



B. TECH
CURRICULUM
AND
SYLLABUS

Semester I

Code	Subject	L	T	P	C
HSS101	English for Technical Communication I	2	0	0	2
MAT101	Mathematics I	3	0	0	3
PHY101	Physics I	3	0	0	3
CHY102	Chemistry	3	0	0	3
MEC101	Engineering Drawing	1	0	3	2
CIV101	Basic Civil and Mechanical Engineering	4	0	0	4
MEC181	Work Shop	0	0	3	1
CHY181	Chemistry Laboratory	0	0	3	1
	Total	16	0	9	19

Semester II

Code	Subject	L	T	P	C
HSS102	English for Technical Communication II	2	0	0	2
MAT102	Mathematics II	3	0	0	3
PHY102	Physics II	3	0	0	3
EEE101	Basic Electrical and Electronics Engineering	4	0	0	4
CHY101	Environmental Sciences	2	0	0	2
CSE102	Programming Languages	2	0	0	2
MEC102	Engineering Mechanics	3	0	0	3
PHY181	Physics Laboratory	0	0	3	1

CSE181	Programming Languages Laboratory	0	0	3	1
	Total	19	0	6	21

Semester III

Code	Subject	L	T	P	C
MAT202	Mathematics III	3	0	0	3
HSSXXX	Humanities Elective I	3	0	0	3
CHE201	Chemical Process Calculations	3	1	0	4
CHE202	Inorganic Chemical Technology	3	0	0	3
CHE203	Mechanical Operations	3	0	0	3
CHE204	Fluid Mechanics and Engineering	3	1	0	4
CHE205	Chemical Engineering Thermodynamics I	3	0	0	3
CHE281	Mechanical Operations Laboratory	0	0	3	2
CHE282	Fluid Mechanics Laboratory	0	0	3	2
	Total	21	2	6	27

Semester IV

Code	Subject	L	T	P	C
MAT212	Mathematics IV	3	0	0	3
HSSXXX	Humanities Elective II	3	0	0	3
CHE206	Heat Transfer	3	1	0	4

CHE207	Material Science and Technology	3	0	0	3
CHE208	Chemical Engineering Thermodynamics II	3	0	0	3
CHE209	Technical And Instrumental Methods of Analysis	3	0	0	3
CHE210	Organic Chemical Technology	3	0	0	3
CHE283	Heat Transfer Laboratory	0	0	3	2
CHE284	Technical and Instrumental Analysis Laboratory	0	0	3	2
	Total	21	1	6	26

Semester V

Code	Subject	L	T	P	C
CHEXXX	Major Elective I	3	0	0	3
	Minor Elective I	3	0	0	3
CHE301	Process Instrumentation Dynamics and Control	3	1	0	4
CHE302	Chemical Reaction Engineering I	3	1	0	4
CHE303	Mass Transfer I	3	1	0	4
CHE304	Numerical Methods for Chemical Engineers	3	1	0	4
CHE381	Process Dynamics and Control Laboratory	0	0	3	2
CHE382	Chemical Reaction Engineering Laboratory	0	0	3	2
	Total	18	4	6	26

Semester VI

Code	Subject	L	T	P	C
CHEXXX	Major Elective II	3	0	0	3
CHE305	Chemical Reaction Engineering II	3	0	0	3
CHE306	Transport Phenomena	3	1	0	4
CHE307	Biochemical Engineering	3	0	0	3
CHE308	Process Equipment Design	3	1	0	4
CHE309	Mass Transfer II	3	0	0	3
CHE383	Mass Transfer Laboratory	0	0	3	2
CHE384	Process Equipment Design and Drawing Laboratory	0	0	3	2
CHE385	Biochemical Engineering Laboratory	0	0	3	2
	Total	18	2	6	26

Semester VII

Code	Subject	L	T	P	C
CHEXXX	Major Elective III	3	0	0	3
CHEXXX	Major Elective IV	3	0	0	3
HSSXXX	Humanities Elective III	3	0	0	3
	Free Elective I	3	0	0	3
	Free Elective II	3	0	0	3

	Minor Elective II	3	0	0	3
CHE481	Computer Applications in Chemical Engineering Laboratory	0	0	3	2
	Total	18	0	3	20

Semester VIII

Code	Subject	L	T	P	C
CHEXXX	Self study Elective	3	0	0	3
CHE499	Project	0	0	24	10
	Total	3	0	24	13

Total Credits (from 1st semester to 8th semester = 178)

MAJOR ELECTIVES

Code No.	Subject	L	T	P	C
CHE310	Fertilizer Technology	3	0	0	3
CHE311	Corrosion Science and Engineering	3	0	0	3
CHE312	Electrochemical Engineering	3	0	0	3
CHE313	Polymer Technology	3	0	0	3
CHE314	Colloids and Surface Science	3	0	0	3
CHE315	Thin Films	3	0	0	3
CHE316	Biomedical Engineering	3	0	0	3

CHE317	Food Engineering and Technology	3	0	0	3
CHE318	Safety in Chemical Industries	3	0	0	3
CHE319	Paper and Pulp technology	3	0	0	3
CHE320	Energy Engineering	3	0	0	3
CHE321	New Separation Techniques	3	0	0	3
CHE322	Nanotechnology	3	0	0	3
CHE323	Membrane Science and Technology	3	0	0	3
CHE324	Optimization for Chemical Engineers	3	0	0	3
CHE325	Petroleum Refinery Engineering	3	0	0	3
CHE401	Boundary Layer Theory	3	0	0	3
CHE402	Multiphase Flow	3	0	0	3
CHE403	Downstream Processing	3	0	0	3
CHE404	Computational Fluid Dynamics	3	0	0	3
CHE405	Computational Heat Transfer	3	0	0	3
CHE406	Computer Aided Process Plant Design	3	0	0	3
CHE407	Fluidization Engineering	3	0	0	3
CHE408	Principles of	3	0	0	3

	Heterogeneous Catalysis				
CHE409	Multicomponent Mass Transfer	3	0	0	3
CHE410	Finite Element Methods	3	0	0	3
CHE411	Process Modeling and Simulation	3	0	0	3
CHE412	Enzyme Engineering and Technology	3	0	0	3
CHE413	Fermentation Technology	3	0	0	3
CHE414	Pharmaceutical Engineering	3	0	0	3
CHE415	Bioreactor Design and Analysis	3	0	0	3

MINOR ELECTIVES

Code	SUBJECT	L	T	P	C
CIV361	Air Pollution and Control	3	0	0	3
CIV369	Environmental Impact Assessment	3	0	0	3
CIV463	Solid Waste Management	3	0	0	3
CIV464	Industrial Wastewