2. Simulation of Proportional Controller
3. Flow control, Level Control, and Pressure control loop

4. Control valve characteristics
5. Flow co-efficient of control valve and Rangeability of control valve
6. Verifying the response of Non-Interacting level System
7. Verifying the response of Interacting level System
8. Effect of PI controller on flow control System
9. The effect of a P controller on level process for set point and load changes
10. Effect of P, PI, PID Controller on Pressure Control Loop
11. Optimum controller setting using Ziegler's Nichols Method
12. Optimum Controller Tuning on Level Process Station

CHE382	CHEMICAL REACTION ENGINEERING LABORATORY	L	T	P	C
		0	0	3	2

Course Outcomes:

At the end of the course, the student would be able to CO1: Evaluate kinetic constant of a given reaction CO2: Establish parameters of non-ideal flow models

CO3: Determine conversion in various reactors and compare it with the theoretically predicted conversions

CO4: Apply RTD studies in reactors

CO5: Analyze kinetic studies in reactors

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M		M				M				
CO2		H		H				M				
CO3			H	H				M				
CO4			H	H				M				
CO5					M			M				

List of Experiments

1. Reversible reaction in a batch reactor
2. Irreversible reaction in a batch reactor
3. Plug flow reactor
4. Mixed flow reactor
5. Adiabatic reactor
6. Combined reactor: Mixed flow-plug flow
7. Combined reactor: Plug flow -mixed flow
8. Heterogeneous catalytic reactor
9. Biochemical reactor
10. RTD studies
11. Photochemical reactor
12. Segregated flow reactor
13. Semibatch reactor

SEMESTER VI

CHE305	CHEMICAL REACTION ENGINEERING II	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, the student would be able to

CO1: Explain the fundamentals of reaction mechanism and kinetics CO2: Apply the perception of non catalytic fluid-solid reactions CO3: Analyze the mechanism of non catalytic gas-liquid reactions CO4: Design reactors for solid catalyzed reactions

CO5: Apply the kinetics of multiphase reactions

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M		M								
CO2		H		H								
CO3			H	H				M				
CO4			H	H				M				
CO5					M							

TRANSPORT PROCESSES IN HETEROGENEOUS CATALYSIS

Transport processes in heterogeneous catalysis - Interfacial gradient effects, reaction at a catalyst surface, concentration and temperature differences across the external - Film of a catalyst pellet, mass transfer on metallic surfaces - Intraparticle gradient effects - Catalyst internal structure – Pore diffusion, reaction and diffusion within a catalyst pellet - Effectiveness factor and generalized effectiveness factor, Temperature gradients within a catalyst pellet - Weisz-Prater criteria, combined interfacial and intraparticle resistances

NON-CATALYTIC FLUID-SOLID REACTIONS

Non-catalytic fluid-solid reactions - Total particle dissolution - Shrinking core model, reactor design

- Fluidized bed reactors, fluidization principles, key applications - Two and three phase models, transport reactor design - Catalyst deactivation functions

NON-CATALYTIC GAS-LIQUID REACTIONS

Absorption combined with chemical reactions - Mass transfer coefficients and kinetic constants - Application of two film and surface renewal theories - Hatta number - Enhancement number for first order reactions

FIXED BED CATALYTIC REACTOR DESIGN

Pseudo-homogeneous PFR and axially dispersed PFR models - Heterogeneous models - Use of effectiveness factor - Use of intraparticle diffusion equations - Two dimensional models

MULTIPHASE REACTORS

Two-film theory, Hatta number - General design models, simplifications to design models, instantaneous, fast and slow reactions, solid catalyzed reactions, resistances in series chemical engineering and chemical technology approximation - Selection of gas-liquid contactors

TEXT BOOKS

1. Levenspiel, O., Chemical Reaction Engineering, John Wiley and Sons, New York, 3rd Edition, 1999
2. Froment G. F., Bischoff, K. B., Chemical Reactor Analysis and Design, John Wiley and Sons, New York, 2nd Edition, 1999
3. Fogler, H. S., Elements of Chemical Reaction Engineering, 4th edition, Prentice Hall of India Private limited, New Delhi, 2006

REFERENCES

1. Davis Mark, E., E., Davis Robert, J., J., Fundamentals of Chemical Reaction Engineering, Mc Graw Hill, New York, 2003

CHE418	TRANSPORT PHENOMENA	L	T	P	C
		3	1	0	4

Course Outcomes:

At the end of the course, the student would be able to

CO1: Explain the properties of transport processes

CO2: Analyze industrial problems along with appropriate boundary conditions CO3: Develop steady and time dependent solutions along with their limitations CO4: Apply heat and momentum transfer analysis

CO5: Apply mass transfer Analysis

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					M							
CO2	H	M			H							
CO3					H							
CO4				H	M	M	M				M	M
CO5				H		M					M	

TRANSPORT PROPERTIES AND REYNOLDS TRANSPORT THEOREM

Laminar Flow - Transport properties and mechanism - Rate process - flux - types of fluids - phenomenological laws - Rheology of non- Newtonian fluids - Flow through circular pipes - Mathematical foundation, types of time derivatives, divergence operators, control volume - Overall mass, energy and momentum balances - Extended Bernoulli's equation - Reynolds's transport equation - Mass balance with chemical reaction

EQUATIONS OF MOTION AND BOUNDARY LAYER THEORY

Equation of motion - Equation of change based on differential balance Equation of continuity - Navier - Stokes equation, energy equation, application of Navier - Stokes equation to various flows through different geometric shapes, applications of energy equation - Potential, streamline, creeping and ideal flow - Boundary Layer Theory - Flow around submerged solids, flow past flat plate - Boundary layer - Prandtl equation - Expressions for viscous drag - Thermal boundary layer - Von Karman's integral momentum equation, analysis of integral equation, displacement thickness

TURBULENT FLOW

Turbulent Flow - Turbulent flow mechanism - Intensity of turbulence - Reynolds's stress - Prandtl mixing length - Turbulent flow through circular pipes

HEAT TRANSFER ANALYSIS

Heat Transfer Analysis - Analogies of transfer processes, profiles of gradients, Reynolds's - Prandtl, Von Karman, Chilton - Colburn analogies, j factors, Dittus - Boelter's equation

MASS TRANSFER ANALYSIS

Mass Transfer Analysis - Review of classical mass transfer problems - Mass transfer in binary systems without chemical reactions - Theories of interphase mass transfer - Mass transfer analogies

TEXT BOOKS

1. Bird, R. B., Stewart, A., and Lightfoot, E. N., Transport Phenomena, John Wiley and Sons, Singapore, Revised 2nd Edition, 2007
2. Brodkey, R. S., and Hershey, H. C., Transport Phenomena - A Unified Approach, Mc Graw Hill, New York, 1988

REFERENCE BOOKS

1. C. J. Geankopolis, Transport Processes in Chemical Operations, 3rd Edition, Prentice Hall of India, New Delhi, 1996
2. Deen, W. M., Analysis of Transport Phenomena, Oxford University Press, New York, 1998
3. James R.Welty, Charles E.Wicks and Robert E.Wilson, Fundamentals of momentum, heat and mass transfer, John Wiley and sons, Singapore, 4th Edition, 2001

CHE307	BIOCHEMICAL ENGINEERING	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, the student would be able to CO1: Explain biological basics and bio processing CO2: Explain the principles of bioenergetics

CO3: Explain the principles of enzyme engineering

CO4: Apply the principles of biochemical engineering

CO5: Apply fermentation technologies in bioprocesses

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M									
CO2					M		H					
CO3							M					
CO4			H				M					
CO5	M		H									

INTRODUCTION

Introduction to Bioscience - Types of Microorganisms, structure and function of microbial cells - Fundamental of microbial growth - Batch and continuous culture, isolation and purification enzymes from cells, assay of Enzymes

BIOENERGETICS

Functioning of cells and fundamental molecular biology - Metabolism and bio-energetics- Photosynthesis - Carbon metabolism - EMP pathway - Tricarbocyclic cycle and electron transport chain - Aerobic and anaerobic meta (pathways) - Synthesis and regulation of bimolecular - Fundamentals of micro genetics

- Role of RNA and DNA

ENZYME ENGINEERING

Enzyme technology and kinetic - Enzyme immobilization - Immobilization of enzyme in industrial processes - Utilization and regeneration of cofactors - Immobilized enzyme kinetics - Reversible inhibition - Biosynthesis

- Transport across cell membranes - Passive and facilitated diffusion - Active transport - Metabolic

organization and regulation, end products of metabolism, formulation , applications and characterization of immobilized cell - Biocatalysts

REACTION ENGINEERING

Ideal Reactors for kinetic measurements, ideal batch reactor, ideal continuous flow stirred tank reactor - Monod growth kinetics - Growth cycle phase for batch cultivation - Batch and continuous sterilization

FERMENTATION

Fermentation Technology - Medium formulation - Aseptic and aerobic fermentation process - Alternate bioreactor configurations - Product recovery - Commercial enzymes , antibiotics, single cell protein in fermentation industries - Introduction to Bioseparation, chromatography, electrophoresis, crystallization etc **TEXT BOOKS**

1. James E. Bailey and D. F. Ollis. Biochemical Engineering Fundamentals, 2nd Edition, McGraw Hill, New York , 1986
2. Stanbury, P.F., Whitaker, A., Hall, S. J., Principles ofFermentation Technology, Butterworths, London, 2nd Edition, 1999

REFERENCES

1. Blanch, H. W., Clark, D. S., Biochemical Engineering, Marcel Dekker, New York, 1996
2. Aiba, S., Humphrey, A. E., Millis, N. F., Biochemical Engineering, Academic Press, New York, 2nd Edition, 1985
3. Trevan, B., Biotechnology, Tata McGraw Hill Publishing Company, New Delhi, 1999
4. Shuler, M. L., Kargi, F., Bio Process Engineering: Basic concepts, Prentice Hall, New Jersey, 2nd Edition, 2002

CHE308	PROCESS EQUIPMENT DESIGN	L	T	P	C
		3	1	0	4

Course Outcomes:

At the end of the course, the student would be able to

CO1: Design pressure vessels

CO2: Design heat transfer equipments CO3: Design mass transfer equipments CO4: Design reactors

CO5: Design jacketed vessels

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M										
CO2	M			M								
CO3			M									
CO4				H								
CO5												M

PRESSURE VESSELS

Design of High Pressure Systems - Design of high pressure vessels (internal and external pressures) - Vessel accessories - Nozzles, flanges, openings and reinforcements and supports of vessels

HEAT TRANSFER EQUIPMENTS

Process Design of Heat Exchangers - DPHE and types of heat exchanger - Shell and tube heat exchanger

- Process design of evaporator, types of evaporator, methods of feeding evaporators - Design of evaporator - Crystallizer design , types of crystallizer - Design of Crystallizer

MASS TRANSFER EQUIPMENTS

Design of mass transfer equipments - Design of mass transfer equipments such as Design of tall columns for distillation and absorption (plate and packed) - Extraction columns - Process Design of dryer, types of dryer, design of rotary dryer and cooling towers

DESIGN OF REACTORS

Design of Reactors - Design and steady state operation of monolithic structures - Fixed bed - Fluidized bed

- Gas liquid and slurry reactors

JACKETED VESSELS

Design of Process Equipments - Drawing of simple process equipments like jacketed reaction vessels and reboilers

TEXT BOOKS

1. Walas, S. M., Process Equipment Selection and Design, Butterworths, London, 1989
2. Coulson J.M., Richardson J.F., Backhurst J.R. and Harker J.M., Sinott, Coulson and Richardson's Chemical Engineering, Volume VI, Butter worth Heinemann, Oxford, 5th Edition, 2002

REFERENCES

1. Perry, R. H., Chemical Engineers' Handbook, McGraw Hill, New York, 7th Edition, 1998
2. Timmerhaus, K. D., Peters, M. S., and West, R. E., Plant Design and Economics for Chemical Engineers, Mc Graw Hill, New York, 5th Edition, 2002
3. Rohsenow, W. M., Hartnett, J. P., Chou, Y. I., Handbook of Heat Transfer, Mc Graw Hill, New York, 3rd Edition, 1998
4. Douglas, J. M., Conceptual Design of Chemical Processes, Mc Graw Hill, New York, 1988

CHE309	MASS TRANSFER II	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, the student would be able to

CO1: Estimate the number of stages for distillation

CO2: Solve problems related to extraction, leaching

CO3: Solve problems related to drying

CO4: Estimate the factors involved in Crystallization

CO5: Explain about membrane separation operations

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	M							
CO2		H		M	H							
CO3		H		M	H							
CO4		H	H	H	M	H						
CO5			H	H	M		M					

DISTILLATION

Vapour-liquid equilibria - Raoult's law and deviations from ideality - Methods of distillation - fractionation of binary and multicomponent system; design calculations by McCabe-Thiele and Ponchon-Savarit -Methods; continuous contact distillation tower (packed tower) design - Extractive and azeotropic - Distillation low pressure distillation - Steam distillation

LIQUID LIQUID EXTRACTION AND LEACHING

Equilibrium in ternary systems - Equilibrium stagewise contact calculations for batch and continuous extractors - Differential contact extraction equipment - Spray-packed and mechanically agitated contactors and their design calculations - Pulsed extractors - centrifugal extractors - Solid-liquid equilibria; leaching equipment - Batch and continuous types; calculation of number of stages

DRYING

Theory and mechanism of drying - Drying characteristics of materials - Batch and continuous drying - Calculation for continuous drying - Drying equipment - Design and performance of various drying equipments

CRYSTALLIZATION

Nuclei formation and crystal growth - Theory of crystallization - Growth coefficients and the factors affecting these in crystallization - Batch and continuous industrial crystallizers - Principle of design of equipment

MEMBRANE SEPARATION PROCESSES

Membrane separation process - Solid and liquid membranes - Concept of osmosis - Reverse osmosis - Electrodialysis - their applications - Foam separation process - Thermal and sweep diffusion process

TEXT BOOKS

1. Treybal, R.E., Mass Transfer Operations , McGraw Hill, New York, 3rd Edition, 1989
2. Maddox, R., Hines, A., Mass Transfer: Fundamentals and Applications, Prentice Hall, New York, 1985

REFERENCES

1. Geankoplis, C. J., Transport Processes and Separation Process Principles (Includes Unit Operations), Prentice Hall of India, New Delhi, 4th Edition, 2003

2. Strigle (jr), R.F., Packed Tower Design and Applications, Gulf Publishing, Company, USA, 2nd Edition, 1994
3. Wankat, P. C., Separation Process Engineering, Prentice Hall, New York, 2005
4. Coulson J.M., Richardson J.F., Backhurst J.R. and Harker J.M., Coulson and Richardson's Chemical Engineering, Vol. I and II, 6th Edition, Butter worth Heinemann, Oxford, 1999
5. Charles Holland, Fundamentals of Multicomponent Distillation, Mc Graw Hill, New York, 1997

CHE383	MASS TRANSFER LABORATORY	L	T	P	C
		0	0	3	2

Course Outcomes:

At the end of the course, the student would be able to

CO1: Estimate Diffusivity

CO2: Perform Distillation Operations

CO3: Study Spray Column, Plate Column and Packed Column

CO4: Analyze Liquid-Liquid & Liquid-Solid operations

CO5: Apply simultaneous heat & mass transfer operations

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M										
CO2				H								
CO3			M									
CO4				H								
CO5							M					

List of Experiments

1. Diffusivity measurement
2. Wetted wall column
3. Vapor Liquid Equilibria
4. Simple Distillation
5. Steam Distillation
6. Packed Column Distillation
7. Bubble Cap Distillation
8. Hold Up studies in Spray Column, Plate Column and Packed Column
9. Extraction single stage and Multi stage cross current
10. Leaching single stage and Multi stage cross current
11. Batch adsorption and adsorption equilibria
12. Surface evaporation
13. Drying curve in a Tray drier
14. Crystallization

CHE384	PROCESS EQUIPMENT DESIGN AND DRAWING LABORATORY	L	T	P	C
		0	0	3	2

Course Outcomes:

At the end of the course, the student would be able to

CO1: Design & Draw pressure vessels

CO2: Design & Draw heat transfer equipments

CO3: Design & Draw mass transfer equipments

CO4: Design & Draw Fixed & Fluidized beds

CO5: Design & Draw reactors

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M										
CO2	M			M								
CO3			M									
CO4				H								
CO5												M

List of Experiments

Design and drawing of the following units:

1. Pressure vessels
2. Heat exchangers
3. Evaporators
4. Distillation column
5. Absorber
6. Rotary Dryer
7. Cooling Tower
8. Fixed bed
9. Fluidized bed
10. Gas liquid and slurry reactors

CHE385	BIOCHEMICAL ENGINEERING LABORATORY	L	T	P	C
		0	0	3	2

Course Outcomes:

At the end of the course, the student would be able to

CO1: Estimate bio process parameters

CO2: Optimize media formulation

CO3: Analyze processes involving enzyme s

CO4: Apply microbial filtration

CO5: Analyze downstream processes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M										
CO2				H								
CO3			M									
CO4				H								
CO5							M					

List of Experiments

1. Growth of bacteria - estimation of biomass, calculation of specific growth rate, yield coefficient
2. Growth of yeast - estimation of biomass, calculation of specific growth rate, yield coefficient
3. Medium optimization - Plackett burman design
4. Enzyme kinetics - Michelis - Menton parameters and Inhibition kinetics
5. Enzyme activity - effect of temperature and ph
6. Enzyme immobilization - gel entrapment, cross linking
7. Solid liquid separation - centrifugation, microfiltration, ultrafiltration
8. Cell disruption techniques - ultrasonication, French press
9. Precipitation - ammonium sulphate precipitation
10. Aqueous two phase extraction of biologicals
11. Chromatographic techniques

SEMESTER VII

CHE481	COMPUTER APPLICATIONS OF CHEMICAL ENGINEERING LABORATORY	L	T	P	C
		0	0	3	2

Course Outcomes:

At the end of the course, the student would be able to

CO1: Write a program and solve nonlinear algebraic equation

CO2: Write a program and solve linear simultaneous equations

CO3: Write a program and solve first order ordinary differential equation

CO4: Write a program and solve second order ordinary differential equation

CO5: Write a program and solve Boundary value problem

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M										
CO2	M			M								
CO3			M									
CO4				H								
CO5		M										

List of Experiments

1. Solution of a single nonlinear algebraic equation by Newton
2. Raphson method.
3. Solution of a single nonlinear algebraic equation by Regula Falsi method
4. Solution of two simultaneous nonlinear algebraic equations by
5. Newton Raphson method
6. Solution of linear simultaneous equations by Gauss Jordan method.
7. Solution of linear simultaneous equations by Gauss Elimination method.
8. Solution of linear simultaneous equation by Gauss Seidel and
9. Successive over Relaxation method.
10. Solution of single first order ordinary differential equation by 4th order Runge Kutta method.
11. Solution of second order ordinary differential equation by 4th order
12. Runge Kutta method.

13. Solution of simultaneous first order ordinary differential equations by 4th order Runge Kutta method.
14. Solution of Boundary value problem by finite difference techniques.
15. Solution of Boundary value problem by finite element techniques.
16. MATLAB Exercises for Monte Carlo Simulation.
17. Wegstein's Search Method.

MAJOR ELECTIVES

CHE310	FERTILIZER TECHNOLOGY	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, the student would be able to

CO1: Explain the global outlook of fertilizer resources

CO2: Elaborate the production processes of nitrogenous fertilizers

CO3: Describe about phosphate fertilizer production

CO4: Explain the production processes of NPK fertilizers

CO5: Discuss about mixed fertilizers

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M										
CO2				H								
CO3			M									
CO4				H								
CO5							M					

GLOBAL OUTLOOK OF FERTILIZER RESOURCES

Role of organic manures and Chemical Fertilizers - Types of Chemical fertilizers, growth of fertilizer industry in India, their location, energy consumption in various fertilizer processes - materials of various fertilizer processes, materials consumption in fertilizer industry

NITROGENOUS FERTILIZERS

Feed stock for production of Ammonia, Natural gas, associated gas, Coke oven gas Ammonium Sulphate, Ammonium Nitrate, Urea, Calcium Ammonia Nitrate, Ammonium chlorides - Methods of Production, characteristics and specification - Storage and handling

PHOSPHATE FERTILIZER

Raw materials for the manufacture of Phosphate fertilizer - Phosphate Rock, Sulphur, Pyrites etc - Processes for the production of Sulfuric and Phosphoric acid - Phosphate fertilizers, ground rock phosphate, bone meal, methods of production, characteristics and specifications for single super phosphate, triple super phosphate

NPK FERTILIZERS

NPK Fertilizers - Methods of production, Characteristics and specifications for complex fertilizers, methods of production of Ammonia phosphate, Sulphate, Di-ammonium phosphate and Nitro phosphates - NPK Fertilizers

- Urea, Ammonium Phosphate, Monoammonium Phosphate and various grades of NPK fertilizers produced in the country

MIXED FERTILIZERS

Mixed fertilizers - Granulated mixtures - Biofertilizers - Secondary and Micro Nutrients, Fluid Fertilizers

- Controlled release fertilizers - Pollution from fertilizer industry - Solid, liquid and gaseous pollution standards

TEXT BOOKS

1. Slack, A, V., Chemistry and Technology of Fertilizers, Interscience, New York, 1998
2. Pozin, M, E., Fertilizer Manufacture, MIR Publishers, Moscow, 1986

REFERENCES

1. Carpentire, L. J., New Developments in Phosphate Fertilizer Technology, Elsevier, New Delhi, 1971
2. Strelzoff ., Technology and Manufacture of Ammonia, , John Wiley and Sons, New York, 2^n

Edition, 1981

CHE311	CORROSION SCIENCE AND ENGINEERING	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, the student would be able to

CO1: Explain about corrosion and its forms

CO2: Protect boiler against corrosion

CO3: Classify various corrosion test and its ASTM standards

CO4: Describe Polarization and Effect of oxidizing agents on corrosion

CO5: Discuss Corrosion prevention methods and its applications

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H		M									
CO2			H									
CO3				H								
CO4					M							
CO5			H									

CORROSION

Corrosion - Definition, classification, forms of corrosion, expressions for corrosion rate, emf and galvanic series , merits and demerits, Pourbaix diagram for iron, magnesium and aluminium - Forms of corrosion, Uniform, pitting, intergranular, stress corrosion - Corrosion fatigue - Dezincification - Erosion corrosion - Crevice corrosion - Cause and remedial measures, Pilling Bedworth ratio, High temperature oxidation

BOILERS

Boiler water corrosion by carbon dioxide and unstable salts - Corrosion prevention methods by treatment

cooling water, specification, types of scales and causes, use of antiscalant - Water treatments - Maintenance of boilers - Protection of boilers during off loading, high temperature, corrosion, turbine corrosion - Corrosion inhibitors, principles and practice, inhibitors for acidic neutral and other media - Corrosion failure - Inspection and analysis of corrosion damage

CORROSION TESTING

Purpose of corrosion testing, classification, susceptibility tests for intergranular corrosion, stress corrosion test, salt spray test, humidity and porosity tests, accelerated weathering tests - ASTM standards for corrosion testing

POLARIZATION

Polarization - Exchange current density, Activation polarization, Tafel Equation ,Passivating metals and nonpassivating metals, Effect of oxidizing agents

ELECTROLESS PLATING AND ANODISING

Electroless plating and Anodizing - Cathodic protection, metallic, organic and inorganic coatings, corrosion inhibitors - Special surfacing processes - CVD and PVD processes, sputter coating - Laser and ion implantation, arc spray, plasma spray, flame spray, HVOF

TEXT BOOKS

1. Fontana and Greene., Corrosion Engineering, McGraw Hill Book Co, New York, 1983
2. Raj Narayan ., An Introduction to Metallic Corrosion and its prevention, Oxford and IBH, New Delhi, 1983

REFERENC
ES

1. Budinski, K.G., Surface Engineering for Wear Resistance, Prentice Hall Inc., Engelwood Cliff, New Jersey, USA, 1988
2. Uhlig, H.H ., Corrosion and Corrosion Control , John Wiley and Sons, New York, USA, 1985.

CHE312	ELECTROCHEMICAL ENGINEERING	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, the student would be able to

CO1: Describe basic laws of Electrochemical

Processes. CO2: Apply Mass transfer over

Electrochemical Reaction. CO3: Prepare Metallic

Surface against corrosion

CO4: Brief about primary and secondary batteries

CO5: Apply metal finishing techniques

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M										
CO2			H	M								
CO3	H				H							
CO4					H							
CO5			H									

INTRODUCTION

Introduction - Faraday's law, Nernst potential, galvanic cells, polarography - Electrical double layer, its role in electrochemical processes, electro capillary curve, Helmholtz layer, Guoy-Steven's layer, fields at the interface

DIFFUSION CONTROLLED ELECTROCHEMICAL REACTION

Diffusion controlled electrochemical reaction, the importance of convection and the concept of limiting current

- Mass transfer over potential or concentration polarization - Secondary current distribution - Rotating disc electrode

INTRODUCTION OF METALLIC SURFACE PREPARATION

Metallic surface preparation - Phosphating - Inhibitors in acid media - Engine cooling systems - Control measures - Industrial boiler water corrosion control - Protective coatings- Vapor phase inhibitors - Cathodic protection- Sacrificial anodes - Paint removers

PRIMARY AND SECONDARY BATTERIES

Primary And Secondary Batteries - Lechlanche dry cell, Alkaline manganese cell, mercury cell, air depolarised cell, sea, water cell, reserve electrolyte cells like Mg,$CuCl_2$, Zn, PbO, Secondary cells like lead acid, Ni, Cd, Ni, Fe, AgO, Zn, AgO, Cd, Sodium, Sulphur, Li, S, Fuel cells

METALS AND METAL FINISHING

Metals - Graphite, lead dioxide, titanium substrate insoluble electrodes, iron oxide, semi conducting type etc - Metal finishing - Electrodeposition, electro refining, electroforming, electro polishing, anodizing, selective solar coatings

TEXT BOOKS

1. John Newman., Electrochemical Systems, Wiley- Interscience, New York, 3rd Edition, 2004

Geoffrey, A., Electrochemical Engineering Principles, Prentice Hall, New Jersey, 1st Edition, 1997

2. Wendet.H, Kreysa.G., Electrochemical science and technology in chemical and other industries, Springer ,London, 1999

REFERENCES

1. Mantle, C., Electrochemical Engineering, McGraw Hill, New York, 1972

2. Kuhn, A.T., Industrial Electrochemical Process , Elsevier Publishing Co, New Delhi, 1971

3. Ewald Heitz, Gerhard Kreysa., Principles of Electrochemical Engineering, VCH Publishers,1986

4. Fahidy, T.Z., Principles of Electrochemical Reactor Analysis, Elsevier, NewDelhi, 1985

CHE313	POLYMER TECHNOLOGY	L	T	P	C
		3	0	0	3

Course outcome

At the end of the course, students would be able to

CO1: Identify common commercial polymers by their names, properties and syntheses

CO2: Relate properties and applications of polymers to methods of polymer processing

CO3: Apply mechanisms of polymer degradation

CO4: Brief polymer additives and their role in the control of desired properties

CO5: Perform various polymer fabrication methods of extrusion, moulding and conversion of fibres to fabrics

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M											
CO2			H									
CO3		M										
CO4			H									
CO5						M						

INTRODUCTION

Classification and characterization of polymers - Thermal analysis, Morphological characterization, Physical testing

PROPERTIES OF POLYMER

Morphology and order in crystalline polymers - Rheology and mechanical properties of polymer structure and physical properties

POLYMERIZATION

Polymerization - Step reaction polymerization, Chain reaction polymerization, free radical, anionic, cationic, coordination - Copolymers and Copolymerization - Polymerization conditions

PLASTICS AND RESINS

Hydrocarbon plastics and elastomers - Other carbon chain polymers - Heterochain thermoplastics - Thermosetting resins

TECHNOLOGIES

Plastic technology - Fiber technology- Elastomer technology

TEXT BOOKS

1. Billmeyer, F.W., Text book of Polymer Science, 3rd Edition, Wiley Publishers, Singapore, 1994
2. Rudin, A., Elements of Polymer Science and Engineering an Introductory Text and Reference for

   Engineers, Elsevier, New Delhi, 2nd Edition, 1998

REFERENCES

1. Anil Kumar, Gupta, R.K., Fundamentals of Polymers McGraw Hill, New York, 1998
2. Cheremisinoff, N.P., Polymer Mixing and Extrusion Technology, Marcel Dekker, New

   York, 1987
3. Rodriguez, F., Principles of polymer systems, Taylor and Francis, Washington, 1996

CHE314	COLLOIDS AND SURFACE SCIENCE	L	T	P	C
		3	0	0	3

Course outcome

At the end of the course, students would be able to

CO1: Explain the basic forces and theories in collision

CO2: Apply Surface Chemical Models

CO3: Describe Electric double coating hypothesis to explicate the origin of surface repulsive forces of charged particles in electrolyte solutions.

CO4: Stabilize particles with non-ionic polymers

CO5: Apply dispersing power of polyelectrolyte

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H											
CO2					M							
CO3			H	M								
CO4				H								
CO5				M	M							

INTRODUCTION

Hamaker's analysis for interparticle attractive forces, Experiments verifying van der Waals interactions between surfaces, Lifshitz macroscopic theory for the Hamaker constant, Parsegian, Ninham's approximation to Lifshitz theory, Casimir and Polder's correction for relaxation effects, Example calculations of Hamaker constants for several specific metal, polymer, and ceramic systems, the influence of other types of interparticle forces

HIERARCHY OF SURFACE CHEMICAL MODELS

The hierarchy of surface chemical models for surface charging - Monoprotic surface charging systems Lattices and Organic acids, Metallic and Non,oxide Systems - The role of surface oxygen in dictating surface charge for metal and non-oxide ceramic systems

ELECTRIC DOUBLE LAYER

The isolated electric double layer - Overlap of the double layer for interacting particles, free NRGs of isolated and interacting double layers, Repulsive NRG due to overlapping double layers - Derjaguin approximation for the interaction of spherical particles - Concept of the critical coagulation concentration, Influence of salt concentration, ionic strength, and ionic size - Influence of surface charge for monoprotic surface charge systems - The role of surface charging in the dispersion of solids in non,aqueous systems

STABILIZATION OF PARTICLES WITH NON- IONIC POLYMERS

Criteria for stabilization of particles with non,ionic polymers - The role of polymer solubility in stabilization

- The role of co, and ter, polymers in providing stabilization reconciling surface attachment with polymer extension from the surface, the impenetrable barrier model for polymeric stabilization - The compression model by Bagchi for polymeric dispersion, the interpenetration and compression model for polymeric dispersion, Other assumptions with respect to the relative contribution of the Hamaker constant toward stabilization with polymers - Selection criteria for polymeric dispersants for specific types of material systems, Polymeric dispersion of nanometer size particles

FEATURES OF POLYELECTROLYTE

Features of polyelectrolyte that contribute to their dispersing power - pKa, molecular size and distribution, type of polymer - Criteria for polyelectrolyte adsorption to charged surfaces - The role of pKa - Monitoring adsorption via solution depletion, EM scattering, and zeta potential measurements, polyelectrolyte conformation at charged surfaces - The combined electrostatic and impenetrable barrier model for dispersion of particles with polyelectrolytes - Some other concepts regarding "nonionic" dispersants in aqueous systems, interaction of polyelectrolytes with ionic species in solution

TEXT BOOKS

1. Hiemenz, P.C, Raj Rajagopalan., Principles of Colloids and Surface Chemistry, Marcel Dekker, New York, 1997
2. De Keizer, Johannes Lyklema, Hans Lyklema., Fundamentals of Interface and Colloid Science, Elsevier, New Delhi, 1995

REFERENCE

1. Milling, A.J., Surface Characterization Methods Principles, Techniques and Applications,(Surfactant Science Series- V, 87) , CRC, New York 1999

CHE317	FOOD TECHNOLOGY	L	T	P	C
		3	0	0	3

Course outcome

At the end of the course, students would be able to

CO1: Apply Unit Operations and Unit Processes in food process industries

CO2: Manufacture value added food products under aseptic conditions in food process industries

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H		H		H							H
CO2		H				H	H				H	

INTRODUCTION

General aspects of food industry; World food need and Indian situation; Constituents of food; Quality and nutrition aspects; Food additive and standards

DETERIORATIVE FACTORS

Deteriorative factor and their control; Preliminary processing methods; Conservation and Preservation operations

PRESERVATION METHODS

Preservation by heat and cold; Dehydration; Concentration; Frying; Drying; Irradiation; Microwave heating.

PACKING METHODS

Sterilization and pasteurization; Fermentation; Pickling; Packing methods. Cereal, grains; pulses;Vegetables; Fruits; Spices; Fats and Oils.

PRODUCTION AND UTILIZATION OF FOOD PRODUCTS

Bakery, confectionery and chocolate products; Soft and alcoholic beverages; Dairy products; Meat; poultry and fish products: - Factory Hygiene - Wastewater disposal and pollution control in food industry.

TEXT BOOKS

1. Toledo, R.T., Fundamentals of Food Process Engineering, Aspen Publishers, 2nd Edition, 2002
2. Angold, R, Beech.G , Taggart, J., Food Biotechnology, Cambridge University Press, U.S.A, 1989

REFERENCES

1. Jackson, J.M, Shinn, B.M., Fundamentals of Food Canning Technology, AVI Publishing Co., 1978
2. Bernnan,J.G, Butters,J.R, Cowell,N.D,Lilley,A.E.V., Food Engineering Operations, Applied Science Publishers, 2nd Edition, 1976
3. Briggs and Galloway, Nutrition and Physical Fitness, Holt Rinehart Winston, 11th Edition, 1984

CHE421	SAFETY IN CHEMICAL INDUSTRIES	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, the students would be able to

CO1: Identify, Explain and Handle Different safety principles

CO2: Identify Different Hazards And their Fire protection agency's

CO3: Analyze various health hazards

CO4: Identify Safety aspects of reactive chemicals

CO5: Identify Hazards Safety in operations and processes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		H									
CO2			H									
CO3			H									
CO4			H									
CO5			H									

INTRODUCTION

Introduction - Industrial safety principles, Site selection and plant layout, Legal Aspects, design for ventilation

- Emergency response systems for hazardous goods basic rules and requirements which govern the chemical industries

HAZARDS

Chemical hazards - Classification, Hazards due to fire, explosion and radiation - Reduction of process hazards by plant condition monitoring - Materials Safety Data sheets and National Fire protection agency's classifications

DISEASES

Dangerous occupational diseases, poisoning, dust effect – Biomedical and engineering response to health hazards

CONTROL OF HAZARDS

Control of Hazards Engineering control of plants instrumentation - Colour codes for pipe lines - Safety aspects of reactive chemicals

OPERATION AND PROCESS HAZARDS

Operation And Process Hazards Safety in operations and processes - Runaway reactions - unstable products

TEXT BOOKS

1. Daniel, A, Crowl, Joseph, F, Louvar ., Chemical process safety :Fundamentals with applications,
Prentice Hall ,New jersey, 2nd Edition, October 2001

2. John Barton, Richard Rogers., Chemical Reaction Hazards, John Wiley and Sons, Singapore, 2nd Edition,
1997

REFERENCES

1. Yoshida, T., Safety of Reactive Chemicals, Vol. I, Elsevier, New Delhi, 1987
2. William, Industrial Safety Handbook, McGraw Hill, New York, 2nd Edition, 1968
3. Fawcett, H.H, Wood, W.S ., Safety and Accident Prevention in Chemical Operation, Wiley
Interscience, Singapore, 2nd Edition, 1982

CHE422	PAPER AND PULP TECHNOLOGY	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, the students would be able to

CO1: Apply different machines in Paper Industry

CO2: Function and maintain Foudriner

CO3: Apply driers in Paper and Pulp Industry

CO4: Describe about special paper machines

CO5: Detail various processes of paper finishing

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			H	M								
CO2			H	M	M							
CO3		H	M									
CO4				H								
CO5						H						

MACHINES

General description, Stock and machine chest, Regulation boxes, riffles and screens, Origin and development of paper machines

FOUDRINIER

Foudrinier part - Foudrinier part operation details, description of press part, press housing, press rolls and doctors, Management and care of press felts

DRYERS

Dryer part, Description of typical dryer part, Types of dryers, Steam supply, and control, Handling dryers, felts, Paper machine ventilation

SPECIAL PAPER MACHINES

Calendars - Winders, slitters and reels, cylinder machine, web end and machine details, operating details, special paper machines

PAPER FINISHING

Handmade paper and paper finishing, coated papers, paper testing, paper making details

TEXT BOOKS

1. Bearce, George D., Manufacture of Pulp and Paper, Volume V, Mc Graw Hill, New York, 1989
2. MacKinney**,** R.W.J**.,** Technology of Paper Recycling, Springer publishers, London, 1995

REFERENCES

1. Sabit Adanur, Asten ., Paper Machine Clothing: Key to the Paper Making Process, CRC Press

,New York, Published 1997

2. Allison Stark Draper, Paper and Pulp Industry, Rosen Publishing Group, 2001

CHE320	ENERGY TECHNOLOGY	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, the students would be able to

CO1: Analyze solid, liquid and gaseous fuels

CO2: Characterize fuels

CO3: Describe about alternate energy sources

CO4: Design reactors for biofuel production

CO5: Identify available nonconventional (renewable) energy resources and techniques to utilize them effectively

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M										
CO2				H								
CO3			M									
CO4				H								
CO5							M					

COAL

Coal and coal derived fuels - Characteristics, production methods and uses - Coal combustion technology - Waste heat recovery

OIL AND GASES

Oil And Gases - Fuels from oil and gases, Characteristics, production methods and uses - Technology for combustion of fuels derived from oil and gas

SOLAR ENERGY

Solar energy - Utilization, Thermal application and photovoltaic applications - Wind- geothermal and hydro energy utilization

BIO ENERGY

Biomass conversion for fuels - Production methods based on thermo chemical and bioconversion - Characteristics and uses - Design of digestors

NUCLEAR ENERGY

Nuclear Energy - Nuclear fission fuels processing - Nuclear reactions and nuclear reactors, Nuclear

Engineering

TEXT BOOKS

1. Rai, G.N., Non conventional energy sources, Khanna Publishers, New Delhi, 2nd Edition, 1998
2. Samir Sarkar., Fuels and Combustion, Orient Longman Publication, 2nd Edition,1990

REFERENCES

1. Reay D, A., Industrial energy conservation a handbook for engineers and managers, Pergamon

   Press, 1st Edition, 1977
2. Om Prakash Gupta., Fundamentals of Nuclear power reactors, Khanna Publishers, New Delhi

CHE321	NEW SEPARATION TECHNIQHES	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, the students would be able to

CO1: Design Thermal Separation equipment

CO2: Characterize various sorbents, adsorption techniques and chromatographic techniques

CO3: Choose membranes for application in industries

CO4: Detail about Ionic Separation

CO5: Apply other industrial separation techniques

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H											
CO2			H	H								
CO3			M		H							
CO4				M	H							
CO5							M					

THERMAL SEPARATION

Thermal Separation - Basic Rate Law - Thermal Diffusion - Theory of Thermal Diffusion Phenomena for gas and liquid mixtures, Equipments design and Applications - Zone Melting Equilibrium diagrams, controlling factors, apparatus and applications

SORPTION TECHNIQUES

Sorption Techniques - Types and choice of adsorbents, normal adsorption techniques, chromatographic techniques - Equipment and commercial processes - Recent advances and economics - Molecular Sieves

MEMBRANE SEPARATION PROCESSES

Membrane separation processes - Types and choice of membranes, their merits, commercial, pilot plant and laboratory membrane permeators, Dialysis, Reverse Osmosis, Ultrafiltration, and economics of membrane operations

IONIC SEPARATION

Ionic Separation - Controlling factors, applications, equipments for electrophoresis, Dielectrophoresis, Electro Dialysis and Ion-Exchange, commercial processes

OTHER TECHNIQUES

Other Techniques - Adductive Crystallization, molecular addition compounds, Clathrate compounds and adducts, equipments, applications, economics and commercial processes - Foam separation surface adsorption, nature of foams, apparatus, applications and controlling factors.

TEXT BOOKS

1. Coulson, J.M, Richardson, J.F., Chemical Engineering, Vol.II,Butterworth Heinemann, London, 4th Edition, 1991

2. Loeb, C, Lacey, R.E., Industrial Processing with Membranes, Wiley Inter Science, Singapore, 1972

REFERENCES

1. Perry, R.H, Green, D.W., Perry's Chemical Engineers Hand book , McGraw Hill, New York, 6th Edition, 1990

2. Schoen, H.M., New Chemical Engineering Separation Techniques, Inter Science Publications, New York, 1972

CHE322	NANOTECHNOLOGY	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, the students would be able to

CO1: Explain the characteristics of nanomaterials, nanodevices and nanostructures

CO2: Identify various Electron Microscopy Techniques

CO3: Describe the mechanism of Mesoscopic magnetism

CO4: Elucidate the applications of nanotechnology in nanoelectronics

CO5: Suggest a suitable Bio molecular m o t o r s & drug delivery nanodevice

CO/P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					M			M				
CO2					M	H						
CO3					M	H						
CO4		M	M	M	H						M	
CO5		M		M	H			M				

NANOMATERIALS

Nanomaterials - Types, nanowires, nanotubes, fullerenes, quantum dots, dendrimers, Nanocomposites - Properties - Methods of preparation -Top down, bottom Up

ELECTRON MICROSCOPY TECHNIQUES

Electron Microscopy Techniques - SEM, TEM, X-ray methods - Optical Methods Fluorescence Microscopy - Single Molecule Surface Enhanced Resonance Raman Spectroscopy - Atomic Force Microscopy, MRI, STM and SPM

MESOSCOPIC MAGNETISM

Mesoscopic magnetism - Magnetic measurements miniature hall detectors, Integrated DC SQUID Microsusceptometry - Magnetic recording technology - Biological Magnets

BASICS OF NANOELECTRONICS

Basics of nanoelectronics - Single Electron Transistor , Quantum Computation - Parallel architecture for nanosystems - Nanolithography, basic structures and integrated structures - MEMS and NEMS - Dynamics of NEMS - Limits of integrated electronics

BIO MOLECULAR MOTORS

Biological structures and functions - Biomolecular motors, drug delivery systems - Nanofluidics

TEXT BOOKS

1. Steed, J. W., Supramolecular Chemistry, Wiley, New York, 1st Edition, 2000
2. Israelachvilim, J.N., Intermolecular and Surface Forces with applications to Colloidal and Biological

   Systems (Colloid Science), Academic Press, London, 2nd Edition, 1992
3. Katsuhiko Ariga., Supramolecular Chemistry, Fundamentals and Applications Advanced

   Textbook, Springer, London,1st Edition, 2006

REFERENCES

1. Rowlinson, J.S., A Scientific History of Intermolecular Forces, Cambridge University, U.S.A, 2002

2. Jean, Marie Lehn., Supramolecular Chemistry Concepts and Perspectives, Wiley, Singapore, 1995

CHE323	MEMBRANE SCIENCE AND TECHNOLOGY	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, the students would be able to

CO1: Elaborate the types of membrane, its Structure and theory CO2: Explain different types of membranes and its modules CO3: Detail various flow processes using Membranes

CO4: Analyze membrane filtration, applications and its design

CO5: Apply Membranes in medical applications

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M			H						
CO2			M	M								
CO3				M		H						
CO4			H	M	M							
CO5			H									

MEMBRANES

Membranes - Types, membrane process, membrane transport theory, solution diffusion model - Structure, permeability relationships, pore, flow membranes

LIQUID MEMBRANES

Membranes and modules, isotropic membranes, anisotropic membranes, metal membranes and ceramic membranes, liquid membranes, hollow fibre membranes, membrane modules

CONCENTRATION POLARIZATION

Concentration polarization - Liquid separation process, gas separation process, cross flow, co-flow and counter flow - Reverse osmosis, theoretical background, membrane selectivity, module, fouling

ULTRACENTRIFUGATION

Ultracentrifugation membranes - Characterization of ultra filtration membranes - Modules, System design -

Micro filtration, background and applications - Pervaporation, membrane materials, process design - Ion exchange membrane, chemistry of ion exchange membranes, transport in electro dialysis membrane, system design

MEDICAL APPLICATIONS

Medical Applications - Haemodialysis - Blood oxygenators, control drug delivery, membrane processes dialysis - Donan dialysis and diffusion dialysis - Charge mosaic membranes and piezo dialysis, membrane contractors and membrane distillation, membrane reactors

1. Baker, R.W., Membrane Technology and Applications, Wiley Interscience, Singapore, 2nd Edition,
2004
2. Strathmann, H., Ion, Exchange Membrane Separation Processes, Volume 9, Elsevier Science, New Delhi,
2004

REFERENCES

1. Vieth, W.R., Membrane Systems Analysis and Design Applications in Biotechnology, Biomedicine and Polymer Science, Wiley Interscience, Singapore, 1994
2. Timashev, S.F, Kemp T.J., Physical Chemistry of Membrane Process , Prentice Hall, New Jersey,1991
3. Marcel Mulder., Basic Principles of Membrane Technology , Kluwer Academic Publishers, New
York, 1996

CHE324	OPTIMIZATION FOR CHEMICAL ENGINEERS	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, the students would be able to

CO1: Ability to fit data to linear and nonlinear functions

CO2: Ability to formulate chemical processes as optimization problems

CO3: Ability to solve linear convex objective functions

CO4: Ability to simplify and solve complex chemical engineering processes.

CO5: understanding the Optimal Control and Dynamic optimization

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M	M			H						
CO2				M		M						
CO3				H		M						
CO4					H							
CO5			M			M						

PROBLEM FORMULATION

Introduction; formulation of objective functions; fitting models to data; classification of functions; necessary and sufficient conditions for optimum; unimodal, multimodal functions; analytical methods Lagrange multiplier methods.

NUMERICAL METHODS

Unimodal functions; Newton's quasi Newton, secant methods; region elimination methods, polynomial approximation; quadratic and cubic interpolation techniques for optimum. Multimodal functions; direct methods; random, grid. Hooke's Nelder and Mead methods; Powell's technique; indirect methods; gradient and conjugate gradient methods; secant methods.

LINEAR PROGRAMMING

Review on basic concepts of LP formulations; Simplex methods; Duality in linear programming

NON-LINEAR PROGRAMMING

The Lagrange multiplier method, Integer, quadratic, geometric and dynamic programming.

APPLICATIONS

Heat transfer and energy conservation; separation processes; fluid flow systems; reactor design and operation; large scale systems.

1. Edgar, T.F, Himmelblau, D.M, Ladson, L.S., Optimization of Chemical Practice, McGraw Hill International , New York, II Edition., 2003
2. Diwaker, U.M., Introduction to Applied optimization, Kluwer Academic Publication, London, 2003
3. Joshi, M.C, Moudgalya, K.M., Optimization, Theory and Practice, Narsoa Publication, New Delhi, 2004

REFERENCES

1. Singiresu, S.Rao., Engineering optimization - Theory and practices, John Wiley and Sons, Singapore,3rd edition,1996
2. Ravindran, Phillips, Solberg., Operations Research, Principles and Practice, John Wiley and Sons, Singapore, 1987
3. Fredick, S.H, Liberman, G.J., Introduction to Operations Research, McGraw Hill Inc, New York, 1995

CHE325	PETROLEUM REFINERY TECHNOLOGY	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, the students would be able to

CO1: Explain Petroleum refining and thermal cracking processes

CO2: Detail Catalytic cracking and catalytic reforming processes

CO3: Produce fuels such as aviation gasoline, motor fuel, kerosene, jet fuel

CO4: Manufacture lubricating oil

CO5: Store and transport petroleum products

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H											
CO2	H	M										
CO3				H								
CO4					H							
CO5			M					M				

INTRODUCTION

Introduction - Origin, occurrence of petroleum, elementary ideas of gas and liquid reservoirs - Petroleum refining processes - General processing, topping and vacuum distillations - Thermal cracking in vapor, liquid and mixed phase - Thermal reforming and polyforming

CATALYTIC CRACKING

Catalytic cracking - Fixed bed, fluidized bed, T.C.C - Houder flow etc - Catalytic reforming - Conversion of petroleum gases into motor fuel with special reference to alkylation's, polymerization, hydrogenation and dehydrogenation - Blending of petroleum products

PRODUCTION OF VARIOUS FUELS

Production - Aviation gasoline, motor fuel, kerosene, diesel oil, tractor fuel and jet fuel, hydrodesulphurization

LUBRICATING OIL

Lubricating oil manufacture - Vacuum distillation, solvent extraction and uses of lubricating oil - Petroleum waxes and asphalts - Elementary study of multi component distillation as applied to petroleum industry

STORAGE AND TRANSPORTATION OF PETROLEUM PRODUCTS

Octane number, Cetane number, Diesel index, their determination and importance - Storage of petroleum products tanks, bullets, special types of spheres etc - Transportation of petroleum products road, rail, sea and pipeline - Importance of pipeline transportation

REFERENCES

1. Meyers, R.A., Handbook of Petroleum Refining Processes, McGraw-Hill, New York 3rd Edition, 2004
2. Bhaskara Rao, B ,K., Modern Petroleum Refining Process, Oxford and IBH, New Delhi., 3rd Edition, 1990
1. Hobson, G, D and Pohl, W., Modem Petroleum Technology, Gulf Publishers, 2nd Edition, 1990
2. Nelson, W.L., Petroleum Refinery Engineering, McGraw Hill, New York, 4th Edition, 1985

CHE 401	BOUNDARY LAYER THEORY	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, the students would be able to

CO1: Apply the basic laws of fluid flow

CO2: Analyze boundary layer equations

CO3: Differentiate laminar and turbulent flows

CO4: Apply momentum integral equation

CO5: Explain heat transfer in boundary layers

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H											
CO2		H										
CO3			H									
CO4			M								M	
CO5				H								M

BASIC LAWS OF FLUID FLOW

Basic laws of fluid flow - Continuity, momentum and energy equations applied to system and control volume - Concepts of flow fields - Flow around bodies - Moment of momentum theorem and its application to fixed and moving vanes - Hot wire and laser Doppler anemometry

DEVELOPMENT OF BOUNDARY LAYER

Development of boundary layer - Estimation of boundary layer thickness, Displacement thickness, Momentum and energy thicknesses for two dimensional flow - Discussion of Navier Stokes equations - Two dimensional boundary layer equations - Blasius solution

LAMINAR AND TURBULENT FLOWS

Laminar and turbulent flows on a flat plate - Laminar and turbulent boundary layers - Transition from laminar to turbulent boundary layers

MOMENTUM INTEGRAL EQUATION

Momentum Integral Equation for boundary layer flow - Introduction to axisymmetric and three dimensional boundary layer equations - Von Karman - Polhausen method

INTRODUCTION TO HEAT TRANSFER IN BOUNDARY LAYERS

Introduction to heat transfer in boundary layers - Thermal boundary layer - Turbulent boundary layer on a flat plate - Flows in pressure gradient - Boundary layer control

TEXT BOOKS

1. Panton, Ronald L, Incompressible Flow, John Wiley and Sons, Singapore, 3rd Edition, 2005

2. 2Anderson, D., Fundamentals of Aerodynamics, McGraw Hill Science, New York, 4th Edition, 2005

REFERENCES

1. Tuncer Cebeci, Peter Bradshaw., Momentum transfer in boundary layers, Hemisphre Publishing Corporation,Washington,1977

2. Herrmann Schlichting., Boundary Layer Theory, Springer, th Edition, 2004 London, 8

3. Reynolds, A.J., Turbulent flows in Engineering, John Wiley and Sons, Singapore, 1980

CHE402	MULTIPHASE FLOW	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, students would be able to

CO1: Provide general introduction to the theory of multiphase flow

CO2: Describe flow dynamics

CO3: Analyze the multiphase flow problem with multiphase flow dynamics

CO4: Reinforce knowledge through practice with realistic problems

CO5: Quantitatively describe chemical mass transport in permeable porous media

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M									
CO2		H										
CO3			H									
CO4			M								M	
CO5				H								M

FLUID-SOLID SYSTEMS

Fluid-Solid systems - Mobile and stagnant solids, Flow through porous media, Capillary Tube model, Application for flow through packed bed, filters, fluidized beds, Solid-Fluid Convening, Settling and Sedimentation, Fluid-Fluid systems - Flow patterns and flow regimes - Analysis of annular, stratified and bubble flow - Formation of bubbles and drops - Their size distribution and volume distribution

TWO - PHASE FLOW

Two-phase cocurrent flow of gas liquid, Gas/Solid and Liquid/Liquid, Upward and Downward Flow in vertical pipes - Suspensions of sand, gravel coal etc., and their transport in horizontal Pipes - Drag reduction phenomena, Laminar, Turbulent, Creeping flow regimes - Suspension Rheology - Residence Time Distribution studies, Deterministic and stochastic flow system Models for chemical reactors , Prevention of circulatory flow - Role of draft tubes and wall baffles, Diffusion model and bubbling bed model for gas interchange and gas mixing - Axial mixing correlations

THEORIES OF INTENSITY AND SCALE OF TURBULENCE

Theories of intensity and scale of turbulence - Calculation of circulation velocities and power consumption in agitated vessels for Newtonian/ Non Newtonian fluids - Blending and Mixing of phases - Power required for aeration to suspend to an immiscible liquid or solids in Slurry reactors - Segregation phenomena - Prediction of optimum speed of impeller rotor and Design criteria for scale up

BUBBLE SIZE IN PIPE FLOW

Prediction of holdup and pressure drop of volume fraction, Bubble size in pipe flow, Lockhart - Martinelli parameters - Bubble Column and its Design aspects - Minimum carryover velocity, Holdup ratios, Pressure drop and transport velocities and their prediction

FLOW THROUGH POROUS MEDIA OF COMPOSITE MIXTURES

Gas, Solid and Liquid composite slurries in horizontal and vertical pipes - Flow through Porous media of composite mixtures - Prediction of holdup, pressure drop and through put

Velocities in 3 - Phase system - Design of multiphase contactors involving fluidization, prevaporation, lyophilisationand permeation for solids, liquids and gases - Design and Development of Software programmes in multiphase flow - Simulation in packed and fluidized beds and Stirred tank process equipment - Selection of equipment for gaseous, particulate and liquid effluents of various industries such as scrubbers, Stacks and Chimneys, Absorbers, Combustion devices, Electrostatic precipitators and filtration / reverse osmosis devices

TEXT BOOKS

1. Brodkey, R.S., The Phenomena Of Fluid Motion, Mc Graw Hill, New York, 2004
2. Schlichting, H., Boundary layer theory, Springer Verlag, London, 8th revised edition, 2006

REFERENCES

1. Gad Hestsroni., Hand book of Multiphase systems, Hemisphere publishing Corporation, Washington, 1982
2. Govier, G.W , Aziz, K., The Flow of complex Mixture in Pipes , Van Nostrand Reinhold Co, New York, 1972
3. Wallis, G.B., One Dimensional Two Phase Flow, McGraw Hill Book Co, New York, 1969

CHE403	DOWNSTREAM PROCESSING	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, students would be able to

CO1: Provide the fundamentals of downstream processing for biochemical product recovery

CO2: Assess the impact of change in unit's operations and the impact on the process

CO3: Examine traditional, new concepts and emerging technology that is likely to benefit biochemical product recovery in the future

CO4: Analyze the methods of product purification

CO5: Analyze final product formulation and finishing operations

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H											
CO2		H										
CO3			H									
CO4			M								M	
CO5				H								M

DOWNSTREAM PROCESSING

Introduction to downstream processing principles, characteristics of biomolecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pretreatment and stabilization of bioproducts.

PHYSICAL METHODS OF SEPERATION

Unit operations for solid-liquid separation - filtration and centrifugation,flocculation, precipitation and settling of particles.

ISOLATION OF PRODUCTS

Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation - ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.

PRODUCT PURIFICATION BY CHROMATOGRAPHY

Chromatography – principles, instruments and practice, adsorption, reverse phase, ion-exchange, size exclusion, hydrophobic interaction, bio-affinity and pseudo affinity chromatographic techniques.

FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS

Crystallization principles -Equipments, Drying principles-Equipments for drying and Lyophilization in final product formulation.

TEXT BOOKS

1. Asenjo, J. A., Bioreactor system design, Marcel Dekker, New York, 1998
2. Jenkins, R.O., Product Recovery in Bioprocess Technology, Biotechnology by Open Learning Series, Butterworth, Heinemann, London 1992

REFERENCES

1. Scopes, R.K., Protein Purification Principles and Practice, Narosa Publishers, New Delhi, 3rd Edition, 1994
2. Biotol, Product Recovery in Bioprocess Technology, Butterworth Heinemann London, 1992
3. Janson, C, Ryden, L ., Protein Purification, Principles, High Resolution Methods And Applications, VCH Pub, 1989
4. Belter, P. A, Cussler, E.L, Wei, Shou Hu ., Bioseparations Downstream Processing for Biotechnology, Wiley Interscience, Singapore, 1st Edition, 1988

CHE404	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, the students would be able to

CO1: Apply equations of fluid flow and heat transfer for turbulence models

CO2: Apply finite difference, finite volume and finite element methods to fluid flow problems

CO3: Apply finite volume to solve fluid flow problems

CO4: Analyze issues surrounding two-phase flow

modeling CO5: Analyze grid generation

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		H									
CO2			H									
CO3		M										
CO4			H									M
CO5						M						

CONSERVATION LAWS AND TURBULENCE MODELS

Governing equations of fluid flow and heat transfer –mass conservation, momentum and energy equation, differential and integral forms, conservation and non-conservation form. Characteristics of turbulent flows, time averaged Navier Strokes equations, turbulence models-one and two equation, Reynolds stress, LES and DNS

FINITE DIFFERNCE APPROXIMATION

Mathematical behaviour of PDE, finite difference operators, basic aspects of discretization by FDM, explicit and implicit methods, error and stability analysis

FINITE VOLUME METHOD

Diffusion problems – explicit and implicit time integration; Convection-diffusion problems – properties of discretisation schemes, central, upwind, hybrid, QUICK schemes; Solution of discretised equations.

FLOW FIELD COMPUTATION

Pressure velocity coupling, staggered grid, SIMPLE algorithm, PISO algorithm for steady and unsteady flows

GRID GENERATION

Physical aspects, simple and multiple connected regions, grid generation by PDE solution, grid generation by algebraic mapping.

TEXT BOOKS

1. Anderson Jr., Computational Fluid Dynamics, John Wiley, Singapore, 1995
2. Chow, C.Y., Introduction to computational fluid dynamics, John Wiley, Singapore 1979
3. Hirsch, A.A., Introduction to computational fluid dynamics, McGraw Hill, New York, 1989

REFERENCES

1. Wirz, H.J, Smeldern, J.J., Numerical methods in fluid dynamics, McGraw-Hill ,New York,1978
2. Ferziger, J.H,Milovan Peric , Computational Methods for fluid dynamics, Springer Verlag ,London, 2nd Edition,1997
3. Pozrikidis, C., Introduction to Theoretical and Computational Fluid Dynamics, Oxford University Press, London, 1997
4. Bose, T.K., Computation Fluid Dynamics, Wiley Eastern Ltd, Singapore, 1988

CHE405	COMPUTATIONAL HEAT TRANSFER	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, the students would be able to

CO1: Apply governing Differential Equation for various physical phenomena

CO2: Analyze parabolic equations

CO3: Provide algorithm for Conduction and Convection

CO4: Analyze general application of various solution methods

CO5: Apply software packages to heat transfer and diffusion

.CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M										
CO2				M	M							
CO3				H	M	M						
CO4						H						
CO5			M			H						

INTRODUCTION

Physical phenomena governing differential Equation - Energy equation - Momentum Equation - Nature of Coordinates, Discretization Methods

PARABOLIC EQUATIONS

Parabolic Equations - Explicit, Implicit and Crank Nicholson Methods - Cartesian and Polar Co-ordinates - Mixed Boundary Condition – Jacobi - Gauss,siedel and SOR Methods

HEAT CONDUCTION AND CONVECTION

Heat Conduction and Convection - Control volume approach - Steady and Unsteady One dimensional conduction - Two and three dimensional - Power law scheme – Simple algorithm

GENERAL APPLICABILITY OF THE METHOD

General applicability of the method - Approximate analytical solution - Raleigh's method -Galerkin Method, solution methods

CONDUCTION AND DIFFUSION EQUATIONS

Isoparametric element formulations conduction and diffusion equations, heat transfer packages, Heat 2, HEATAX, RADIAT, ANSYS

TEXT BOOKS

1. Muralidhar, K., Sundararajan, T., Computational fluid flow and heat transfer, Narosa publishing house, New Delhi, 2nd edition, 2003
2. Anderson, D.A., Tannehill, J.C and Pletcher, R.H., Computational fluid mechanics and heat transfer, Hemisphere publishing corporation, New York, 1984

REFERENCES

1. Mitchell, A.R, Grifths, D.F., Finite Difference Method in Partial Differential Equations, John Wiley and Sons, Singapore, 1980
2. Suhas Patankar., Numerical Heat Transfer and Fluid Flow, (Hemisphere Series on Computational Methods in Mechanics and Thermal Science),Taylor and Francis,1st Edition,1980
3. Jaluria and Torrance., Computational Heat Transfer ,Hemisphere Publishing Corporation, New York,

1986

CHE406	COMPUTER AIDED PROCESS PLANT DESIGN	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, the students would be able to

CO1: Evaluate Transport properties and thermodynamic properties

CO2: Develop basic model for chemical engineering operations

CO3: Develop CAD model for Fluid moving machinery

CO4: Develop CAD model for heat transfer equipment

CO5: Develop CAD model for mass transfer equipment

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M										
CO2				H	M							
CO3			M	H	M							
CO4			M	H	M							
CO5			M	H	M							

INTRODUCTION AND PROPERTIES EVALUATION

Introduction And Properties Evaluation - Spread sheeting, hierarchy of process design and the Onion model

- Flow sheeting, typical unit of CAD system - Process Synthesis - Physical properties evaluation - Transport properties and thermodynamic properties of gases and binary mixtures

BASIC MODEL DEVELOPMENT

Basic model development for preliminary systems , methods of calculating vapour liquid equilibrium data for ideal and non ideal mixtures, bubble point and dew point, flash and distillation calculations, equipment design, development of software progammes for the following systems, piping system - Single phase and two phases

FLUID MOVING MACHINERY

Cad Model for fluid moving machinery and storage design - Separator system - Two phase and three phase - Storage system - Atmospheric, pressurized cryogenics

HEAT TRANSFER EQUIPMENT

CAD model for heat transfer equipment design - Double Pipe, Shell and tube heat exchanger - PHE - Air cooler - Heat integration of evaporators

MASS TRANSFER EQUIPMENT

Cad Model for mass transfer equipment and safety devices design - Binary mixtures - Pseudo binary, multistage distillation system - Heat integration of distillation columns - Absorber and strippers - Liquid Liquid extractor - Safety devices-pressure safety valve and flare system

TEXT BOOKS

1. Bhattacharyya, B.C, Narayanan, C.M., Computer aided design of Chemical Process Equipment, New

   Central Book Agency (P) LTD, New Delhi, 1st Edition , 1992

2. Robin Smith, Chemical Process Design, McGraw Hill Inc, New York, 1995

REFERENCES

1. Hussein, A., Chemical Process Simulation, Wiley, Singapore, 1986

2. Coker, A.K., FORTRAN programme for chemical process design, analysis and Simulation, Gulf
Publishing Co, 1995
3. Mc Gee Y.A, Robert E Peerly, W., Recent developments in chemical process and plant design, John Wiley, New York,1987.
4. Lesley, M. L., Computer Aided Process Plant Design, 1982
5. Douglas, J.M., Conceptual Design of Chemical Processes, McGraw Hill, New York, 1981

CHE407	FLUIDIZATION ENGINEERING	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, the students would be able to

CO1: Explain fluidization behavior

CO2: Estimate pressure drop, bubble size, TDH ,voidage, heat and mass transfer rates for the fluidized beds

CO3: Write model equations for fluidized beds

CO4: Design gas-solid fluidized bed reactors

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H											
CO2		H										
CO3			H									
CO4			M								M	

FUNDAMENTALS OF FLUIDIZATION

Introduction and applications, Introduction to fluidized bed systems - Fundamentals of fluidization - Industrial applications of fluidized beds, Physical operations - Synthesis reaction, cracking and reforming of hydrocarbons, gasification, carbonization, gas-solid reactions , calcining and clinkering

DESIGN OF FLUIDIZED BED

Gross behavior of fluidized bed - Minimum and terminal velocities in fluidized beds -Types of fluidization - Design of distributors - Voidage in fluidized beds - TDH - Variation in size distribution with height, viscosity and fluidity of fluidized beds - Power consumption

ANALYSIS OF BUBBLE AND EMULSION PHASE

Analysis of bubble and emulsion phase - Davidson's model, frequency measurements, bubbles in ordinary bubbling bed model for bubble phase and emulsion phase - Experimental findings - Turn over rate of solids- Bubbling bed model for emulsion phase - Interchange coefficient

FLOW PATTERN IN FLUIDIZED BEDS

Flow Pattern Of Gas , Heat and Mass Transfer In Fluidized Beds - Flow pattern of gas through fluidized beds - Experimental findings - The bubbling bed model for Gas inter change Interpretation of Gas mixing data - Heat and Mass Transfer between fluid and solid Experiment findings on Heat and Mass Transfer - Heat and Mass Transfer rates from bubbling bed model

HEAT TRANSFER IN FLUIDIZED BEDS

Heat transfer between fluidized beds and surface - Experiment finding theories of bed heat transfer comparison of theories - Entrainment above TDH - Model for entrainment and application of the entrainment model to elutriation

TEXT BOOKS

1. Zenz, F.A, Othmer, D.F., Fluidization and Fluid Particle Systems (Chemical Industries), CRC, New York, 2003
2. Levenspiel, Octave, Daizeo, Kunii., Fluidization Engineering (Chemical Engineering Series), nd Butterworth - Heinemann , 2nd Edition, 2001

REFERENCE

1. Davidson , J.F., Harrison, D., Fluidization , Academic Press, California, 1971

CHE 408	PRINCIPLES OF HETEROGENEOUS CATALYSIS	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, students would be able to

CO1: Describe the working of a catalyst in a given chemical reaction among the major catalytic mechanisms and their elementary steps.

CO2: Deduce the role of the different co-reagents (and eventually the products) in a catalytic mechanism

CO3: Predict the impact of variations of operating conditions

CO4: Discriminate between specificity and selectivity (in particular their 'shape' variants) of a catalytic system, and propose different catalysts preparation strategies allowing to improve these performance indicators;

CO5: Propose a method, and the conditions and reagents to utilize, allowing to prepare a catalyst meeting givenspecifications

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H											
CO2		H										
CO3			H									
CO4			M								M	
CO5				H								M

BASIC CONCEPTS IN HETEROGENEOUS CATALYSIS

Basic concepts in heterogeneous catalysis - Catalyst preparation and characterization, poisoning and regeneration - Basic concepts of catalysis - Theories of active centers, Adsorption and chemisorptions, Rate theories and expressions - Catalysts specificity

INDUSTRIAL CATALYSTS

Industrial Catalysts - Production, testing and characterization of industrial catalyst - Industrially important catalysts and processes such as oxidation, processing of petroleum and hydrocarbons, synthesis gas and related processes, commercial reactors (adiabatic, fluidized bed, trickle, bed, slurry, etc.)

HETEROGENEOUS CATALYSIS

Heat and mass transfer and its role in heterogeneous catalysis - Calculations of effective diffusivity and thermal conductivity of porous catalysts

REACTOR MODELING

Reactor modeling - Emphasizes the chemistry and engineering aspects of catalytic processes along with problems arising in industry - Catalyst deactivation kinetics and modeling.

GAS, LIQUID, SOLID CATALYTIC AND NONCATALYTIC REACTING SYSTEMS

Gas, liquid - Solid catalytic and noncatalytic reacting systems - Interaction of physical and chemical inter and intraparticle transport - Development of kinetic models - Isothermal and non isothermal systems - Stability criteria - Flow modeling - Hydrodynamic - Deterministic and stochastic description - Evaluation of model parameters - Interfacial area - Bubble breakup, distributions, coalescence and dynamics

TEXT BOOKS

1. Smith, J.M., Chemical Engineering Kinetics, Mc Graw - Hill, 3rd Edition, 1999

2. Houston, P.L., Chemical Kinetics and Reaction Dynamics, Dover Publications, 2006

REFERENCES

1. Thomas, C.C., Catalytic Processes with Proven Catalysts, Academic Press, California, 1998

2. Bond, G., Heterogeneous Catalysis, Principles and application, Oxford University Press, 2nd Edition,1986

3. Laidler, K.J., Chemical Kinetics, Prentice Hall, New Jersey 3rd Edition ,1997

CHE409	MULTICOMPONENT MASS TRANSFER	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, students would be able to

CO1: Apply multi-component Distillation

CO2: Analyze azeotropic distillation

CO3: Design liquid-liquid extraction systems

CO4: Apply interphase mass transfer

CO5: Analyze multi-component gas absorption models

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H											
CO2		H										
CO3			H									
CO4			M								M	
CO5				H								M

MULTICOMPONENT DISTILLATION

Multicomponent distillation - Determination of key components at minimum reflux ratio by the method of Shiras, minimum reflux ratio by Underwood's method, Fenske equation for total reflux and computation of product distribution - Flash vaporization of feed to the distillation column - Rigorous methods of Lewis, Matheson, Thiele, Geddes, bubble point, sum rates method, Naphthali, Sandholm method

AZEOTROPIC DISTILLATION

Azeotropic distillation - Stage wise calculations for multicomponent with multiple feed streams, graphical method for location of feed plates for multiple feeds

LIQUID - LIQUID EXTRACTION

Liquid liquid extraction - Stage wise calculations for multicomponent with multiple feed streams using reflux and mixed solvents - Liquid liquid extraction with chemical reaction

INTERPHASE MASS TRANSFER

Interphase mass transfer for multicomponent fluids in laminar and turbulent flows Interfacial turbulence and Marangoni effects

MULTICOMPONENT GAS ABSORPTION

Multicomponent gas absorption - Horton Franklin method, Edmister method - Mass transfer in gas absorption with and without chemical reaction - Model solutions by Dankwerts - Brian, Perry and Pig ford

TEXT BOOKS

1. Seader, J. D., Separation Process Principles, John Wiley and Sons, Singapore, 2nd Edition, 2005
2. Ross Taylor., Multicomponent Mass Transfer, Wiley Series in Chemical Engineering, Singapore, 1993
3. Wesseling, J.A, Krishna, R., Mass Transfer in Multicomponent Mixtures, VSSD Paperback, 2006

REFEREN CES

1. Ruthven, Douglas M., Principles of Adsorption and Adsorption Processes, Wiley, Singapore, 1984

2. Grandison., Separation Processes Principles and Applications, Ellis Harwoo Ltd,Netherland, 1996

CHE410	FINITE ELEMENT METHODS	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, the students would be able to

CO1: Identify mathematical model for solution of common engineering problems.

CO2: Formulate simple problems into finite elements

CO3: Obtain an understanding of the fundamental theory of the FEA method

CO4: Solve structural, thermal, fluid flow problems

CO5: Use professional-level finite element software to solve engineering problems in Solid mechanics, fluid mechanics and heat transfer

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M											
CO2			H									
CO3		M										
CO4			H									M
CO5						M						

STRUCTURAL ANALYSIS

Review of various approximate methods in structural analysis - Stiffness and flexibility matrices for simple cases - Basic concepts of finite element method - Formulation of governing equations and convergence criteria

BAR AND BEAM ELEMENTS IN STRUCTURAL ANALYSIS

Use of bar and beam elements in structural analysis - Computer implementation of procedure for these element

2-D ELEMENTS

Different forms of 2-D elements and their applications for plane stress, plane strain and axisymmetric problems

- Consistent and lumped formulation - Use of local coordinates - Numerical integration

3-D ELEMENTS

Definition and use of different forms of 2 D and 3 D element - Computer implementation of formulation of these elements for the analysis of chemical process equipments

SIMULTANEOUS EQUATIONS

Different methods of solution of simultaneous equations governing static, dynamics and stability problems - General purpose Software packages

TEXT BOOKS

1. Cook, Robert D., Concepts and Applications of Finite Element Analysis, Wiley, Singapore, 4th Edition, 2001
2. Zienkiewicz, O.C., The Finite Element Method Its Basis and Fundamentals, Butterworth- Heinemann, London, 6th Edition, 2005

REFERENCES

1. Segerlind, L.J., Applied Finite Element Analysis, John Wiley and Sons, New York, 2nd Edition,
1984
2. Bathe, K.J, Wilson, E.L., Numerical Methods in Finite Elements Analysis, Prentice Hall of India Ltd, New Jersey, 1983
3. Krishnamurthy, C.S., Finite Elements Analysis, Tata McGraw Hill, New Delhi, 1987

CHE 411	PROCESS MODELING AND SIMULATION	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, the students would be able to

CO1: Detail the importance of ODE and PDE

CO2: Develop model equations for the given system

CO3: Solve structural, thermal, fluid flow problems

CO4: Demonstrate the model solving ability for various processes/unit operations

CO5: Demonstrate the ability to use a process simulation

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M		H								
CO2				H								
CO3			M									
CO4	M			H								
CO5							M					

INTRODUCTION TO MODELING

Introduction to modeling - Uses of mathematical models, scope of coverage, principles of formation, review on algebraic, ordinary and partial differential equations, solutions of the above equations, linearization, probabilization models, development of models by experiment and statics - Regression and correlation analysis

ELEMENTARY MATRIX CONCEPTS

Elementary matrix concepts - Simple array models, multicomponent distillation, dynamic simulation of
distillation column, solution techniques for matrix differential equations, matrix formation of distributed parameter system, flow pattern in stirred tanks, design of mixers

INTRODUCTION TO LUMPED PARAMETER SYSTEM

Introduction to lumped parameter system, mathematical description of multiphase transfer process - Non isothermal reactors etc. - Axial dispersion in packed beds - Reactor design from response curves - Reactor effectiveness factor - Computer aided modeling of reaction networks

ONE DIMENSIONAL UNSTEADY STATE PROBLEM IN HEAT TRANSFER

Formation and solution of one dimensional unsteady state problem in heat transfer and mass transfer systems - Multidimensional problems - Application in heat and mass transfer equipments

INTRODUCTION OF DYNAMIC SIMULATION

Dynamic Simulation - Introduction, application, analytical and numerical techniques for multivariable problems, techniques for constrained optimization - Simulation - Introduction discrete event and continuous simulation, dynamic simulation of reactors, distillation columns, absorbers, evaporators and crystallizers - Simulation in process control

TEXT BOOKS

1. Ramirez, W., Computational Methods in Process Simulation, Butterworth Publishers, London, 1989

2. Rice, Applied Mathematics for Chemical Engineer, John Wiley and Sons, New York, 1994

3. Edgar, T.F, Himmelblau, D.M., Optimization of Chemical Processes, McGraw Hill, Singapore,
19
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REFEREN CES

1. Myers, A.L, Seider, W.D., Introduction to Chemical Engineering and Computer Calculations, Prentice Hall, Englewood Cliffs, New Jersey,
1976

2. Chemical Engineering Refresher Series on "Process Dynamics", McGraw Hill, Singapore, 1983

CHE412	ENZYME ENGINEERING AND TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Characterize the enzymes and relate it with the production of pharmaceuticals in industrial scale

CO2: Identify enzyme inhibition patterns and determine kinetics of single substrate enzyme catalyzed reactions

CO3: Characterize enzymes and design enzyme assays

CO4: Describe immobilization techniques and their principles, advantages and disadvantages

CO5: Suggest a preliminary design for biosensors

CO/P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M		M								
CO2	H	M		M								
CO3	H	M	H	M	M							
CO4	H				M							
CO5	H		H		H						M	

INTRODUCTION TO BIOCHEMISTRY

Introduction to biochemistry - Function and applications, nature and function of enzyme. coenzyme/ cofactor -

Classification of enzymes - Assay methods and units - Applications of enzymes in industry, analytical techniques, medicine and pharmaceuticals

KINETICS AND MECHANISM OF ENZYME CATALYSIS

Kinetics and mechanism of enzyme catalysis, Enzyme catalysis and controlling factors - Kinetics of enzyme catalyzed reactions in solution - Immobilized enzyme reaction kinetics - Effect of mass transfer resistance

ENZYME PRODUCTION ON LARGE SCALE TECHNOLOGY

Enzyme production on large scale technology, isolation and purification of enzyme, protein, protein fractionalization methods

IMMOBILIZATION TECHNOLOGY AND DEVELOPMENT

Immobilization technology and development, immobilization technique for enzymes - Characteristics and uses for immobilized enzyme systems

INDUSTRIAL BIOREACTORS UTILIZING ISOLATED ENZYMES

Industrial bioreactors utilizing isolated enzymes and biosensors development and applications - Reactor design and analysis for immobilized enzyme reactors - Applications in biosensors - Some modern developments for enzyme in organic synthesis

TEXT BOOKS

1. Bailey, J. E, Ollis, D.F., Biochemical Engineering Fundamentals, McGraw Hill Publishing Company, New York, 2nd Edition, 1986
2. Wiseman, Hand book of Enzyme Biotechnology, Ellis - Hardwood, Netherlands, 1983

REFERENCES

1. Enzyme Handbook Volume 12 Class 2.3.2, 2.6 Transferases, Springer Loose Leaf, London, 1st Edition, 1996
2. Pye, E.K, Wingard, L.B, Enzyme Engineering II, Plenum Press, 1974

CHE414	PHARMACEUTICAL ENGINEERING	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, students would be able to

CO 1: Apply the principles of pharmacokinetics and pharmacodynamics

CO 2: Analyze the mechanisms of chemical conversion processes

CO 3: Apply the manufacturing processes of various pharmaceutical products

CO 4: Describe various antipyretic and anti inflammatory agents

CO 5: Apply analytical techniques of pharmaceutical products and their quality control

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H		M									
CO2			H									
CO3			H					M				
CO4				H								
CO5					H							

DEVELOPMENT OF DRUGS AND PHARMACEUTICAL INDUSTRY

Development of drugs and pharmaceutical industry - Organic therapeutic agents uses and Economics - Drug Metabolism and Pharmaco Kinetics - Drug Metabolism Physio Chemical principles -

Radioactivity, Pharma kinetic reaction of Drugs on Human bodies

CHEMICAL CONVERSION PROCESSES

Chemical conversion processes - Alkylation, carboxylation, condensation and cyclisation, dehydration, esterification, halogenation, oxidation, sulfonation, complex chemical conversions, fermentation

GRANULATION

Compressed Tablets - Wet granulation - Dry granulation or slugging - Direct compression Tablet Presses Formulation, Coating Pills, Capsules, Sustained dosage Forms, Parental Solution - Oral liquids - Injections External preparations - Ointments - Standard of Hygiene and Good Manufacturing practice as per Drugs and Cosmetics Act as amended update

ANTIPYRETIC AND ANTI INFLAMMATORY

Based on Antipyretic and anti inflammatory, respiratory, cardio intestinal and liver, hormones, C.N.S Stimulants, histamine and anti histamine, vitamins and other nutrients, sedatives, analgesics

ANTIBIOTICS

Antibiotics - Anti infective, biological, hormones, vitamins and preservation, pharmaceutical analysis,
analytical methods and tests for various drugs and pharmaceuticals, packing techniques, quality control

TEXT BOOKS

1. Rawlins E.A., Bentleys Text Book of Pharmaceutics, A.I.T.B.S. Publisher and Distributors, Delhi, 1996
2. Remingtons, Alfonso R.Gennaro., The Science Practice of Pharmacy, Mack Publishing Company of
Eastern, Pennsylvania, 1997

REFERENCES

1. Berry, I.R.A.R, Robert A. Nash., Pharmaceutical process validation, 2003
2. Hickey, A.J, David Handerton., Pharmaceutical Process Engineering, 2001
3. Turner, S.G., Pharmaceutical Engineering Change Control,2nd Edition , 2000

CHE415	BIOREACTOR DESIGN AND ANALYSIS	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, students would be able to

CO1: Describe the heat and mass transfer effect in the microbial processes

CO2: Design equations to determine the performance of ideal reactors

CO3: Create various models for describing non- ideal behavior of reactors with its process control

CO4: Perform modeling and simulation for various microbial processes

CO5: Describe the Scale up criteria of bioreactors

CO/P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H							M				
CO2				H							M	
CO3				H							M	
CO4				H							M	
CO5	H							M				

INTRODUCTION

Thermodynamic and Stoichiometric aspects of microbial processes - Interaction of heat and mass transfer in the microbial processes - Engineering analysis of metabolic pathways

ANALYSIS OF OTHER CONFIGURATIONS

Definition of bioreactor - Basic principles of bioreactor, Classification of bioreactors and their configurations - Analysis of batch, continuous, fed batch and semi, continuous bioreactors - Immobilized enzyme/cell reactors

CONTROL AND MONITORING

Non ideal effects - Sensors for monitoring bioprocess parameters - Bioprocess control and computer coupled bioreactors, mechanical design of bioreactors and its components

MODELING AND SIMULATION

Optimization of fermentation media - Kinetic modeling of enzyme/ microbial processes - Mass transfer in biochemical processes - Bioreactor modelling and stability analysis - Dynamic simulation of batch, fed batch, steady and transient culture metabolism

BIOREACTOR SCALE - UP

Regime analysis of bioreactor processes - Oxygen mass transfer in bioreactors - Microbial oxygen demands - Methods for the determination of mass transfer coefficients - Mass transfer correlations - Scale up criteria for bioreactors based on oxygen transfer - Power consumption and impeller tip speed

TEXT BOOKS

1. Joaquim, M.S, Cabral , Manuel Mota , Johannes Tramper, Multiphase Bioreactor Design, Harwood

Academic Publishers,California,1ST Edition ,2001

2. Johannes Tramper, Klaas van't Riet., Basic Bioreactor design, 1991

REFERENCE

1. Asenjo, A, José C. Merchuk., Bioreactor System Design, Marcel Dekker, New Delhi, 1995

CHE416	PROCESS ENGINEERING ECONOMICS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, students would be able to

CO1: Develop knowledge on investment

CO2: Integrate knowledge about financial statements, Depreciation Accounting and other areas

CO3: Integrate knowledge about the capital cost of equipment

CO4: Create entrepreneurs with Business ethics

CO5: Evaluate the new techniques and its effects

CO/P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							H					
CO2							H					
CO3			H				M					
CO4								H		H	M	
CO5	H				M							

INTEREST AND PLANT COST

Time value of money - equivalence, Depreciation, Depletion, estimation of capital cost, Capital requirement for complete plant, cost indices, capital recovery.

PROJECT PROFITABILITY AND FINANCIAL RATIOS

Estimation of project profitability, Investment alternatives, income statement and financial ratios, balance sheet preparation- problems.

ECONOMIC BALANCE IN EQUIPMENTS

Essentials of economic balance, economic balance in batch operations, cyclic operations, economic balance for insulation, evaporation, heat transfer equipments.

PRINCIPLES OF MANAGEMENT

Principles of management, planning, organizing, staffing, coordinating, directing, controlling and communicating. Types of organizations, Management information systems (MIS).

PRODUCTION PLANNING CONTROL

Work measurement techniques, motion study, principles of time study, elements of production control, forecasting, planning, routing, scheduling, dispatching, inventory and control, role of control charts in production and quality control.

TEXT BOOKS

1. Max Peters, Klaus Timmerhaus, Ronald West, plant design and economics for chemical Engineers, Fifth Edition, McGraw Hill (ISE), 2004.
2. Ahuja K.K, Industrial management, Khanna publishers, New Delhi, 1985.
3. H.E. Schwyer, Process Engineering Economics, McGraw Hill Book, New York, 1970

REFERNCE BOOKS

1. FC Jelen, JH Black, Cost and Optimization Engineering, Second Edition, McGraw-Hill., New York, 1983.
2. Robin Smith, Chemical Process Design, McGraw Hill Book co., New York, 1995.

CHE417	PROCESS INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, students would be able to

CO1: Analyse the response of instruments.

CO2: Ability to integrate knowledge about the instrument used for temperature.

CO3: Capability to assimilate facts about the instrument used for pressure.

CO4: Analyse the different flow of fluids based on its concentration.

CO5: Evaluate the supporting process and its effects.

CO/P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				M								
CO2				M	H							
CO3				M	H							
CO4	H											
CO5		M										

PRINCIPES OF MEASUREMENT

Analysis : Measurement of Force, Strain and Torque- Use of strain gauges. Transducers - Resistive, capacitive, Inductive and piezoelectric pickups. Static and Dynamic response of Instruments. Errors in measurements.

TEMPERATURE MEASUREMENT

Liquid filled, Gas filled and Vapour pressure Thermometers. Bimetallic and Resistance thermometers. Thermocouples and Thermistors. Optical and Radiation pyrometers.

PRESSURE MEASUREMENT

Manometers, Bourdon gauge and Bellows gauge. Measurement of pressure and Vacuum. Use of Transducers.

FLOW, DENSITY AND LEVEL MEASUREMENTS

Variable head flow meters. Area flow meters. Positive displacement meters. Pressure Probes. Level measurements - Direct and Inertial types. Measurement of density and specific gravity. Instruments for weighing and feeding.

MISCELLANEOUS MEASUREMENTS

Analysis of gas mixtures. Thermal conductivity, Viscosity and Electrical conductivity. Supporting instrumentation - Standard cells, Balancing circuits and Terminating devices. Principles of Telemetering. P and I diagrams.

TEXT BOOKS

1. Eckman, D.P, Industrial Instrumentation, Wiley Eastern, New Delhi, 2006.

2. Jain, R.K, Mechanical and Industrial Measurements, Ninth Edition Khanna Publishers, New Delhi 2011.

REFERENCE BOOKS

1. Perry, R.H., Green, D.W., Perry's Chemical Engineer's Handbook, Eighth Edition, McGraw Hill (ISE), 2007.

2. Considine, D.N., Process Instruments and Controls Handbook, Third Edition, McGraw Hill. New York, 1997.

3. Benedict, R.P, Fundamentals of temperature, Pressure and Flow measurements, Third Edition, John Wiley, New York. 1984.

4. Notlingk. B.E., Jones' Instrument Technology, Vol. I and II, Fourth Edition, ELBS,

1987. Patranabis. D., Principles of Instrumentation, Second Edition, Tata-McGraw Hill,

New Delhi, 2007.

MINOR ELECTIVES

CIV 320	AIR POLLUTION AND CONTROL	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, students would be able to

CO1: Develop of major problems in indoor air pollution and control, regulations

CO2: Be familiar with regulations pertinent to air pollutions

CO3: Describe general air pollution problems, meteorological definitions, air transport equations and pollution control matters and devices

CO4: Present the results as a report in the record notebook

CO5: Develop the ability to learn from the mistakes ethically and increase the quality of design

CO/P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			H									
CO2					M					H		
CO3							H					
CO4			M							H		
CO5								H				

INTRODUCTION

Air resource management system - Air quality management - Scales of air pollution problem - Sources and classification of pollutants and their effect on human health vegetation and property - Global implications of air pollution - Meteorology Fundamentals - Atmospheric stability - Atmospheric turbulence - mechanical and thermal turbulence - Wind profiles - Plume rise - Ambient air quality and emission standards - Air pollution indices - Indoor Air Pollutants - Models - Air Quality Sampling and Monitoring

CONTROL OF PARTICULATE CONTAMINANTS

Settling chambers - Filters, gravitational, Centrifugal - Multiple type cyclones, prediction of collection efficiency, pressure drop, wet collectors, Electrostatic Precipitation theory - ESP design - Operational Considerations - Process Control and Monitoring - Automobile air pollution and control

CONTROL OF GASEOUS CONTAMINANTS

Absorption - Principles - Description of equipment - Packed and plate columns - Design and performance equations - Adsorption - principal adsorbents - Equipment descriptions - Design and performance equations - Condensation - Incineration - Equipment description - Biological Air Pollution Control Technologies - Bio-Scrubbers, Biofilters - Operational Considerations - Process Control and Monitoring

NOISE

Noise Standards - Measurement - Modeling - Control and preventive measures

TEXT BOOK

1. Noel de Nevers, Air Pollution Control Engg., McGraw-Hill, New York, 2000

REFERENCES

1. Lawrence Kwan, Norman C Pereira, Yung-Tse Hung, Air Pollution Control Engineering, Tokyo, 2004
2. David H.F Liu, Bela G.Liptak, Air Pollution, Lewis Publishers,2000
3. Singal, S.P., Noise Pollution and Control Strategy, Narosa Publishing House, New Delhi, 2005

CIV 322	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, students would be able to

CO1: Develop of major problems in Environmental impact and control, regulations

CO2: Familiar with regulations pertinent to environmental problems

CO3:Describe general environmental impact problems, meteorological definitions,

CO4: Present the results as a report in the record notebook

CO5: Learn from the mistakes ethically and increase the quality of design

CO/P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			H									
CO2					M					H		
CO3							H					
CO4			M							H		
CO5								H				

INTRODUCTION

Impact of development projects under Civil Engineering on environment - Environmental Impact Assessment (EIA) - Environmental Impact Statement (EIS) – EIA capability and limitations– Legal provisions on EIA.

METHODOLOGIES

Methods of EIA –Check lists – Matrices – Networks – Cost-benefit analysis – Analysis of alternatives – Case studies.

PREDICTION AND ASSESSMENT

Assessment of Impact on land, water and air, noise, social, cultural flora and fauna, Mathematical models, public participation - Rapid EIA.

ENVIRONMENTAL MANAGEMENT PLAN

Plan for mitigation of adverse impact on environment - options for mitigation of impact on water, air and land, flora and fauna, addressing the issues related to the Project Affected People – ISO 14000

CASE STUDIES

EIA for infrastructure projects - Bridges - Stadium - Highways - Dams - Multi-storey Buildings - Water Supply and Drainage Projects

TEXT BOOKS

1. Canter,L., Environmental Impact Assessment, McGraw-Hill Inc., New Delhi, 1996.
2. Shukla, S.K. and Srivastava, P.R., Concepts in Environmental Impact Analysis, Common Wealth Publishers, New Delhi, 1992.

REFERENCES

1. John G. Rau and David C Hooten (Ed)., Environmental Impact Analysis Handbook, McGraw-Hill Book Company, New York,1990.
2. Environmental Assessment Source book, Vol. I, II and III. The World Bank, Washington, D.C., 1991.
3. Judith Petts, Handbook of Environmental Impact AssessmentVol. I and II, Blackwell Science, 1999.

CIV 463	SOLID WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, students would be able to

CO1: Explain municipal solid waste management systems with respect to its physical properties, and associated critical considerations in view of emerging technologies

CO2: Outline sources, types and composition of solid waste with methods of handling, sampling and storage of solid waste.

CO3: Select the appropriate method for solid waste collection, transportation, redistribution and disposal

CO4**:** Describe methods of disposal of hazardous solid waste

CO/P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					H		M					
CO2				H		M						
CO3			H				M					
CO4					H			H				

SOURCES AND TYPES OF MUNICIPAL SOLID WASTES

Sources and types of solid wastes - Quantity - Factors affecting generation of solid wastes; characteristics - methods of sampling and characterization; Effects of improper disposal of solid wastes - public health effects. Principle of solid waste management - social and economic aspects; Public awareness; Role of NGOs; Legislation

ON-SITE STORAGE AND PROCESSING

On-site storage methods - Materials used for containers - on-site segregation of solid wastes - public health and economic aspects of storage - options under Indian conditions - Critical Evaluation of Options

COLLECTION AND TRANSFER

Methods of Collection - types of vehicles - Manpower requirement - collection routes; transfer stations - selection of location, operation and maintenance; options under Indian conditions

OFF-SITE PROCESSING

Processing techniques and Equipment; Resource recovery from solid wastes - composting, incineration, Pyrolysis - options under Indian conditions

DISPOSAL

Dumping of solid waste; sanitary land fills - site selection, design and operation of sanitary landfills - Leachate collection and treatment

TEXT BOOKS

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil Integrated SolidWaste Management, McGraw-Hill Publishers, 1993
2. B.Bilitewski, G.HardHe, K.Marek, A.Weissbach, and H.Boeddicker, “Waste Management”, Springer, 1994

REFERENCES

1. Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2000
2. R.E.Landreth and P.A.Rebers, Municipal Solid Wastes - problems and Solutions, Lewis Publishers, 1997
3. Bhide A.D. and Sundaresan, B.B., Solid Waste Management in Developing Countries, INSDOC, 1993

CIV 464	INDUSTRIAL WASTE WATER MANAGEMENT	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Describe the nature and composition of industrial pollutants, their origin and their impact on the environment

CO2: Explain the principles of various processes available for wastewater treatment

CO3: Choose methods for waste minimization and water conservation

CO4: List the problems associated with the operation of industrial wastewater treatment facilities and provide an explanation of the causes and possible solutions

CO5: Determine the toxicity levels of industrial effluents

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H		M					M				
CO2	H							M			M	
CO3			H								M	
CO4	H							M				
CO5			M	H								

INTRODUCTION

Industrial scenario in India- Industrial activity and Environment - Uses of Water by industry - Sources and types of industrial wastewater - Industrial wastewater and environmental impacts - Regulatory requirements for treatment of industrial wastewater - Industrial waste survey - Industrial wastewater generation rates, characterization and variables - Population equivalent - Toxicity of industrial effluents and Bioassay tests

INDUSTRIAL POLLUTION PREVENTION

Prevention Vs Control of Industrial Pollution - Benefits and Barriers - Source reduction techniques - Waste Audit - Evaluation of Pollution prevention options - Environmental statement as a tool for pollution prevention - Waste minimization Circles

INDUSTRIAL WASTEWATER TREATMENT

Equalisation - Neutralisation - Oil separation - Flotation - Precipitation - Heavy metal Removal - Refractory organics separation by adsorption - Aerobic and anaerobic biological treatment - Sequencing batch reactors - High Rate reactors - Chemical oxidation - Ozonation - Photocatalysis - Wet Air Oxidation - Evaporation - Ion Exchange - Membrane Technologies - Nutrient removal

WASTEWATER REUSE AND RESIDUAL MANAGEMENT

Individual and Common Effluent Treatment Plants - Joint treatment of industrial wastewater - Zero

effluent discharge systems - Quality requirements for Wastewater reuse - Industrial reuse - Disposal on water and land - Residuals of industrial wastewater treatment - Quantification and characteristics of Sludge - Thickening, digestion, conditioning, dewatering and disposal of sludge - Management of RO rejects

CASE STUDIES

Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles - Tanneries - Pulp and paper - metal finishing - Petroleum Refining - Pharmaceuticals - Sugar and Distilleries - Food Processing - fertilizers - Thermal Power Plants and Industrial Estates

REFERENCES

1. Eckenfelder, W.W., Industrial Water Pollution Control, McGraw-Hill, 1999
2. Arceival a, S.J., Wastewater Treatment for Pollution Control, Tata McGraw-Hill, 1998
3. Frank Woodard, Industrial waste treatment Handbook, Butterworth Heinemann, New Delhi, 2001
4. World Bank Group Pollution Prevention and Abatement Handbook - Towards Cleaner Production, World Bank and UNEP, Washington D.C.1998
5. Paul L. Bishop Pollution Prevention: - Fundamentals and Practice, McGraw-Hill International, 2000

CSE 255	DATA STRUCTURES	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Explain different data structures and its applications

CO2: Develop ability to analyze algorithms, to determine algorithm correctness and time efficiency

CO3: Design data structures for complex computing problems.

CO4: Identify, model, solve and develop code for real life problems like shortest path, network flow, and minimum spanning using graphs

CO5: Evaluate the performance of computing solutions in terms of time and space

CO/P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H											
CO2					H							
CO3			H									
CO4		H					M					
CO5					H		M					

PROBLEM SOLVING

Problem solving - Top-down Design - Implementation - Verification - Efficiency - Analysis - Sample algorithms.

LISTS, STACKS AND QUEUES

Abstract Data Type (ADT) - The List ADT - The Stack ADT – The Queue ADT

TREES

Preliminaries - Binary Trees - The Search Tree ADT - Binary Search Trees - AVL Trees - Tree Traversals - Hashing - General Idea - Hash Function - Separate Chaining - Open Addressing - Linear Probing - Priority Queues (Heaps) - Model - Simple implementations - Binary Heap

SORTING

Preliminaries - Insertion Sort - Shellsort - Heapsort - Mergesort - Quicksort - External Sorting

GRAPHS

Definitions - Topological Sort - Shortest-Path Algorithms - Unweighted Shortest Paths - Dijkstra's Algorithm - Minimum Spanning Tree - Prim's Algorithm - Applications of Depth- First Search - Undirected Graphs - Biconnectivity - Introduction to NP-Completeness

TEXT BOOKS

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, Introduction to Algorithms, 2nd Edition, Prentice Hall India,2002
2. Aho, J. E. Hopcroft and J. D. Ullman, "Data Structures and Algorithms",Pearson Education Asia, 1983

REFERENCES:

1. Aaron M. Tenenbaum, Yeedidyah Langsam, Moshe J. Augenstein, 'Data structures using C', Pearson Education, 2004/ PHI
2. M. A. Weiss: Data Structure and Algorithm Analysis in C, Addison Wesley, 1997
3. E. Horowitz, S. Shani: Fundamentals of Data Structures, Pittman, 1977
4. D.E. Knuth: The Art of Computer Programming, Vols. 1 to 3, Addison-Wesley, Massachusetts, 1973
5. R.L. Kruse: Data Structures and Program Design, Prentice-Hall, Englewood Cliffs, 1984
6. J.P. Tremblay, P.G. Sorenson: An Introduction to Data Structures with Applications, Second Edition, McGraw-Hill,1984
7. G. Brassard and P. Bratley: Fundamentals of Algorithms, Prentice Hall, 1996

ECE304	MICROPROCESSOR AND MICROCONTROLLER	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Describe the architecture, role of CPU, registers of intel microprocessors

CO2: Write a assembly language programs by using the knowledge on instruction set and programming of 8085 and 8086 processors

CO3: Interface a peripheral with 8085/8086 processor

CO4: Select a microcontroller required an application by using knowledge gained on architecture of microcontrollers

CO5: Develop a microcontroller based system by acquiring knowledge on programming a microcontroller

CO/P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H						H					H
CO2			M	M	M							M
CO3					M							
CO4	H											
CO5			H		H							

8085 ROCESSOR

Microprocessors Introduction: Computer and its organisation, Programming system, Address Bus, Data Bus and Control Bus, Tristate Bus, Clock generation, Connecting Microprocessor to I/O Devices, Data transfer schemes, Architectural Advancements, Evolution – 8085: Hardware Architecture, Instruction set and Programming

8086 ROCESSOR

8086: Hardware Architecture, Instruction set and Programming – Introduction to Architecture of: Intel's P5, Netburst, Core, Nehalem, Skylake, Bonnell, Goldmont and AMD's Bulldozer, Jaguar **PROCESSOR - PERIPHERAL INTERFACING**

8085 and 8086 Peripheral Interfacing

MICROCONTROLLERS

Introduction to Computing: Numbering and coding systems review, Digital primer, Semiconductor memory, Computer architecture – Embedded systems - Introduction to architecture of: Intel 8051, PIC 32, Cold fire 32bit, ARM Cortex A processor- Introduction to Arduino - AVR

Microcontroller History and Features – AVR Architecture and Assembly Language Programming, Programming in C – I/O Port Programming – Instructions – Addressing Modes – Bit addressability

– AVR Fuse bits – Timer, Counter programming – AVR Interrupts – SPI Bus protocol – SPI Programming in AVR

MICROCONTROLLER INTERFACING

ATMEGA32 connection to RS232 – LCD Interfacing – Keyboard Interfacing – ATMEGA32

ADC features – Interfacing temperature sensor to AVR – DAC Interfacing – AVR connection to relay – AVR connection to solid state relay – DC motor interfacing – DC motor control using PWM – Seven Segment Decoder interfacing

TEXT BOOKS

1. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, AVR Microcontroller and Embedded Systems: Using Assembly and C, Pearson India, 2014
2. Krishna Kant, Microprocessors and Microcontrollers, PHI, 1st Edition, 2011
3. ATmega48A/PA/88A/PA/168A/PA/328/P Complete Datasheet, ATMEL,2012

REFERENCES

1. Douglas Hall, S S S P Rao, Microprocessors and its Interfacing, TMH, 3rd Edition, 2012
2. Rafiquzzaman M, Microprocessors: Theory and Applications, PHI, 2008
3. N. Senthil Kumar, M. Saravanan, S. Jeevananthan and S. K. Shah, Microprocessors and Interfacing, Oxford Press India, 1st Edition, 2012
4. Dhananjay Gadre, Programming and Customizing the AVR Microcontroller, TMH, 1st Edition, 2009
5. Richard H. Barnett, Larry D. O'Cull, Sarah Alison Cox, Embedded C Programming and the ATMEL AVR, Cengage International, 2010

6. Dale Wheat, Arduino Internals, e-book (Google Books, Amazon.com), 2011

EEE 259	ELECTRICAL DRIVES AND CONTROLS	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Explain the basic concept of electrical drives, its types and classes of motor duty

CO2: Describe the basic concepts of different types of electrical machines and their performance

CO3: Expose different methods of starting D.C motors and induction motors

CO4: Apply Knowledge in the operation of the converter / chopper fed DC drives and its control

CO5: Apply Knowledge in the conventional and solid-state speed control of AC drives

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1	PO1	PO1
CO1				M						M		M
CO2							M			M		M
CO3				H			M			H		M
CO4												M
CO5												M

INTRODUCTION

Basic Elements - Types of Electric Drives - Factors influencing the choice of electrical drives - Heating and cooling curves - Loading conditions and classes of duty - Selection of power rating for drive motors with regard to thermal overloading and Load variation factors

DRIVE MOTOR CHARACTERISTICS

Mechanical characteristics - Speed-Torque characteristics of various types of load and drive motors

- Braking of Electrical motors - DC motors: Shunt, series and compound - Single phase and three phase induction motors

STARTING METHODS

Types of D.C Motor starters - Typical control circuits for shunt and series motors - Three phase squirrel cage and slip ring induction motors

CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES

Speed control of DC series and shunt motors - Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers - Applications

CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES

Speed control of three phase induction motor - Voltage control, voltage / frequency control, slip

power recovery scheme - Using inverters and AC voltage regulators - Applications

TEXT BOOK

1. Vedam Subrahmaniam, Electric Drives (concepts and applications), Tata McGraw-Hill, 2001.

REFERENCES

1. Nagrath, I.J., and Kothari, D.P., Electrical Machines, Tata McGraw-Hill, 1998.
2. Pillai, S.K., A first course on Electric drives, Wiley Eastern Limited, 1998.
3. Singh, M.D., Khanchandani, K.B., Power Electronics, TataMcGraw-Hill, 1998.
4. Partab, H., Art and Science and Utilisation of electrical energy, Dhanpat Rai and Sons,

EEE409	INDUSTRIAL AUTOMATION	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to
CO1: Detail about the production concept & strategies of automation
CO2: Describe the CIM architecture & FMS
CO3: Analyze the details flow lines & line balancing methods
CO4: Select the mechanical handling systems & injections methods
C05: Manipulate the techniques & apply in industries

CO/P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M				H			H				
CO2								M				
CO3	H				M			M				
CO4	M				H			M				
CO5	H				M			H				

INTRODUCTION

Definition of SCADA - Applicable processes - Elements of SCADA systems - SCADA Architecture - Operation and Control using SCADA - Development from telemetry - Dependence on communications and computers

COMPONENTS OF AUTOMATED SYSTEMS

Sensors, Transducers and Actuators- Forgotten cost - Special considerations - Standardization and Maintenance - Remote Terminal Unit: Communication interface - Protocol detailed - Discrete control - Analog control - Pulse control , Serial control - Monitor discrete and analog signals - Monitor pulse count and serial signals. Master Terminal Unit: Communication interface - Configuring a picture of the process - Data storage - Applications

COMMUNICATIONS

Analog to digital conversion - Communication models and types - Communication standards - Communications system components - Protocol - Modems - Field buses - Synchronous or Asynchronous - Telephone cable or radio

PROGRAMMABLE LOGIC CONTROLLERS

Structure of PLC - Control program - Programming- Simple Relay Layouts and Schematics - PLC Connections - Ladder Logic Inputs - Ladder Logic Outputs - Tutorial problems - Case studies

SUBSTATIONS AND DISTRIBUTION AUTOMATION

Substation Automation- Structure of Subsystem Automation - Substation communications

- Substation functions through SCADA.Distribution Automation: Functions of distribution automation - Distribution Automation for improved Energy Management - Relative rating of

TEXT BOOKS

communication media for DA - Automation in Process industries - SCADA systems in Industries - Requirements of Industrial Automation System - SCADA System in sugar Industries: Purification Systems - Evaporation - Crystallization - Centrifugation and Sugar Handling

TEXT BOOKS

1. Stuart A. Boyer, SCADA: Supervisory Control and Data Acquisition, 3rd Edition,
2. ISA-The instrumentation systems and Automation Society

REFERENCES

1. ISA's Practical Guide Series, Analytical Instrumentation (1996), Maintenance of Instrumentation and systems - 2nd Edition (2005), Fundamentals of Industrial Control - 2nd Edition (2006)

EEE 410	NEURAL NETWORK AND FUZZY LOGIC	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Expose the concepts of biological neuro system and mathematical model of neuro systems.

CO2: Expose the concepts of feed forward neural networks and feedback neural networks.

CO3: Explain the concept of fuzziness involved in various systems and fuzzy set theory.

CO4: Apply neuro-fuzzy model for classification, regression and clustering.

CO5: Apply hybrid algorithms to Identify and describe soft computing techniques and their roles in building intelligent machines in various applications.

CO/P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H										M
CO2	M											
CO3	H											
CO4	M											
CO5	H											

INTRODUCTION TO NEURAL NETWORKS

Overview of biological Neuro-system - Mathematical Models of Neurons -Learning rules - Learning Paradigms - Supervised - Unsupervised and reinforcement learning

FEEDFORWARD AND FEEDBACK NETWORKS

Perceptron networks - Training rules - Multilayer perceptron - Back Propagation Algorithm - Associative Memories- Hopfield Networks - Boltzman machine - Self Organizing Map

FUZZY LOGIC

Overview of Classical Sets - Introduction to Fuzzy Logic - Membership Function - Fuzzy rule generation - Operations on Fuzzy Sets - Compliment - Intersections - Unions - Combinations of Operations- Fuzzy if-then rule-Fuzzy inferencing -Mamdani, TSK- Defuzzification

TEXT BOOKS

NEURO FUZZY SYSTEM

Adaptive Neuro Fuzzy Inference Systems (ANFIS)- architecture-hybrid learning algorithm-Parameter identification-Rule base structure identification - input selection-input space partitioning

- Neuro-Fuzzy control

APPLICATIONS

Applications of neural network - pattern recognition - Fuzzy logic control - Inverted pendulum - Image processing - Home heating system - Biomedical applications - Applications of neurofuzzy system- character recognition-channel equalization-noise cancellation

1. J.S.R.Jang, C.T.Sun, E.Mizutani, Neuro-Fuzzy and Soft Computing, ,Prentice Hall of India Pvt. Ltd,New Delhi, 2005
2. Jacek M. Zurada, Introduction to Artificial Neural Systems, Jaico Publishing home, 2002
3. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Tata McGraw Hill, 1997

REFERENCE BOOKS

1. Laurance Fausett, Englewood cliffs, N.J., Fundamentals of Neural Networks, Pearson Education, 1992
2. H.J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publication Ltd., 1996
3. Simon Haykin, Neural Networks', Pearson Education, 2003
4. John Yen and Reza Langari, Fuzzy Logic - Intelligence Control and Information, Pearson Education, New Delhi, 2003
5. George Klir and Tina A. Folger, Fuzzy sets,Uncertainty and Information, Prentice Hall of India

EIE319	PIPING AND INSTRUMENTATION DIAGRAMS	L	T	P	C
		3	0	0	3

COURSE OUTCOME:

After the successful completion of the course, the students will be able to: CO1: Develop the knowledge of mathematical symbols and software

CO2: Apply fundamental knowledge of mathematics to modelling and analysis of fluid flow, level, pressure, temperature problems

CO3: Conduct experiments in pipe flows and open-channel flows and interpreting data from model studies to interlock the Process Operation

CO4: Develop the knowledge of various pipe line symbols and gates

CO5: Analyse the risk of Operating conditions

TEXT BOOKS

CO/P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		H	M									
CO2	H	M										
CO3			M	H								
CO4					H							
CO5			H		M							

FLOW SHEET DESIGN

Types of flow sheets, flow sheet presentation, flow sheet symbols, line symbols and designation, process flow diagram, synthesis of steady state flow sheet, flow sheeting software

PIPING AND INSTRUMENTATION DIAGRAM EVALUATION AND PREPARATION

P and I D Symbols, line numbering, line schedule, P and I D development, various stages of P and ID-P and ID for pumps, compressors process vessels, absorber, evaporator

CONTROL SYSTEMS AND INTERLOCKS FOR PROCESS OPERATION

Introduction and description, need of interlock, types of interlocks, interlock for pumps, compressor, heater-control system for heater, distillation column, expander

INSTRUMENT LINE DIAGRAM:

Line diagram symbols, logic gates, representation of line diagram

APPLICATION OF P AND ID'S

Applications of P and ID in design state, construction stage, commissioning state, operating stage revamping state, applications of P and ID in HAZAPS and risk analysis

1. Ernest E. Ludwig, Applied Process Design for Chemical and Petrochemical Plants Vol- I, Gulf Publishing Company, Houston,1989
2. Max. S. Peters and K.D. Timmerhaus, Plant Design and Economics for Chemical Engineers, 4th Edition, McGraw Hill Inc., New York, 1991

REFERENCES

1. Anil Kumar, Chemical Process Synthesis and Engineering Design, Tata McGraw Hill, New Delhi, 1982
2. A.N Westerberg et al., Process Flow sheeting, Cambridge University Press, New Delhi, 1979

MEC313	TURBO MACHINERY	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Detail the key concepts and fundamental principles, together with the assumptions made in their development, pertaining to the operation and design of turbo machines

CO2: Explain the interaction of fluid and structure of the turbo machines

CO3: Illustrate the major turbo machinery blade design philosophies

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		H	H	H								M
CO2	H			H								M
CO3			H	H	H							

INTRODUCTION

Stages of turbo machines - Energy transfer between fluid and rotor, stage velocity triangles, thermal turbo machines, classification, general energy equation, modified turbo machines, compression and expansion process.

FAN AND BLOWERS

Fan, blowers - Blade design, velocity triangles, stage parameters, flow analysis in impeller blades, design parameter, volute and diffusers, efficiencies and losses, fan noises, causes and remedial measures.

CENTRIFUGAL FLOW COMPRESSORS

Centrifugal compressors - Definition and classifications, stage parameters, performance characteristics - Cascade of blades, cascade tunnel, blade geometry, cascade variables, energy transfer and loss in terms of lift and drag.

AXIAL FLOW COMPRESSORS

Axial flow compressors - Definition and classifications, constructional details, stage velocity triangles, stage work, stage pressure rise, H-S diagram, stage efficiencies and losses, degree of reaction, radial equilibrium, surging and stalling, performance characteristics.

AXIAL AND RADIAL FLOW TURBINES

Axial and radial flow turbines - Construction details, 90° IFR turbine, stage work, stage velocity triangles, stage pressure rise, impulse and reaction stage, effect of degree of reaction, H-S diagram, efficiencies and losses, performance characteristics.

TEXT BOOK

1. Yahya, S.M., Turbines, Compressors and Fans, Tata McGraw-Hill Publishing Company, 1996.

REFERENCES

1. Dixon S.L, Fluid Mechanics, Thermodynamics of turbo machines, Pergamon press, 2nd Edition, 1990.
2. Kadambi, V., and Manohar Prasad, An Introduction to energy conversion - Vol. III, Turbo machines- Wiley Eastern India Ltd, 1977.
3. Shepherd, D.H., Principles of Turbo-machinery, The Macmillan Company, 1969.

MEC318	REFRIGERATION AND AIR CONDITIONING	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Apply the fundamental principles of heating and cooling and their knowledge of mathematical principles

CO2: Analyze and Identify the Types of refrigerants suitable for the applications

CO3: Understanding the basics of Psychrometric principles and applying the acquired knowledge in providing solution for Cooling of space

CO4: Apply the safety and reliability concepts in the designing of a solution for a cooling situation

CO5: Classify the Air conditioning systems and components and able to suggest a solution for a requirement

CO6: Justify a design project in a formal report and present design calculations in a neat and organized manner

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H										M
CO2		H										
CO3	H		H	M								
CO4			H			H						
CO5				H								
CO6											M	

INTRODUCTION

Review of thermodynamic principles of refrigeration, concept of aircraft refrigeration system, vapour compression refrigeration cycle, use of P-H charts, multistage and multiple evaporator systems, cascade system, COP comparison, vapor absorption refrigeration system, ammonia water and lithium bromide water systems, steam jet refrigeration system.

REFRIGERANTS AND APPLICATIONS

Refrigerants - Properties - Selection of refrigerants, alternate refrigerants, refrigeration plant controls - Testing and charging of refrigeration units - applications to refrigeration systems.

PSYCHROMETRY AND COOLING LOAD CALCULATION

Psychrometric processes - Use of psychrometric charts, grand and room sensible heat factors, bypass factor, requirements of comfort air conditioning, comfort charts, factors governing optimum effective temperature, recommended design conditions and ventilation standards.

LOAD

Types of load - Design of space cooling load, heat transmission through building, Solar radiation , infiltration , internal heat sources (sensible and latent) , outside air and fresh air load , estimation of total load - domestic, commercial and industrial systems - central air conditioning systems.

AIR CONDITIONING EQUIPMENTS

Air conditioning equipments - Air cleaning and air filters, humidifiers, dehumidifiers, air washers, condenser , cooling tower and spray ponds, elementary treatment of duct design, air distribution system, Thermal insulation of air conditioning systems - applications - car, industry, stores, and public buildings

TEXT BOOK

1. Manohar Prasad, Refrigeration and Air Conditioning, Wiley Eastern Ltd., 1983.

REFERENCES

1. Arora, C.P., Refrigeration and Air Conditioning, Tata McGraw- Hill, New Delhi, 1988.
2. Roy.J Dossat, Principles of Refrigeration, Pearson Education, New Delhi, 1997.
3. Jordon and Prister, Refrigeration and Air Conditioning, Prentice Hall of India Pvt Ltd., New Delhi, 1985.
4. Stoecker, N.F., and Jones, Refrigeration and Air Conditioning, TMH, New Delhi, 1981.

MEC326	COMPOSITE MATERIALS SCIENCE	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Recognize & summarize the composites based on the matrix type and application.
CO2: Apply the micromechanics to predict the deformations
CO3: Choose the suitable method of composite manufacturing for specific application.
CO4: Analyze the failure modes of composite materials
CO5: Evaluate and justify the failures of composite structure

CO/P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H										
CO2												
CO3		M		M								
CO4	H	H	H									
CO5		H										

INTRODUCTION TO COMPOSITE MATERIALS

Introduction to material science - conventional materials - limitations of conventional materials - definition of composite materials - types and characteristics - applications.

METAL MATRIX COMPOSITES (MMC) AND POLYMER MATRIX COMPOSITES (PMC)

MMC - Introduction - Processing - Microstructure characterization - Micromechanics and mechanics of deformation - Applications - PMC - Introduction - Types - Fillers - Manufacturing processes - applications.

FABRICATION PROCESSES

Fundamentals - Bag moulding - Compression moulding pultrusion- Filament winding - Other manufacturing process - Quality inspection and non-destructive testing

TESTING OF COMPOSITES

Introduction to micro-mechanics - Unidirectional lamina - Laminates - Inter-laminar stresses - Static mechanical properties - Fatigue properties - Impact properties - Environmental effects - Fracture mechanics and toughening mechanisms, damage prediction, failure modes

FAILURE PREDICTIONS

Failure predictions - Design considerations - Joint design - Codes - Design examples - Optimization of laminated composites - Application of FEM for design and analysis of laminated composites.

TEXT BOOK

1. Ronald Gibson, Principles of Composite Material Mechanics, Tata McGraw Hill, New Delhi, 1994.

REFERENCES

1. Micael hyer, Stress Analysis of Fiber - Reinforced Composite Materials, Tata McGraw Hill, New Delhi, 1998.
2. Mallicak, P.K., Fiber-reinforced composites, Monal Deklar Inc., New York, 1988.
3. Agarwal, B.D., and Broutman, L.J., Analysis and Performance of Fiber Composites, John Wiley and Sons, New York, 1980.

		L	T	P	C
MEC405	**VIBRATION ANALYSIS AND NOISE MONITORING**	**3**	**0**	**0**	**3**

Course Outcomes:

At the end of the course, students would be able to

CO1: Know the causes for vibration discriminate and analyze them according to degrees of freedom

CO2: Finding the source of noise levels in various automotive components

CO3: Explain various noise controlling techniques in engine parts for safe operation of engine

CO4: justify a project in vibration of engine noise and control in a formal report and present n a neat and organized manner

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					M							
CO2	M						M					
CO3		H	H	M	H							
CO4	M	H			M					M		

FUNDAMENTALS OF VIBRATION

Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies

NOISE ANALYSIS

Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis

NOISE CHARACTERISTICS

Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise,

assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise

FORCED VIBRATION

Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

NOISE MONITORING

Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers

TEXT BOOK

1. Singiresu S.Rao, Mechanical Vibrations, Pearson Education, New Delhi, 2004.

REFERENCES

1. Kewal Pujara, Vibrations and Noise for Engineers, Dhanpat Rai and Sons, 1992.
2. Bernard Challen and Rodica Baranescu, Diesel Engine Reference Book, SAE International, Second edition, 1999.
3. Julian Happian and Smith, An Introduction to Modern Vehicle Design, Butterworth - Heinemann, 2004.
4. John Fenton, Handbook of Automotive body Construction and Design Analysis - Professional Engineering Publishing, 1998.

MEC417	WORK STUDY	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Correlate the relationship between productivity, work content and time

CO2: Analyze the operations and ineffective time in shop floor

CO3: Understand the data related to process and time study

CO4: Identify the problems associated with the job and the salary

CO5: Know the basic problems in shop floor related to ergonomics

CO/P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H	H	H	H		M	
CO2							H	H			M	
CO3							H				M	
CO4						H	H		H			
CO5							H	M	H			

INTRODUCTION

History of work study, productivity and living standards, productivity measurement, work design and the organization, work content and time

OPERATIONS STUDY

Total time for a job or operation, total work content and ineffective time, methods and motions, graphic tools

PROCESS AND TIME STUDY

Process analysis, process and activity charts, operation analysis, basic procedure, micro motion study, principles of motion economy. Work measurement - stop watch time study, standard data, methods time measurement (MTM), development of production standards, learning effect, work sampling, rating and allowances, setting standard times for jobs, standard data, and predetermined time standards

JOB EVALUATION

Basic concepts, objective and subjective methods, compensation schemes, relationship of work study to incentive schemes, wage incentive plans

ERGONOMICS

Fundamental concepts, issues in design of systems, human performance in physical work, measuring work by physiological means, work posture, fatigue measurement and evaluation, environmental factors and work systems, industrial product design

TEXT BOOK

1. Introduction to work study, International Labor Organization, Geneva, 4th edition, 1992.

REFERENCES

1. Curri and Faraday, Work Study, ELBS, 4th edition, 1978.
2. Benjamin W.Niebel, Motion and Time Study, Richard, D. Irwin Inc., Seventh Edition, 1982.
3. Barnes, R.M., Motion and Time Study, John Wiley, 1980.

4. Stephen Konz., Work Design, Publishing Horizon Inc., Second Edition, 1979.
5. Bridger, R.S., Introduction to Ergonomics, McGraw-Hill, 1995.

CHE315	THIN FILMS	L	T	P	C
		3	0	0	3

Course outcome

At the end of the course, students would be able to

CO1: Identify, Explain and Handle Different Types of Vacuum Systems

CO2: Identify Different Pressure Gauges and Their

Uses; CO3: Differentiate Microscopes

CO4: Identify Various Sources of Contaminations /Causes Of Faults In Vacuum Systems

CO5: Discuss the Industrial Applications Of Thin Films

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M	M									
CO2				H								
CO3			M									
CO4				H								
CO5							M				M	

KINETIC ASPECTS OF GASES IN A VACUUM CHAMBER

Kinetic aspects of Gases in a vacuum chamber - Classifications of vacuum ranges Production of vacuum - Pressure measurement in vacuum systems - Physical vapour deposition - Evaporation Techniques - Sputtering (RF and DC) - Pulsed Laser deposition - Liquid Phase Epitaxy, Vapour Phase Epitaxy, Molecular Beam Epitaxy

THERMODYNAMICS AND KINETICS OF THIN FILM FORMATION

Thermodynamics and Kinetics of thin film formation - Film growth , five stages - In corporation of defects and impurities in films - Deposition parameters and grain size - structure of thin films - Microbalance technique - Quartz crystal monitor photometric - Ellipsometry and interferometers - Measurement of rate of deposition using ratemeter - cleaning of substrate

X-RAY DIFFRACTION

X-ray Diffraction(XRD) - SEM, Photoluminescence(PL) - Raman Sepectroscopy, UV, Vis, IR Spectrophotometer - AFM - Hall effect - SIMS - X,ray Photoemission Spectroscopy (XPS) - Vibrational Sample Magnetometers - Rutherford Back Scattering (RBS)

DIELECTRIC PROPERTIES

Dielectric properties - Experimental techniques for dielectric film , annealing effect, effect of film thickness on dielectric properties - Determination of optical constants - Experimental techniques for determination of optical parameters , Magnetic and mechanical properties - Hall effect compilations - Adhesion, stress, strength, Raleigh surface waves - Ferromagnetic properties of Thin films - Experimental methods for measurement of mechanical properties of thin films

MICRO AND OPTOELECTRONIC DEVICES

Micro and optoelectronic devices, quantum dots - Data storage- corrosion and wear coatings , Polymer films, MEMS, optical applications , Applications in electronics

- Electric contacts, connections and resistors, capacitors and inductances - Applications of

ferromagnetic and super conducting films - Active electronic elements, micro acoustic elements using surface waves - Integrated circuits - Thin films in optoelectronics and integrated optics

TEXT BOOKS

1. Hiemenz, P.C, Raj Rajagopalan., Principles of Colloids and Surface Chemistry, Marcel Dekker, New York,1997
2. De Keizer, Johannes Lyklema, Hans Lyklema., Fundamentals of Interface and Colloid Science, Elsevier, New Delhi, 1995

REFERENCES

1. Milling, A.J., Surface Characterization Methods Principles, Techniques, and Applications, Marcel Dekker, New York, 1999
2. Freund, L.B , Suresh, S., Thin Film Materials' Stress, Defect Formation and Surface Evolution, Cambridge University Press ,U.S.A, 2007

CHE 316	BIOMEDICAL ENGINEERING	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Apply the understanding of biology and physiology

CO2: Apply advanced mathematics (including differential equations and statistics) to solve the problems at the interface of engineering and biology

CO3: Apply avalanched science and engineering to solve the problems at the interface of engineering and biology

CO4: Make measurements on and interpret data from living systems

CO5: Address the problems associated with the interaction between living and non-living materials and systems.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M									
CO2					H							
CO3				M								
CO4					H							
CO5								M				

CELL AND ITS FUNCTION

Nervous system - Cardio vascular system - Respiratory system - Renal physiology - Basis of bipotentials - Principles of ECG, EEG, EMG

INTRODUCTION TO BIOCHEMICAL MODELS

Introduction to biochemical - Biodynamic models and its application - Cardiac assist devices - Biomechanics of head injury - Amplifier constraints and specification - Recording systems - Electrical grounding and patient safety- Transducers, electrodes for recording biopotentials

DATA ACQUISITION SYSTEM

Introduction of data acquisition - Extraction of signals from noise - Introduction to pattern recognition - Regulation of body temperature - Recognition and control in the CV system - Rheology of blood - Radiation dosimetry - Neutron activation analysis - Safety procedures for radiation diagnostics - Ultra sound effects

POLYMERS AS PROSTHETIC DEVICES

Introduction - Nature and composition of polymers used as prosthetic devices with special reference to heart valves, artificial bones, denatures, autures

RENAL AND RESPIRATORY SYSTEM

Introduction to renal and respiratory system - Lung oxygenator and their design characteristics - Artificial kidney and their design features - Role of computer in medical data logging and diagnosis CAT and NMR scanning - Transplants - Introduction to aviation and space medicine speciallydrugs and their mode of action

TEXT BOOKS

1. Joseph, D., Bronzino., Biomedical engineering fundamentals, CRC Press, New York , 2006
2. Brown, B.B, Smallwood, R.H, Barber, D.C, Lawford, P.V, Hose, D.R., Medical Physics and Biomedical Engineering, Taylor and Francis ,Washington, 1999

REFERENCES

1. Jack Harold Upton Brown., Advances in Biomedical Engineering Vol 5, Academic Press, London, 1979
2. Kennedy, K., Advances in Biomedical Engineering, Academic Press, London, 1970

HUMANITIES ELECTIVES

HSS001	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

Course outcomes

At the end of the course, the students would be able to
CO1: Explain meaning of TQM and frameworks
CO2: Describe the evolution of TQM
CO3: Identify the features of TQM and philosophy
CO4: Derive tools for identity and solving quality problem
CO5: Apply the knowledge of quality management in their field of use

CO/P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H						
CO2												M
CO3						M	M					
CO4									H		M	H
CO5							M					

INTRODUCTION TO QUALITY MANAGEMENT

Definitions - TOM framework, benefits, awareness and obstacles - Quality - vision, mission and policy statements - Customer Focus - customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality

PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT

Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa,
Taguchi, Shingeo and Walter Shewhart - Concepts of Quality circle, Japanese 5S principles and 8D methodology

STATISTICAL PROCESS CONTROL AND PROCESS CAPABILITY

Meaning and significance of statistical process control (SPC) - construction of control charts for variables and attributed - Process capability - meaning, significance and measurement - Six sigma concepts of process capability - Reliability concepts - definitions, reliability in series and parallel, product life characteristics curve - Business process re-engineering (BPR) - principles, applications, reengineering process, benefits and limitations

TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT

Quality functions development (QFD) - Benefits, Voice of customer, information organization,
House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) - requirements of reliability, failure rate, FMEA stages, design, process and documentation

TAGUCHI TECHNIQUES

Taguchi techniques - introduction, loss function, parameter and tolerance design, signal to noise ratio - Seven old (statistical) tools - Seven new management tools - Bench marking and POKA YOKE

REFERENCES

1. Dale H.Besterfield et al, Total Quality Management, Perarson
2. Education, Thrid edition, (First Indian Reprints 2004)
3. Shridhara Bhat K, Total Quality Management - Text and Cases, Himalaya Publishing

House, First Edition, 2002

4. William J.Kolarii, Creating quality, Mcgraw Hill, 1995
5. Poornima M.Charantimath., Total quality management, Pearson Education, First Indian Reprint, 2003

HSS002	ENGINEERING MANAGEMENT	L	T	P	C
		3	0	0	3

Course Outcomes

At the end of the course, the students would be able to

CO1: At the end of the course, the students will be able to Explain the Management Techniques in Product Development

CO2: Describe cognitive and affective growth related to ethics and leadership skills and emotional intelligence.

CO3: Assess team, team member and project performance.

CO4: Explain multinational strategies in Global environment.

CO5: Improve skills in effective communication both Oral and written, especially with regard to Management issues in Engineering.

CO6: Engage with their peers in public discourse with diversity in culture on ethical challenges, which serves to inform autonomous choices and manage differing opinions on complex management scenarios.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							M				H	
CO2								H	H			H
CO3											M	
CO4						M						M
CO5												
CO6								M				

INTRODUCTION

Demand and Revenue Analysis - Demand Forecasting - Production Analysis - Cost and Supply Analysis, Price and output Determination - Investment Analysis - Plant Location - Economic Optimization.

FORMS OF BUSINESS AND FUNCTIONS

Types of Business Organisation, Forms - Planning - Organizing - Designing effective organizations - Coordination

HUMAN RESOURCE DEVELOPMENT

Motivating individuals and workgroups - Leadership for Managerial Effectiveness - Team working and Creativity - Managerial Communication - Personal Management - Time Management - Stores Management - Career Planning.

FINANCIAL MANAGEMENT

Product development - Management techniques in product development - Nature of controlling - Operations Management - Just-in-Time.

GLOBAL ENVIRONMENT

Managing World Economic Change - The global environment - Multinational Strategies - Economic Cycles and Director Investment - Change and Organisation Development - Managerial Ethics and Social responsibilities.

REFERENCES

1. Harold Koontzand Heinz Weihrich, Essentials of Management, Tata McGraw Hill publishing company Ltd.
2. Koontz, Weihrichand Aryasri, Principles of Management, Tata McGraw Hill publishing company Ltd.
3. Tripathi and Reddy, Principles of Management, Tata McGraw Hill publishing company Ltd.
4. Hampton, Management, Tata McGraw Hill publishing company Ltd.
5. L.M.Prasad, Principles of Management.

HSS003	INDIAN ECONOMIC DEVELOPMENT	L	T	P	C
		3	0	0	3

Course Outcomes

At the end of the course, the students would be able to

CO1: Identify key relevant Indian economic factors and analyze the impact of these economic factors on businesses.

CO2: Explain their interactions with domestic macroeconomic policies.

CO3: Develop a perspective that is supported with relevant information and integrative thinking and draw and assess conclusions

CO/P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H				M		M
CO2							H	M			H	M
CO3						M				H		M

INDIAN ECONOMIC SCENARIO

Indian economy before and after Independence: National income trends and compositions Sources of capital formation and savings. Sectoral growth. Demographic trends in India and it effect on economic development. Occupational structure of the labour force.

ECONOMIC PLANNING AND POLICY

Indian Economic Planning, fiscal policy, Monetary Policy, Unemployment in India and othe economic policies

INDUSTRIAL DEVELOPMENT

Industry: Industrial development during the planning period. Industrial policies Industrial licensin policy – MRTP Act, FERA and FEMA. Growth and problems of small-scale industries. Role o Public sector enterprises in India's industrialization. Impact of economic reforms on India industrial sector after 1991.

FOREIGN TRADE

External Sector: Role of foreign trade. Trends in exports and imports. Composition and direction o India's foreign trade. Balance of payments crisis and the New Economic Reforms – Expor promotion measures and the new trade policies. Foreign capital – FDI, aid: Multinationa corporations in India

AREAS OF CONCERN

Important Areas of Concern: Poverty and inequality. Unemployment. Rising prices. Industria relations. Industrial structure and causes of industrial backwardness.

REFERENCES:

1. Agrawal, A.N. Indian Economy, Problems of Developmental Planning, Wiley Eastern Ltd., Calcutta (latest edition).
2. Ahluwalia, I.J. and I.M.D. Little (eds.) (1999). India's Economic Reforms and Development: Essays in honour of Manmohan Singh, Oxford University Press, New Delhi.
3. Alam, K. (ed.) (1993). Agricultural Development in North East India: Constraints and Prospects, Deep & Deep Publications, New Delhi.
4. Choudhuri, Pramit. (1975). Aspects of Indian Economic Development, Lord George Allen & Unwin Ltd., London.
5. Dutt, R.C. (1950). The Economic History of India Under Early British Rule, Low Price
6. Publications, Delhi.
7. Dutt, Ruddar and K.P.M. Sundaram (2001). Indian Economy, S. Chand & Co. Ltd., New Delhi.

HSS004	INDUSTRIAL PSYCHOLOGY	L	T	P	C
		3	0	0	3

Course Outcomes

At the end of the course, the students would be able to

CO1: Apply psychological theories and concepts to problems and questions they find personally important

CO2: Apply psychological theories concepts and principles to personal and broader social systems and issues

CO3: Recognise and understand the complexity of cultural diversity

CO4: Apply basic methods in psychology

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H	M		M	L		H
CO2						M	L	H	L	L	H	M
CO3						L			M	L	H	M
CO4						H		H			H	M

INTRODUCTION

The role of the psychologist in industry, the field of occupational Psychology - Study of behaviour in work situation and applications of Psychological principles to problems of selection, Placement, Counseling and training

DESIGN OF WORK ENVIRONMENTS,

Human engineering and physical environment techniques of job analysis, Social environment- Group dynamics in Industry Personal psychology - Selection, training, placement, promotion, counseling, job motivations, job satisfaction .Special Study of problem of fatigue, boredom and accidents,

UNDERSTANDING CONSUMER BEHAVIOUR

Consumer behaviour; study of consumer preference, effects of advertising, Industrial morale - the nature and scope of engineering psychology, its application to industry

WORK METHODS

Efficiency at work, the concept of efficiency, the work curve, its characteristics - The work methods; hours of work, nature of work, fatigue and boredom, rest pauses. The personal factors; age abilities, interest, job satisfaction The working environment - noise, illumination, atmospheric conditions - Increasing efficiency at work; improving

the work methods, Time and motion study, its contribution and failure resistance to time and motion studies, need for allowances in time and motion study.

WORK AND EQUIPMENT DESIGN

Criteria in evaluation of job-related factor, job design, human factors, Engineering information, input processes, mediation processes, action processes, methods design, work space and its arrangement, human factors in job design. Accident and Safety - The human and economic costs of accidents, accident record and statistics, the causes of accidents situational and individual factors related to accident reduction

REFERENCES

1. Tiffin,J and McCormic E.J., Industrial Psychology, Prentice Hall, 6th Edition, 1975.
2. McCormic E.J., Human Factors engineering and design, McGraw Hill, 4th Edition,1976. Mair, N.R.F., Principles of Human relations
3. Gilmer, Industrial Psychology
4. Ghiselli and Brown, Personnel and Industrial Psychology.
5. Myer, Industrial Psychology.
6. Dunnete, M.D., Handbook of Industrial and OrganizationalPsychology.
7. Blum and Taylor, Industrial Psychology.

HSS005	CONSUMER PSYCHOLOGY	L	T	P	C
		3	0	0	3

Course Outcomes

At the end of the course, the students would be able to

CO1: Identify the mental processes that guide consumer perception attitudes memory and choices

CO2: Analyze how these processes might differ as a consequence of social, cultural and group influences and apply this knowledge to generate effective marking tactics

CO3: Provide recommendations if needed for public policy to protect consumer right

CO/P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H		H	M		M	H
CO2						H		L		H	L	M
CO3						M	L	L	M	L		M

CONSUMER BEHAVIOUR

Introduction - Consumer behaviour - concepts - dimensions of consumer behaviours - application of consumer behaviour knowledge in marketing decisions - approaches to the study of consumer behaviour

LEAENING AND DECISION MAKING PROCESS

Motivation, ability and opportunity; exposure, attention and perception Categorizing and comprehending information Attitude formation and change - memory and retrieval Process of decision making - psychographics Consumer behaviour outcomes - consumer welfare

GROUP BEHAVIOUR

Group dynamics and consumer reference groups - Family - Social class cultural and sub-cultural aspects - cross cultural consumer behaviour

INFLUENCER BEHAVIOR

Personal influence and opinion leadership - diffusion of innovations - consumer decision - making process - models of consumer decision process - Nicosia- Howard Sheth and Engel-Kollat model- post purchase behaviour

CONSUMERISM

Consumer protection - difficulties and challenges in predicting consumer behaviour - online consumer behaviour - organizational and industrial buyer behaviour - consumer behaviour in Indian context - emerging issues

REFERENCES

1. David L.Loudon, Albert J Della Bitta, Consumer Behaviour, McGraw Hill, New Delhi, 2002.
2. Jay D. Lindquist and M.Joseph sirgy, Shopper, buyer and consumer Behaviour, Theory and Marketing application, Biztantra Publication, New Delhi, 2005.
3. Sheth Mittal, Consumer Behaviour A Managerial Perspective, Thomson Asia (P) Ltd., Singapore, 2003.
4. K.K.Srivastava, Consumer Behaviour in Indian Context, Goal Gotia Publishing Co, New Delhi, 2002.
5. S.L. Gupta and Sumitra Pal, Consumer Behaviour an Indian Perspective, Sultan Chand, New Delhi, 2001.
6. Ms.Raju, Dominique Xavedel, Consumer behaviour, Concepts Applications and Cases, Vikas publishing house (P) Ltd., New Delhi, 2004.

HSS006	PROFESSIONAL ETHICS	L	T	P	C
		3	0	0	3

Course Outcomes

At the end of the course, the students would be able to

CO1: Understand the importance of balancing professional and personal commitments

CO2: Appreciate the spirit of team-play in attaining group-specific goals

CO3: Recognize the importance of avoiding conflicts of interest at the workplace

CO4: Cite case-studies for unethical conduct and behavior in corporations and government organizations

CO5: Explain how ethical theories help in resolving moral dilemmas confronting professionals

CO6: Describe the dividing line between loyalty to employers and commitments to public welfare

CO7: Appreciate the need to avoid gender-bias and related discrimination at the workplace

CO8: Improve skills in effective communication, both oral and written, especially with regard to ethical and professional issues in engineering.

CO9: Engage with their peers in a public discourse with diversity in culture on ethical challenges, which serves to inform autonomous choices and manage differing opinions on complex ethical scenarios.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						M		H	M	M		M
CO2									H	M	M	
CO3						M						
CO4							H			M		
CO5								M		M		
CO6						H			M			
CO7								H		M		
CO8								H		H		H

CO9								M			M	

ENGINEERING ETHICS

Functions of Being a Manager - Stock holder and stakeholder management - Ethical treatment of employees - ethical treatment of customers- supply chain management and other issues

ENGINEERING AS SOCIAL EXPERIMENTATION

Senses of Ethics - Variety of moral issues - Types of inquiry - Moral dilemmas - Moral Autonomy -

Kohlberg's theory - Gilligan's theory - Consensus and Controversy - Professions and Professionalism - Professional ideals and virtues - Theories about right action - Self-interest - Customs and religion - Use of Ethical Theories

ENGINEER RESPONSIBILTY FOR SAFETY

Corporate social responsibility - Collegiality and loyalty - Respect for Authority - Collective Bargaining - Confidentiality - Conflicts of Interest - Occupational Crime - Professional Rights - Employee Rights - Discrimination

RESPONSIBILITY AND RIGHTS

Moral imagination, stake holder theory and systems thinking - One approach to management Decision - making Leadership

GLOBAL ISSUES

Multinational Corporations - Environmental Ethics - Computer Ethics - Weapons Development - Engineers as Managers - Consulting Engineers - Engineers as Expert Witnesses and Advisors - Moral Leadership - Sample code of conduct

REFERENCES

1. Mike Martin and Roland Schinzinger, Ethics in Engineering, McGraw Hill, New York, 1996
2. Charles D Fledderman, Engineering Ethics, Prentice Hall, New Mexico, 1999
3. Laura Schlesinger, How Could You Do That: The Abdication of Character, Courage, and Conscience, Harper Collins, New York, 1996
4. Stephen Carter, Integrity, Basic Books, New York, 1996
5. Tom Rusk, The Power of Ethical Persuasion: From Conflict to Partnership at Work and in Private Life, Viking, New York,1993

HSS007	OPERATIONS MANAGEMENT	L	T	P	C
		3	0	0	3

Course Outcomes

At the end of the course, the students would be able to

CO1: At the end of the course, the students will be able to assess the various cultural, legal and political issues that impact international business effort

CO2 : Trace investment theory, foreign exchange and the determination of foreign exchange rates

CO3: Develop insight into the management implications of international business strategy and operations

CO/P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H		M		H		H
CO2						M	L		H		H	L
CO3						H		L			M	H

INTRODUCTION TO PRODUCTION AND OPERATION MANAGEMENT

Production and Operations Management (POM) - Need, History, System, Types, functions and communication in POM

MATERIAL AND INVENTORY MANAGEMENT

Material Management (MM) - Handling Technology (Robots, Automated storage and retrieval systems (ASRS) and methods (JIT, / Kanban, ABC Systems) - Independent Demand Inventory Models - Fixed order system, Basic EOQ, EBQ Models, Quantity discount models - Dependent Demand Inventory models - MRP and MRP II systems Introduction to ERP, e-business and e-operations strategies

PLANNING AND FORECASTING

Introduction to Strategic, Tactical, Operational, Aggregate and Capacity Planning - Planning Product design and development - Applications of CAD, CAM, Computer Integrated Manufacturing

FORECASTING AND SCHEDULING:

Forecasting - Types, Methods (Qualitative and Quantitative), Types of variation in data, Minimizing forecasting errors and selection of forecasting methods. Johnson's Algorithm for job sequencing (n job thro' 2 machines, n jobs thro' 3 machines, n jobs thro' m machines and 2 jobs thro' m machines) Use of Gantt charts, Queuing analysis and Critical Ratios as methods for job scheduling

FACILITY, LAYOUT LOCATION AND WORK MEASUREMENT

Facility Location Decisions (FLcD) - Facility Layout Decision (FlyD) - Types (Fixed Position, and

Production, Process, Flexible), Methodologies (Distance Minimising, Computer software systems (CRAFT, CORELAP, ALDEP), Line Balancing and performance ratios, work measurement methods (WM) - Time study, methods-time measurement

REFERENCES

1. R.Paneer Selvam, Production and Operations Management, Prentice Hall of India, 2002
2. Sang M Lee and Marc J Schniederjans, Operation Management, All India Publishers and Distributors, First Indian edition, 1997
3. Robert H. Lowson, Strategic operations Management (The new competitive advantage), Vikas Publishing House, First Indian reprint, 2003

HSS008	INTRODUCTION TO ECONOMICS	L	T	P	C
		3	0	0	3

Course Outcomes

At the end of the course, the students would be able to

CO1: Define the main concepts and describe the models and methods in economic analysis

CO2: Explain economic events in individual markets and the aggregate economy using basic theory and tools

CO3: Apply supply and demand analysis to relevant economic issues

CO4: Explain how individual decisions and actions as a member of society affect the economy locally , nationally and internationally

CO5: Distinguish between perfect competition and imperfect competition and explain the welfare loss in non-competitive markets

DEFINITION AND SCOPE OF ECONOMICS

Definitions by A. Smith, A. Marshal and L. Robbins, P.Samuelson and their critical examination - Nature and scope of Economics - Micro- economics in relation to other branches of Economics

LAW OF DEMAND

Elasticity of demand - price, income and cross, concepts and measurement - Marshallian theory of consumers' behaviour and its critical examination - Indifference curve analysis - Price, income and substitution effects - Giffen goods- Engel curve

MARKET STRUCTURE

Definition of market. Concepts of product and factor markets. Different types of market: perfect competition, monopoly, imperfect competition, monopolistic, competition and oligopoly. Demand and Supply schedules. Price determination under perfect competition in long and short run. Price determination under monopoly. Discriminating monopoly

MACRO-ECONOMICS

Meaning, Macro-economic Policy and Its Objectives and Instruments - National Income and Social Accounting - Concepts, components, and measurement - Basic circular flow of income model, Unemployment, trade cycle, Inflation - causes, types, effects and control

COMMERCIAL AND CENTRAL BANKS

Credit creation, monetary policy and tools - Balance of payments - Items in the balance of payments account, equilibrium in the balance of payments

REFERENCES

1. Ackley, G., Macroeconomics: Theory and Policy, Macmillan Publishing Company, New York, 1978
2. Gupta, S.B., Monetary Economics, S. Chand and Co., New Delhi, 1994
3. Ruddar Datt and K.P.M.Sundharam, Indian Economy, S.Chand and Company Ltd., New Delhi, 2003

4. Kindleberger, C.P., R.D. Irwin, International Economics, Home Wood, 1973.
5. Lewis, M.K. And P.D. Mizan, Monetary Economics, Oxford University Press, New Delhi, 2000
6. Ahuja H.L., Economic Environment of Business, Macroeconomic analysis, S.Chand and Company Ltd., New Delhi, 2005
7. Gupta, G.S. Macroeconomics, Theory and Applications, Tata McGraw-Hill publishing company Ltd., New Delhi, 2001
8. D.N. Dewedi, Macro economic - Theory and policy, TataMcGraw-Hill publishing company Ltd., New Delhi, 2001

HSS009	APPLIED ECONOMICS	L	T	P	C
		3	0	0	3

Course Outcomes

At the end of the course, the students would be able to

CO1: Effectively communicate an economic concepts both orally and written and apply them in their profession

CO2: Identify the issues related to their sector , natural resource policies , rural and urban communities

CO3: Effectively communicate the essence of taxation theory

CO4: Analyse public policy and derive improved decision making within the policy context to maximize the profitability

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						M				H	M	
CO2							M		M	H		M
CO3							M			H		H
CO4						M	M	M		M	H	M

Course Topic(s)

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 and Public Utility Pricing
6) Taxation
7) Health Economics and Urban Economics
8) Economics of Environment and Pollution
9) Economics of Education and Transport Economics

REFERENCES:

1. Reta Kelly, Economic Development Finance, Sage publications.
2. Karl Seidman, Economic Development Finance, Sage publications.

HSS010	INTERNATIONAL TRADE AND FINANCE	L	T	P	C
		3	0	0	3

Course Outcomes

At the end of the course, the students would be able to

CO1: Identify the reasons for international trade

CO2: Describe the importance of balance of trade and balance of payments to the development of macroeconomic policy

CO3: Explain the role that international institutions play in the global arena

CO4: Analyse whether international parity conditions are met

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H		H			M	H
CO2							M		H	M		M
CO3						M	M				M	H
CO4						H						M

INTERNATIONAL TRADE

International Trade - Meaning and Benefits - Basis of International Trade - Foreign Trade and Economic Growth - Balance of Trade - Balance of Payment - Current Trends in India - Barriers to International Trade - WTO - Indian EXIM Policy.

EXPORT AND IMPORT FINANCE

Special need for Finance in International Trade - INCO Terms (FOB, CIF, etc.,) - Payment Terms - Letters of Credit - Pre Shipment and Post Shipment Finance - Forfeiting - Deferred Payment Terms - EXIM Bank - ECGC and its schemes - Import Licensing - Financing methods for import of Capital goods.

FOREX MANAGEMENT

Foreign Exchange Markets - Spot Prices and Forward Prices - Factors influencing Exchange rates

- The effects of Exchange rates in Foreign Trade - Tools for hedging against Exchange rate variations - Forward, Futures and Currency options - FEMA - Determination of Foreign Exchange rate and Forecasting.

DOCUMENTATION IN INTERNATIONAL TRADE

Export Trade Documents - Financial Documents - Bill of Exchange- Type- Commercial Documents - Performa, Commercial, Consular, Customs, Legalized Invoice, Certification of Origin Certificate Value, Packing List, Weight Certificate, Certificate of Analysis and Quality, Certificate of Inspection, Health certificate. Transport Documents - Bill of Landing, Airway Bill, Postal Receipt, Multimodal Transport Document. Risk Covering Document: Insurance Policy, Insurance Cover Note. Official Document: Export Declaration Forms, GR Form, PP From, COD Form, Softer Forms, Export Certification, Certification of Origin, GSPS - UPCDC Norms

EXPORT PROMOTION SCHEMES

Government Organizations Promoting Exports - Export Incentives : Duty Exemption - IT Concession - Marketing Assistance - EPCG, DEPB - Advance License - Other efforts I Export Promotion - EPZ - EQU - SEZ and Export House.

REFERENCES

1. Apte P.G., International Financial Management, Tata McGraw Hill.
2. Larceny and Bhattacharya, International Marketing, Sulta Chand and Sons.
3. B.M.Wali and AB Kalkumdrikas, Export Management, Sterling Publishers Pvt., Ltd.
4. Websites of WTO, World Bank, IMF, Ministry of Commerce, ECGC and EXIM Bank.

HSS011	INFORMATION SYSTEMS FOR MANAGERIAL DECISION MAKING	L	T	P	C
		3	0	0	3

Course Outcomes

At the end of the course, the students would be able to

CO1: Develop essential skills of analyzing and solving quantitative models with computer programs used in business (especially spread sheets).

CO2: Explain the roles played by information technology in today's business and define various technology architectures and methodologies on which information systems are built

CO3: Define and analyse typical information system and identify how they meet the needs of the firm to deliver efficiency and competitive advantage

CO4: Identify the basic steps in systems and software developments

CO5: Apply specific quantitative models and tools in various functional areas in business

CO6: Explain critical ethical and social issues in information systems

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H	M		M		M	
CO2						H	H		H	M		M
CO3						H	M					H
CO4							M					M
CO5							M	H		M		M
CO6							M				M	

INTRODUCTION

Information system - establishing the framework - business model - information system architecture - evolution of information systems.

INFORMATION SYSTEM

Functional areas, Finance, marketing, production, personnel - levels, Concepts of DSS, EIS, ES - comparison, concepts and knowledge representation - managing international information system.

SYSTEM DEVELOPMENT

Modern information system - system development life cycle - structured methodologies - designing computer based method, procedures control, designing structured programs.

IMPLEMENTATION AND CONTROL

Testing security - coding techniques - detection of error - validation - cost benefits analysis - assessing the value and risk information systems.

SOFTWARE ENGINEERING

Software engineering qualities - design, production, service, software specification, software metrics, and software quality assurance - software life cycle models - verification and validation.

REFERENCES

1. Kenneth C. Laudon and Jane Price Laudon, Management Information systems Managing the digital firm, Pearson Education, Asia.
2. Gordon B.Davis, Management Information system: Conceptual Foundations, Structure and Development, McGraw Hill, 1974.
3. Joyce J. Elam, Case series for Management Information System, Silmon and Schuster, Custom Publishing, 1996.
4. Steven Alter, Information system - A Management Perspective, AddisonWesley, 1999.
5. James AN O' Brein, Management Information Systems, Tata McGraw Hill, New Delhi, 1999.
6. Turban Mc Lean, Wetherbe, Information Technology Management making connection for strategic advantage, John Wiley, 1999.
7. Ralph M.Stair and George W.Reynolds, Principles of Information Systems - A Managerial Approach Learning, 2001.

HSS012	ADVERTISING AND MEDIA SERVICES	L	T	P	C
		3	0	0	3

Course Outcomes

At the end of the course, the students would be able to

CO1: Analyze the value of media.

CO2: Develop a media plan that applies the media Objective(s) concepts and terms, considering economic, social and legal constraints

CO3: Use critical market factors that influence advertising decisions

CO4: Describe ways in which communication media as well as techniques and strategies differ according to social, cultural and legal norms

CO5: Plan and test innovative advertising concepts by measuring their impact

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H	M			M		M
CO2									M	M	H	H
CO3							H					
CO4						H				M		
CO5						H	M		M	M	M	

ADVERTISING MANAGEMENT

Advertiser – facilitating institutions – perspectives on advertising

ADVERTISING PLANNING AND DECISION-MAKING

Situation analysis – marketing program – segmentation strategies – social and legal factors – budget decision advertising Objective(s)s image and competitive position.

ATTITUDE AND MARKET STRUCTURE

Behavioural Objective(s)s Communications – persuasion and market processes – copy decisions – copy testing

MEDIA DECISIONS-

Media planning, Economic, social and legal constraints

MEDIA RESEARCH

Testing validity and reliability of ads – measuring impact of advertisements.

REFERENCES:

1. Kenneth Clow. Donald Baack, "Integrated Advertisements, Promotion and Marketing communication", Prentice Hall of India, New Delhi, 2003.
2. S.H.H.Kazmi, Satish K Batra, "Advertising & Sales Promotion", Excel Books, New Delhi, 2001.
3. George E Belch, Michel A Belch, "Advertising & Promotion", McGraw Hill, Singapore, 1998

HSS013	COST ANALYSIS AND CONTROL	L	T	P	C
		3	0	0	3

Course Outcomes

At the end of the course, the students would be able to

CO1: Analyse and provide recommendations to improve the operations of organisations through the application of management accounting techniques;

CO2: Apply techniques associated with costing systems, cost management systems, budgeting systems and performance measurement systems

CO3: Appreciate the need for a balance between financial and non-financial information in decision making, control and performance evaluation applications of management accounting

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H		M		M	H	M
CO2							M		H		M	
CO3									M		M	H

INTRODUCTION TO COSTING

Costing, Elements of costing, Types of cost, Preparation of cost sheet.

COST ANALYSIS

Marginal costing, Cost - volume - Profit analysis, Break-Even-Analysis, Break - Even-Chart, Applications.

CONTROL TECHNIQUES

Budgeting and Budgetary control, Types of Budgets , Preparation of purchase Budget, Flexible budgets, Cash Budget, Sales Budget, Materials Budget, Master Budget, Zero based Budgeting.

STANDARD COSTING

Types of Standards, Setting up of standards, Advantages and Criticism of Standard Costing - Control through variances.

ACTIVITY BASED COSTING

Transfer Pricing, Target costing, Life Style Costing, Activity Based Costing (only theory).

REFERENCES

1. K.Saxena and C.D. Vashist, Advanced Cost Accounting and Cost Systems, V.Sultan Chand and Sons Publisher
2. S.P. Jain and K. L. Narang, Advances Cost Accounting Kalyani Publishers.

3. Cost Management, The Institute of Charted Accountants of India.
4. J. Blocher, K. H. Chen, G. Cokins and T. W. Lin., Cost Management: A Strategic Emphasis, Irwin/McGraw-Hill, 3d edition, 2005
5. J. Sha, Cases in Cost Management: a Strategic Emphasis by Second Edition. South-Western, 2001
6. Bhabatosh Bangerjee, Financial Policy and Management , Prentice Hall
7. Anthony.Dearden and Vancil, Management Control Systems, Irwin

HSS014	INTRODUCTION TO MARKETING MANAGEMENT	L	T	P	C
		3	0	0	3

Course Outcomes

At the end of the course, the students would be able to

CO1: Analyse the relevance of marketing concepts and theories in evaluating the impacts of environmental changes on marketing planning, strategies and practices.

CO2: Explain the importance of consumer behaviour as it relates to buying behaviour.

CO3: Apply key marketing concepts.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H	H			M	M	M
CO2						H				H		
CO3							H	H		H	M	M

MARKETING

Meaning - concept - functions - marketing Planning and implementation marketing Programmes - Marketing environment - Market Segmentation and consumer behaviour - Influencing factors, Decision process - Marketing mix - Marketing department

PRODUCT

Meaning - Product planning - policies - positioning - New product development Product life cycle - BCG Matrix-branding. Packing, labelling

PRICING

Pricing objectives - Setting and modifying the price - Different pricing method Product line pricing and new product pricing

DISTRIBUTION

Nature of Marketing channels - Types of Channel flows - Channel functions - Channel co- operation, conflict and competition - Direct Marketing Telemarketing, Internet shopping **PROMOTION**

Promotion Mix - Advertisement - Message - copy writing – Advertisement - budgeting - Measuring advertisement effectiveness - Media strategy - sales promotion - Personal selling, publicity and direct marketing

REFERENCES

1. Philip Kotler, Marketing Management- Analysis Planning and Control, Prentice Hall of India, New Delhi
2. Cundiff, Still and Govoni, Fundamentals of Modern Marketing, Prentice Hall of India, New Delhi

3. Ramaswamy. V S and Namakumari. S, Marketing Management- Planning Implementation and Control, Macmillan Business Books, 2002
4. Jobber, Principles and Practice of Marketing, McGraw-Hill.

HSS015	MANAGEMENT CONCEPTS AND TECHNIQUES	L	T	P	C
		3	0	0	3

Course Outcomes

At the end of the course, the students would be able to

CO1: Explain the differing approaches to defining management and the standard cycle of the management process.

CO2: Explain various ethical perspectives in decision making and corporate social an environmental responsibility.

CO3: Organize a management structure effectively

CO4: Identify politics, apply power and resolve conflicts in an organization

CO5: Analyze control as a function of management

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1											M	
CO2						H	H	H		M		
CO3											H	
CO4						M		M		M		
CO5											H	

DEVELOPMENT OF MANAGEMENT THOUGHT

Scientific Management Movement, Administrative Movement, Human-Relations Movement, Decision-Science Movement, Behavioural Movement, Systems Movement, Contingency Movement

ESSENTIALS OF PLANNING

Objective(s)s, goals, Programmed Decisions and Un programmed Decisions; Decision-Making, Creativity in Decision-Making, Forecasting and Strategy to Formulation.

EFFECTIVE ORGANIZING

Span of Control, Departmentation, Authority; Responsibility, Bureaucracy and Adhocracy; Group Dynamics

REALITIES OF ORGANIZATIONAL LIFE

Organizational Politics, Organizational Power, Organizational Conflict

COMMUNICATION & CONTROL

Communication Process Evaluation, Control Process, Qualities of a Good Control System, Management Audit, and Human – Offset Accounting, Cost Benefit Analysis.

REFERENCES:

1. Harold Koontz& Heinz Weihrich - Essentials of Management Tata McGraw Hill publishing company Ltd.
2. Koontz, Weihrich& Aryasri – Principles of Management Tata McGraw Hill publishing company Ltd.
3. Tripathi& Reddy - Principles of Management Tata McGraw Hill publishing company Ltd.
4. Hampton – Management Tata McGraw Hill publishing company Ltd

5. L.M.Prasad - Principles of Management

HSS016	ORGANIZATIONAL PSYCHOLOGY	L	T	P	C
		3	0	0	3

Course Outcomes

At the end of the course, the students would be able to

CO1: Design and implement research, analyze data appropriately and judge the significance of the findings

CO2: Work effectively with a diversity of individuals and groups

CO3: Apply theory and research to contemporary problems

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						M		H		M		H
CO2							H		M			
CO3						M						M

FOCUS AND PURPOSE

Definition, need and importance of organizational Behaviour – nature and scope – frame work.

INDIVIDUAL BEHAVIOUR

Personality – types – factors influencing personality – theories – learning – types of learners – learning theories – organizational Behaviour modification. Attitudes – characteristics – components – formation – measurement. Perceptions – importance – factors influencing perception – interpersonal perception.

GROUP BEHAVIOUR

Organization structure – formation – groups in organizations – influence – group dynamics – emergence of informal leaders and working norms – group decision making techniques – interpersonal relations – communication – control.

POWER

Leadership styles – theories – leaders Vs managers – sources of power – power centers – power and politics.

DYNAMICS OF ORGANIZATIONAL BEHAVIOURS

Organizational climate – factors affecting organizational climate – importance. Job satisfaction – determinants – measurements – influence on behavior. Organizational change – importance – stability Vs change – proactive Vs reaction change – the change process – resistance to change – managing change. Organizational development – characteristics – Objective(s)s – team building. Organizational effectiveness – perspective – effectiveness Vs efficiency – approaches – the time dimension – achieving organizational effectiveness.

REFERENCES:

1. Stephen P.Robins, Organisational Behavior, Prentice Hall of India, 9th edition, 2001.
2. Hellriegel, Slocum and Woodman, Organisational Behavior, South-Western, Thomson Learning, 9th edition, 2001.
3. Schermerhorn, hunt and Osborn, Organisational behavior, John Wiley, 7th edition, 2001.
4. Jit S.Chand, Organisational Behavior, Vikas publishing House Pvt. Ltd. 2nd edition,
5. 2001.
6. Fred Luthans, Organisational Behavior, McGraw Hill Book Co., 1998.
7. New Strom & Davis, Organisational behaviour, McGraw Hill, 2001.

8. Jaffa Harris and Sandra Hartman, Organisational Behaviour, Jaico, 2002.

HSS017	INTERNATIONAL ECONOMICS	L	T	P	C
		3	0	0	3

Course Outcomes

At the end of the course, the students would be able to

CO1: Apply economic reasoning to the analysis of selected contemporary economic problems CO2: Analyze the efficiency and equity implications of government interference in markets CO3: Recognize and identify situations leading to market failures and government failures

CO4: Evaluate the intent and outcomes of government stabilization policies designed to correct macroeconomic problems

CO5: Use economic problem solving skills to discuss the opportunities and challenges of the increasing globalization of the world economy

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H		M		M		M
CO2								M			H	M
CO3						H			M			
CO4								M				M

CO5								M		M		M

INTRODUCTION

The Traditional Theory of International Trade, The Basic Trade Model, Heckscher-Ohlin- Samuelson Model, Effects of Tariffs and Quotas, Theory of Factor Movements - New Theories of International Trade and Industrial Policies

EXCHANGE RATE AND BALANCE OF PAYMENT

The Balance of Payments and National Accounts, Determinants of Exchange Rates the Exchange-Rate Regime Choice and a Common Currency Area, International Debt and Currency Crises

INTERNATIONAL REGULATORY AUTHORITY

Political Economy of Trade Disputes, the FTA and the WTO - The role of the IMF and other International Financial Organizations Reasons for Protection World Trade, International Movements of Capital - The Balance of Trade and Other Measures of International Transactions. Export and import policies

INTERNATIONAL MACROECONOMICS

European Monetary Unification and the Euro - Preferential Trading Arrangements and the NAFTA International Policies for Economic Development, Trade Outsourcing and Off shoring

REFERENCES

1. N. Bhagwati, A. Panagariya and T. N. Srinivasan, Lectures on International Trade, MIT Press, 2nd edition, 1998
2. M. Obstfeld and K. Rogoff, Foundation of International Macroeconomics, McGraw-Hill, 1996
3. Romer, D., Advanced Macroeconomics, McGraw Hill, 1996

HSS018	COMMUNICATION SKILLS	L	T	P	C
		3	0	0	3

Course Outcomes

At the end of the course, the students would be able to

CO1: Apply communication theories.

CO2: Use current technology related to the communication field.

CO3: Respond effectively to cultural communication differences.

CO4: Communicate ethically.

CO5: Demonstrate positive group communication exchanges.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H	H		L	H		H
CO2						H	H	M		H		H
CO3						H	H		L	H		H

COMMUNICATION IN BUSINESS

Systems approach, forms of business communication, management and communication, factors facilitating communication.

COMMUNICATION PROCESS

Interpersonal perception, selective attention, feedback, variables, listening barriers to listening, persuasion, attending and conducting interviews, participating in discussions, debates and conferences, presentation skills, paralinguistic features, oral fluency development.

BUSINESS CORRESPONDENCE

Business letter. Memos, minutes, agendas, enquiries, orders, sales letters notice,
tenders, letters of application, letter of complaints.

TECHNICAL REPORTS

Format, Choice of vocabulary, coherence and cohesion, paragraph writing, organization.

PROJECT REPORTS

Project proposal, project reports, and appraisal reports.

REFERENCES

1. Sharan J.Genrson and Steven M.Gerson, Technical Writing - Process and Product, Pearson Education, 2000.
2. Raymond V.Lesikar, John D. Pettit and Mary E.Flatley, Lesikass Basic Communication, Tata McGraw Will, 8th Edition, 1999.
3. Stevel. E. Pauley, Daniel G.Riordan, Technical Report Writing Today, AITBS Publishing and Distributors, India 5th edition, 2000.
4. Robert L.Shurter, Effective letters in business, Third Ed., 1983.
5. McGraith, Basic Managerial Skills for all Prentice Hall of India, 6th Edition, 2002.
6. Halliday, M.A.Ky R.Hasan, Cohesion in English, Longman, London, 1976

HSS019	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

Course Outcomes

At the end of the course, the students would be able to

CO1: Identify and develop operational research models from the verbal description of the real System

CO2: Apply the mathematical tools that are needed to solve optimisation problems

CO3: Use mathematical software to solve the proposed models

CO4: Develop a report that describes the model and the solving technique, analyse the results and propose recommendations in language understandable to the decision-making processes in Management Engineering

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1						H	M		H			H
CO2								M		H		
CO3						M				H		
CO4						H	M		H	H		M

INTRODUCTION TO LINEAR PROGRAMMING

Introduction to applications of operations research in functional areas of management. Linear Programming-formulation, solution by graphical and simplex methods (Primal - Penalty, Two Phase), Special cases. Dual simplex method.

TRANSPORTATION MODELS AND ASSIGNMENT MODELS

Transportation Models (Minimising and Maximising Cases) – Balanced and unbalanced cases – Initial Basic feasible solution by N-W Corner Rule, Least cost and Vogel's approximation methods. Check for optimality. Solution by MODI / Stepping Stone method. Cases of degeneracy. Transhipment Models. Assignment Models (Minimising and Maximising Cases) – Balanced and Unbalanced Cases. Solution by Hungarian and Branch and Bound Algorithms. Travelling Salesman problem. Crew Assignment Models.

INTEGER LINEAR PROGRAMMING AND GAME THEORY

Solution to pure and mixed integer programming problem by Branch and Bound and cutting plane algorithms. Game Theory-Two person Zero sum games-Saddle point, Dominance Rule, graphical and LP solutions.

REPLACEMENT MODELS AND DECISION THEORY

Replacement Models-Individuals replacement Models (With and without time value of money)– Group Replacement Models. Decision making under risk – Decision trees – Decision making under uncertainty.

PROJECT MANAGEMENT METHOD AND SIMULATION

PERT / CPM – Drawing the network, computation of processing time, floats and critical path. Resource levelling techniques. Application of simulation techniques for decision making. **REFERENCES:**

1. Kalavathy S, Operations Research, Second Edition, third Reprint 2004, Vikas Publishing House.
2. Paneerselvam R., Operations Research, Prentice Hall of India, Fourth Print, August 2003.
3. Tulsian P.C, Vishal Pandey, Quantitative Techniques (Theory and Problems), Pearson Education (Asia), First Indian Reprint, 2002.

HSS020	HUMAN RESOURCE MANAGEMENT	L	T	P	C
		3	0	0	3

Course Outcomes

At the end of the course, the students would be able to

CO1: Interpret the strategic role of human resources in a concern

CO2: Evaluate employee job performance, appraise the performance of employee, Schedule the training need and develop discipline in an organization

CO3: Outline the trends of HRM in terms of globalization
CO4: Develop a knowledge of managing employee compensation and welfare
CO5: Develop effective written and oral communication skills

CO/P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H			M	M		
CO2								M	H	H		
CO3							H					M
CO4						M					M	
CO5									H	M		

BASICS FUNCTIONS

Functions of a human resources manager - recruitment and selection process interview methods.

EVALUATION AND DEVELOPMENT

Performance appraisal, Training and development, disciplinary procedures, collective bargaining and employee welfare.

TRENDS

The recent methods and trends in HRM with a few case studies in the context of globalization.

STRATEGIC ROLE

Strategic role of human resource management Job analysis Personnel planning and recruiting Employee testing and selection, interviewing candidates, Appraising performance.

CAREER AND COMPENSATION

Managing careers Compensation Benefits and services Labour relations and collective bargaining Employee safety and health

REFERENCES:

1. Decenzo and Robbins, Human Resource Management, Wiley, 6th edition, 2001.
2. Biswajeet Pattanayak, Human Resource Management, Prentice Hall of India, 2001.
3. Eugene McKenna and Nic Beach, Human Resource Management, Pearson Education.
4. Dessler, Human Resource Management, Pearson Education Limited, 2002.
5. Mamoria C.B and Mamoria S., Personnel Management, Himalaya Publishing.
6. Wayne Cascio, Managing Human Resources, McGraw-Hill, 1998.
7. Ivancevich, Human Resource Management, McGraw-Hill, 2002.

HSS021	PUBLIC FINANCE IN THEORY AND PRACTICE	L	T	P	C
		3	0	0	3

Course Outcomes

At the end of the course, the students would be able to

CO1: Identify legal issues that impact financial and other risks affecting

business. CO2: Give examples of different types of taxation

CO3: Describe the Indian taxation and list the most important areas of spending

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H		M				M
CO2							H	M		M	M	M

CO3						M			M			M

THE ROLE AND SIZE OF THE PUBLIC SECTOR

Economic Rationale for Public Sector Interventions, Market Efficiency and Market Failure, Distributional Concerns, The Nature and Magnitude of Public Sector Interventions, Defining the Responsibilities and Measuring the Size of the Public Sector.

PUBLIC EXPENDITURE POLICY

Public Goods and Private Goods, Public Choice in Determining the Level of Public Expenditure, Public Sector Production and Provision, Government Failure, and Private Sector Participation/Public-Private Partnerships in Production and Provision, Government Social Protection Policies, Assessment of Public Sector Expenditure Efficiency and Effectiveness.

PUBLIC RESOURCE MOBILIZATION

Economics of Taxation, Taxation of Income and Wealth, Taxation of Consumption and Trade,Taxation and the Environment, Taxation and Natural Resources, Tax Incentives, Compliance, and Enforcement, Tax Reform, User Charges

INTERGOVERNMENTAL FISCAL RELATIONS

Fiscal Federalism and Fiscal Decentralization, Resource Transfers.

LOCAL GOVERNMENT FINANCE

Local Government Debt Financing, Fiscal Balance, Deficit Financing, and Capital Formation

REFERENCES:

1. Harvey S Rosen- Public Finance
2. Richard A.Musgrave, Peggy B. Musgrave, Public Finance Theory and Practice, Tata Mc Graw – Hill

HSS022	BANKING THEORY AND PRACTICE	L	T	P	C
		3	0	0	3

Course Outcomes

At the end of the course, the students would be able to

CO1: Calculate yield from banking investments and an impact of inflation on savings and banking investments

CO2: Explain accounting methods

CO3: Explain the role of transactions costs and informational asymmetries in the operation of the banking system

CO4: Explain why bank need regulation, a central bank and illustrate the key reason for and against the regulation of banking systems

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H	M					H
CO2						H		M	M	M		H
CO3						M	M		H			M

CO4						M	M	M	H	H		

EVOLUTION OF BANKING SYSTEM

Central Banking functions, Reserve Bank control over banks

BANKER - CUSTOMER RELATIONSHIP

Bank as borrowers, customer accounts, duties of paying and collecting bankers

LENDING BY BANKS

RBI control over loans and advances, Securities for loans

AGENCY SERVICES BY BANKS

Banker as bailey, safe deposit vaults, credit

cards **CONSUMERS OF**

BANKINGSERVICES Protection against

deficiency in banking services.

REFERENCES:

1. M.L.Tannan, "Tannan's Banking Law and Practice in India", India Law House, New Delhi (1997).
2. S.N.Gupta, "The Banking Law in theory and Practice", Vol. I & II, Universal Law Publishing Co. (1999).

HSS023	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
		3	0	0	3

Course Outcomes

At the end of the course, the students would be able to

CO1: Apply effective written and oral communication skills to business situations

CO2: Analyze the global and local business environment

CO3: Use critical thinking skills in business situations

CO4: Apply an ethical understanding and perspective to business situations

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						H		H		H		H
CO2						M	MM	H			M	
CO3						M		M	H			H
CO4						M		M			M	H

ENTREPRENEURIAL COMPETENCE

Entrepreneurship concept - Entrepreneurship as a Career – Entrepreneur - Personality Characteristics of Successful. Entrepreneur - Knowledge and Skills Required for an Entrepreneur

ENTREPRENEURIAL ENVIRONMENT

Business Environment - Role of Family and Society - Entrepreneurship Development Training and Other Support Organisational Services - Central and State Government Industrial Policies and Regulations - International Business

BUSINESS PLAN PREPARATION

Sources of Product for Business - Pre-feasibility Study - Criteria for Selection of Product - Ownership - Capital - Budgeting Project Profile Preparation - Matching Entrepreneur with the

Project - Feasibility Report Preparation and Evaluation Criteria

LAUNCHING OF SMALL BUSINESS

Finance and Human Resource Mobilization Operations Planning - Market and Channel Selection - Growth Strategies - Product Launching

MANAGEMENT OF SMALL BUSINESS

Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units - Effective Management of small Business

REFERENCES

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2001.
2. P. Saravanavel, Entrepreneurial Development, Ess Pee kay Publishing House, Chennai,1997.
3. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, New Delhi, 2001.
4. Prasama Chandra, Projects - Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill Publishing Company Limited, 1996.
5. P.C.Jain (ed.), Handbook for New Entrepreneurs, EDII, Oxford University Press, New Delhi, 1999.
6. Staff College for Technical Education, Manila and Centre for Research and Industrial Staff Performance, Bhopal, Entrepreneurship Development, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1998

FREE ELECTIVES

BCY501	NANO CHEMISTRY	L	T	P	C
		3	0	0	3
Objective(s)	Educate them in synthesis and characterization of nano materials				
Course Outcome(s)					
CO1	Summarize the basis of nano technology				
CO2	Compare the properties of nanomaterials with micro and macro materials				
CO3	Sketch the synthesis of nanomaterials				
CO4	Illustrate the synthesis techniques of nanomaterials				
CO5	Choose best technologies for characterization of nanomaterials				

Unit-I: Basics of Nano chemistry

Basics of nanomaterials: Properties of nanomaterials, quantum confinement effect, surface to volume ratio, surface properties of nanoparticles. Classification of the nano materials – zero dimensional, one dimensional, two dimensional and three dimensional nanostructures.

Unit-II: Properties of Nanomaterials

Mechanical, optical, electronic, magnetic, thermal and chemical properties of nanomaterials. Size dependent properties-size dependent absorption spectra

Unit-III: Synthetic Techniques

Chemical methods: sol-gel synthesis, solvothermal synthesis, thermolysis route. Physical methods: Pulsed laser deposition- Magnetron sputtering

Unit-IV: Applications of Nanomaterials

Catalysis on nanoparticles, semiconductors, sensors, and electronic devices, photochemistry and nanophotonics, applications of CNTs, nanomaterials in biology and medicine.

Unit-V: Characterization Techniques

X-ray diffraction- Electron microscopes – scanning electron microscopes (SEM) – transmission electron microscopes (TEM) – scanning probe microscopy – atomic force microscopy (AFM) – scanning tunneling electron microscope (STEM) – basic principles only.

Reference Books:

1. S.Shanmugam, Nanotechnology, , MJP Publishers, Chennai (2010).
2. Patrick Salomon , A Handbook on Nanochemistry,, Dominant Publishers andDistributers, New Delhi.
3. S. Balaji , Nanobiotechnology, MJP Publishers, Chennai (2010).
4. CNR Rao The Chemistry of Nanomaterial: Synthesis, Properties and Applications, Vol. I and II, Springer (2006).
5. Nanotechnology: Basic Science and Emerging Technologies, Mick Wilson, KamaliKannangara, Geoff Smith, Michelle Simmons, Burkhard Raguse, Overseas Press, (2005).
6. G. B. Segreev, Nanochemistry, , Elsevier, Science, New York, (2006).

7. C. N. R. Rao, A. Mu¨ller, A. K. Cheetham, "The Chemistry of Nanomaterials:Synthesis, Properties and Applications" WILEY-VCH Verlag GmbH & Co. KGaA, weinheim, 2004
8. C.N.R. Rao, G.U. Kulkarni, P.J. Thomas, Nanocrystals: Synthesis, Properties and Applications" Springer Series in materials science-95, Springer-Verlag Berlin Heidelberg 2007
9. Znong Lin Wang, "Characterization of nanophase materials" WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, 2000.

BPY502	LASER PHYSICS (common to B.Sc Physics)	L	T	P	C
		3	0	0	3
Prerequisite	Basic ideas on properties of lasers				
Objective	This paper deals with the fundamental concepts of laser				
Course Outcomes					
CO1	At the end of the course, students should be able to: Know about the fundamentals of laser				
CO2	Get the basic ideas on the production of laser				
CO3	Understand the classification of laser				
CO4	Acquire the knowledge on applications of laser in various fields				
CO5	Carry out the research work on laser				

Course Topics

Fundamentals of LASER

Spontaneous emission – stimulated emission – meta stable state – Population inversion – pumping – Laser Characteristics

Production of LASER

Helium – Neon Laser – Ruby Laser – CO2 Laser – Semiconductor Laser

Industrial Applications of LASER

Laser cutting – welding – drilling – Hologram – Recording and reconstruction of hologram

Lasers in Medicine:

Lasers in Surgery – Lasers in ophthalmology – Lasers in cancertreatment

Lasers in Communication

Optic fibre communication- Total internal reflection – Block diagram of fibre optic communication system – Advantages of fibre optic communication

Text Books

1. Laser fundamentals – William T. Silfvast Cambridge University Press – Published in South Asia by foundation books, 23, Ansari Road, New Delhi , 2008
2. An introduction to LASERS – N. Avadhanulu, S. Chand & Company, 2001.

References

1. LASER Theory and Application – K. Thyagarajan and A.K. Ghatak, Mac millan, India Ltd., 1981.
2. Lasers and non-linear optics, B. B. Laud, New Age International (P) Ltd., IIIrdEdn., 2011

BCY504	APPLIED CHEMISTRY	L	T	P	C
		3	0	0	3
Objective(s)	Awareness about recent technologies in applied chemistry				
Course Outcome(s)					
CO1	Solve water related problems				
CO2	Illustrate electrochemical concepts				
CO3	Employ corrosion prevention methodologies				
CO4	Develop innovative fuels				
CO5	Formulate novel polymers				

Unit-I: Water Treatment

Brief introduction regarding sources, impurities in water. Hardness of water, types, determination of hardness using EDTA method. Brief discussion and chemistry involved in the process of sedimentation, coagulation, filtration and sterilization, UV, Ozone, chlorination including break point chlorination. Softening of Water: (i) Lime-soda, process: Principles in hot, cold, lime-soda process. (ii) Zeolite softener, demineralization by synthetic ion exchange resins, Comparison between lime-soda, Zeolite and ion exchange process.

Unit-II: Electrochemistry

Introduction, Arrhenius ionic theory, Debye-Huckel theory of strong electrolytes, Activity and Activity coefficient, Conductivity of electrolytes, Kohlrausch's law of independent migration of ions, Oswald's dilution law, Acids and Bases, Concept of pH and pOH , Buffer solutions, Solubility product, common ion effect, Hydrolysis of salts, Conductometric titrations, transport number. Potentiometric titrations.

Unit-III: Corrosion of Metals and Alloys

Definition and classification of corrosion. Electrochemical corrosion- General revision of concept of electrode potential, galvanic cells, electrochemical and galvanic series, causes of corrosion, mechanism of direct chemical attack, pilling- Bed worth rule, concentration cells. Differential aeration theory of corrosion, types of corrosion, pitting corrosion, intergranular stress, waterline and microbial corrosion. Corrosion prevention : (a) Design and material selection, (b) Anodic and Cathodic inhibitors, (c) Cathodic and Anodic protection, (d) Protective coatings- types of surface, coatings and its application.

Unit-IV: Fuels

Introduction, Classification of fuels, Calorific value, Characteristics of a good fuel, comparison between solid, liquid and gaseous fuels. Bomb calorimeter. Calorific value of a gaseous fuel, Theoretical calculation of calorific value of a fuel, Wood, Coal, Classification of coal, selection of coal , analysis of coal, Types of carbonization of coal. Diesel engine fuel, Petroleum, synthetic petrol. LPG as a fuel. Non petroleum fuels, Natural gas, Coal gas, water gas. Non conventional sources of energy-bio mass, biogas, wind energy, solar.

Unit-V: Polymers

Introduction, Nomenclature and functionality of polymers, Classification of polymers, Types of polymersation. Methods of polymerization, Characteristics of polymers, structure and properties of polymers. Plastics, Inorganic polymers, Silicones, Rubbers, vulcanization of rubbers, synthetic rubber or elastomers, Application of rubber, Conducting polymers and bio polymers.

Reference Books:

1. S.S. Dara, A Text Book of Engineering Chemistry, S.Chand& Co. New Delhi, first Edition, 1985.
2. P.C.Jain and Monika Jain, Engineering Chemistry, Dhanpat Rai & Sons, New Delhi, Fifteenth Edition,2009.
3. Fontana and Green , Corrosion Engineering, Tata McGraw Hill International Book Co. 2nd edition, 2005.
4. V.R.Gowariker, N.V.Viswanathan, Jayadevsreedhar, Polymer Science, New Age International publishers, (1986) Reprint 2010.

BPY504	**RADIATION PHYSICS** (common to B.Sc Physics)	L	T	P	C
		3	0	0	3
Prerequisite	Basic ideas on properties of radiation physics				
Objective	This paper deals with the detailed theoretical and experimental concepts on radiation physics.				
Course Outcomes					
CO1	At the end of the course, students should be able to: Gain knowledge on the concepts of radiation				
CO2	Get the basic ideas on the x-rays				
CO3	Acquire the knowledge on radiation therapy				
CO4	Get the knowledge on instrumentation techniques in radiation therapy				
CO5	Gain the knowledge on clinical radiation therapy				

Course Topics

STRUCTURE OF MATTER, NUCLEAR TRANSFORMATION AND X-RAYS

Elementary particles - Electromagnetic radiation-wave model and quantum model. Nuclear Transformation - Nuclear transformation-radioactivity - Decay constant – Activity - Radioactive series - Radioactive equilibrium -Activation of nuclides.X-Rays-Production of X-rays - X-ray tube - X-ray circuit - voltage rectification - Physics of X-ray production - X-ray energy spectra - Operating characteristics.

Clinical Radiation Generators

Kilo-voltage units- Grenz-ray therapy - Contact therapy - Superficial therapy - Orthovoltage therapy or deep therapy - Super voltage therapy - Resonant transformer units - Megavoltage therapy - Van de graff generator - Linear accelerator - Betatron - Cyclotron - Microtron - Machines using radionuclides-Cobalt-60 unit - Heavy particle beams.

Ionizing Radiation, Quality of X-Ray Beams, Measurement of Absorbed Dose

Ionizing Radiation - Interaction of ionizing radiation-Ionization - Photon beam description - Photon beam attenuation - Attenuation coefficient - Energy transfer - energy absorption coefficient - Interaction of photons with matter - Coherent scattering - The Roentgen - Free air ionization chamber - String electrometer - Ion collection-Saturation and collection efficiency - Measurement of exposure. Quality of X-Ray Beams- Half value layer and its measurement - Peak voltage-Direct indirect measurement - Effective energy. measurement of Absorbed Dose-Radiation absorbed dose - Relation between Kerma - Exposure - Absorbed dose.

Classical Radiation Therapy

Dose distribution and scatter analysis-Phantoms - Depth dose distribution - percentage depth dose-Dependence on beam quality and depth - Tissue air ratio (TAR)-relationship between TAR and percent depth dose- Dose calculation parameters- Collimator Scatter Factor - Phantom Scatter Factor - Tissue-Phantom and Tissue-Maximum Ratios - Scatter-Maximum Ratio-Practical Applications - Accelerator Calculations- SSD Technique - Cobalt 60 Calculations. Treatment planning-Acquisition of Patient Data- Internal Structures- Computed Tomography - Magnetic Resonance Imaging-Ultrasound. Skin Dose. Electron beam therapy - Brachytherapy.

Modern Radiation Therapy, Dosimetry and Radiation Protection

Modern Radiation Therapy-Image-Guided Radiation Therapy - Proton Beam Therapy. Dosimetry-Dosimeter - Film badge dosimeter - Pocket dosimeter. Radiation Protection-Radiation Protection - Dose Equivalent - Effective Dose Equivalent - Background Radiation - Low-Level Radiation Effects - Effective Dose-Equivalent Limits- Occupational and Public Dose Limits.

Text Books

1. Meredith W.J. and J.B. Massey, *Fundamental Physics of Radiology*, A. John Wright and Sons Ltd.,3rd Edition, 1983.
2. William.R.Hendee, Geoffery.S.Ibbott and Eric.G.Hendee, *Radiation TherapyPhysics*, A.John Wiley and Sons.,Inc, 3rdEdition, 2005.

References

1. Smith F.A., *A Primer in Applied Radiation Physics*, World scientific publishing Co., 2000.
2. Podgarsak E.B., *Radiation Physics for Medical Physicists*, Springer, 2006.
3. Evans R. D., *Atomic Nucleu*s, Textbook Publications, 2003.
4. Fiaz.M.Khan, *The Physics of Radiation Therapy*, Lippincott Williams and Wilkins, 4th Edition, 2010.

BCY505	INSTRUMENTAL METHODS OF ANALYSIS	L	T	P	C
		3	0	0	3
Objective(s)	Educate them in operating analytical instruments				
Course Outcome(s)					
CO1	Summarize chromatographic techniques				
CO2	Interpret spectroscopic data				
CO3	Compute the spectral results				
CO4	Employ gas chromatography in separating mixture of compounds				
CO5	Identification of elements using microscopic analysis				

Unit-I: Chromatography

Introduction – solvent extraction (basic concepts only) – ion exchange (basic concepts only) – electrophoresis (basic concepts only) – column and thin layer chromatography - Principles, instrumentation, theory and applications of GC and HPLC.

Unit-II: Qualitative Optical Spectroscopy

Introduction-Principles, instrumentation, theory and applications of Infrared spectroscopy, Raman spectroscopy, Nuclear Magnetic Resonance (NMR) spectroscopy and X-ray diffraction methods.

Unit-III: Quantitative Optical Spectroscopy

Introduction - Principles, instrumentation, theory and applications of Atomic absorption spectroscopy(AAS)–Inductively coupled plasma atomic emission spectroscopy- Inductively coupled plasma mass spectrometry - Atomic fluorescence spectroscopy- X-ray fluorescence spectroscopy – Ultraviolet (UV)-visible spectroscopy.

Unit-IV: Mass Spectrometry

Introduction-Principles, instrumentation, theory and applications of Gas chromatography mass spectrometry (GCMS) – High performance liquid chromatography electrospray ionization mass spectrometry (LC-ESI-MS) – Laser mass spectrometry (MALDI).

Unit-V: Microscopic and Surface Analysis

Introduction-Principles, instrumentation, theory and applications of Atomic force microscopy (AFM)–Auger electron spectroscopy-X-ray photoelectron spectroscopy (XPS)- Scanning electron microscopy (SEM)–Transmission electron microscopy (TEM).

Reference Books:

1. Frank A.Settle (Editor), Handbook of instrumental techniques for analytical chemistry, Prentice-Hall Inc., New Jersey, 1997.
2. Vogel's Textbook of quantitative chemical analysis, G.H.Jefferey, J Bassett, J Mendham, and R C Denney, Longman scientific and technical publishers, London
3. D.A.Skoog, F.J.Holler, S.R.Crouch, Instrumental Analysis, Cengage Learning, New Delhi, 2007.
4. H.H. Willard, L.L.Merritt, and J.A.Dean, Instrumental Methods of Analysis,6th Edition (1986),CBS Publishers & Distributors, Shahdara, Delhi.

BPY506	**NUCLEAR PHYSICS** (common to B.Sc Physics)	L	T	P	C
		3	0	0	3
Prerequisite	Basic ideas on nuclear physics				
Objective	This paper deals with the detailed theoretical and experimental concepts on radioactivity and elementary particles				
Course Outcomes					
CO1	At the end of the course, students should be able to: Gain knowledge on nucleus and nuclear models.				
CO2	Get the basic ideas on the nuclear reactions				
CO3	Acquire the knowledge on fundamentals in elementary particles				
CO4	Carry out research in nuclear physics				
CO5	Acquire the knowledge on Radioactive materials				

Course Topics

Nucleus and nuclear models

Introduction to nucleus- classification of nuclei – general properties of nucleus – charge, mass, spin , magnetic moment, quadruple moment – mass defect - binding energy- models of nuclear structure - liquid drop model – shell model.

Radioactivity

Introduction – discovery of radioactivity - natural radioactivity - alpha, beta and gamma rays - properties of the rays - experimental measurement of the range of alpha particles – beta ray spectra – origin of the line and continuous spectrum – the neutrino theory of beta decay.

Nuclear Reactions

Soddy Fajan's displacement law - law of radioactive disintegration - the mean life - measurements of decay constants - units of radioactivity - law of successive disintegration - radioactive dating -nuclear reactions - energy balance in nuclear reactions - threshold energy of an endoergic reaction- applications of radio isotopes.

Particle accelerators, detectors, Cosmic rays

GM Counter - Wilson cloud chamber - bubble chamber – cyclotron – synchrotron – synchrocyclotron - betatron – Cosmic rays : introduction – discovery of cosmic rays –cosmic showers –origin of cosmic radiation.

Elementary particles

Introduction – fundamental interactions - elementary particle quantum numbers – quark model.

Text Book

1. Modern Physics by R. Murugesan and KiruthigaSivaprasath, S.Chand& Co., 2005.

References

1. Atomic and Nuclear Physics by Shatendra Sharma, Dorling Kindersley India, 2005.
2. Nuclear Physics by D.C. Tayal, Himalaya Publishing House, reprint 2007.
1. Nuclear Physics, An introduction by S.B.Patel, New Age international(P) Ltd., (reprint 2003)

BCY506	ENVIRONMENTAL CHEMISTRY	L	T	P	C
		3	0	0	3
Objective(s)	Demonstrate the analysis of environmental degradation				
Course Outcome(s)					
CO1	Examine various water quality parameters				
CO2	Model instrumental methods of water analysis				
CO3	Identify gaseous pollutants and its effects				
CO4	Point out degradation of atmosphere by electromagnetic radiation				
CO5	Categorize various soil pollutants				

Unit-I: Environmental Chemistry of Water

The principles and application of aqueous chemistry to the environmental systems. Unique properties of water, Water Quality Parameters: physico-chemical, biological, bacteriological; Water Quality Criteria and Standards; Water quality monitoring and management aspects, Chemical methods involved in treating water and wastewater, Removal of dissolved organics and inorganics, Heavy metal pollution and its abatement.

Unit-II: Water and Wastewater Analysis

Basic concepts and Instrumental methods of analysis; Determination of major parameters of water such as pH, acidity, alkalinity, hardness, BOD, COD, solids, fluoride, nitrogen, iron, manganese, sulphate, phosphate, volatile acids and trace contaminants.

Unit-III: Atmospheric Chemistry

Structure and properties of atmosphere, Classification and chemistry of major air pollutants and their control. Types and sources of air pollution-natural, Combustion and other combustion sources.

Atmospheric Composition &Behaviour: Gaseous & particulate constituents of the atmosphere, Temperature and pressure profile of atmosphere, General circulation of atmosphere.

Unit-IV: Atmospheric Photochemistry

Electromagnetic radiations, Kinetics of thermal and photochemical processes, Reactions in the upper atmosphere, Photo processes in the troposphere, Photochemical smog, Photosynthesis, Ozone chemistry.

Unit-V: Soil Chemistry

The nature and importance of soil; Soil in the natural and man-made environment, Soil properties; Acid-Base and Ion-exchange reactions in soils. Macro and Micronutrients; Fertilisers and other soil amendments.

Waste and pollutants in soil, Heavy metals and radio-nuclides in soil. Colloidal chemistry of inorganic constituents, clays, OM and soil humus; Absorption in soils - forces and isotherms; Soil as cation and anion exchanger; Degradation of natural substances; Remediation of metal contaminated soil.

Reference Books:

1. T.G. Spiro and W.M.Stigliani, Chemistry of the Environment, 2nd ed., Tsinghua University Press, 2003.
2. V.Snoeyink and D.Jenkins, Water Chemistry, J.Wiley and Sons, 1980.
3. Shugui Dai, Environmental Chemistry, (ed.), Higher Education Press, 1997.
4. C.N. Sawyer, P.L. McCarty, G. F. Parkin, Chemistry for Environmental Engineering, McGraw Hill, 4th edition, 2002.
5. L.D. Bene_eld, J. F. Judkins and B. L. Weand, Process Chemistry for Water and Wastewater Treatment, Prentice Hall, 1982.
6. R.A. Bailey, H. M. Clark, J. P. Ferris, S. Krause, R. L. Strong, Chemistry of the Environment, Academic Press Second Edition, 2002.

BPY507	**SPACE PHYSICS** (common to B.Sc Physics)	L	T	P	C
		3	0	0	3
Prerequisite	Basic ideas on space physics				
Objective	This paper deals with the detailed concepts on space science.				
Course Outcomes					
CO1	At the end of the course, students should be able to: Know about the earth's atmosphere.				
CO2	Get the basic ideas on the interplanetary medium				
CO3	Acquire the knowledge on planets				
CO4	Carry out the research work on space physics				
CO5	Acquire the knowledge on sun atmosphere				

Course Topics

The Earth's Upper Atmosphere

Variations of atmospheric densities and temperature. Formation and structure of Ionosphere. Studies of ionosphere by ground based and space techniques. The radiation belts. Auroras. Lyman glow of the night sky. The geo-corona and airglow studies.

Sun

Structure of solar atmosphere. Solar convection and differential rotation. Large scale and small scale magnetic fields. Solar granulation and super granulation. Sunspots. Solar flares.

Unit III Interplanetary Medium

Xray and g-ray studies of sun. Solar X-ray and radio bursts. Solar wind. Interaction with planetary atmosphere. Structure of bow shocks. Magnetosphere. Ring Current. Radiation belts and interplanetary magnetic field.

Unit - IV Moon

Origin of Moon. Solar and Lunar eclipses. Lunar ranging experiments. Studies of lunar surface from various space missions and their results. Satellites of other planets of the solar system.

Unit - V Planets

Infrared spectroscopy of planetary atmospheres. Principal results of the Mariner, Venera and Viking Space Missions to Mars and Venus. Voyager space mission studies of outer planets and their satellites and rings. Comparative studies of planetary atmospheres. Planetary ionospheres. Extra-solar system planets.

Text Books

1. Sun, Earth and radio: An Introduction to the Ionosphere and Magnetosphere, J.A.Ratcliffe, 1970, Littlehampton Book Services Ltd
2. An Intoduction to Planetary Physics: The Terrestrial Plants, Kaula. W.M, 1969, John Wiley & Sons Inc.
3. Harold Zirin: Astrophysics of the Sun, 1988, Cambridge University Press

References

1. W.N.Hess and G.Mead(Ed): Introduction to Space Science, 1965, Gorden and Breach,
2. V.Bumba and Kleczek, Basic Mechanism of Solar Activity, 1976.
3. W. J. Kaufmann, Exploration of the Solar System, Mac Millan, 1978, New york.

BMA331	COMBINATORICS	L	T	P	C
		3	0	0	3

Unit I

Basic Combinatorial Numbers – Stirling Numbers of the First Kind – Stirling Numbers of the Second Kind.

Unit II

Generating Functions and Recurrence Relations – Symmetric Functions.

Unit III

Multinomials – Multinomial Theorem – Inclusion and Exclusion Principle.

Unit IV

Euler Function – Permutations with Forbidden Positions – The ‘Menage’ Problem – Problem of Fibonacci.

Unit V

Polya Theory – Necklace Problem and Burnside’s Lemma – Cycle Index of a Permutation Group – Polya’s theorems and their Immediate Applications.

Text Book:

1. Kenneth P. Boggart, Introductory Combinatorics, Pitman Books Ltd, 1983.

Reference Books:

1. V. Krishnamurthy, Combinatorics Theory and Applications, East –West Press, 1989.
2. V.K. Balakrishnan, Theory and Problems of combinatorics, Schaums outline series – McGraw Hill, 1994.
3. Ian Anderson, Combinatorics of finite sets, Oxford Science Publication, 2011.

BMA332	MATHEMATICAL MODELLING	L	T	P	C
		3	0	**0**	**3**

UNIT I

Mathematical Modeling through Ordinary Differential Equations of First order: Linear Growth and Decay Models – Non-Linear Growth and DecayModels – Compartment Models – Dynamic problems – Geometrical problems.

UNIT II

Mathematical Modeling through Systems of Ordinary Differential Equations of First Order: Population Dynamics – Epidemics – Compartment Models –Economics – Medicine, Arms Race, Battles and International Trade – Dynamics.

UNIT III

Mathematical Modeling through Ordinary Differential Equations of Second Order: Planetary Motions – Circular Motion and Motion of Satellites –Mathematical Modeling through Linear Differential Equations of Second Order –Miscellaneous Mathematical Models.

UNIT IV

Mathematical Modeling through Difference Equations: Simple Models – BasicTheory of Linear Difference Equations with Constant Coefficients – Economics and Finance – Population Dynamics and Genetics – Probability Theory.

UNIT V

Mathematical Modeling through Graphs: Solutions that can be Modelled Through Graphs – Mathematical Modeling in Terms of Directed Graphs, SignedGraphs, Weighted Digraphs and Unoriented Graphs.

Text Book:

1. Mathematical Modeling, J.N. Kapur, Wiley Eastern Limited, New Delhi, 1988.

Reference:

1. J.N. Kapur, Mathematical Models in biology and Medicine, EWP, New Delhi,1985.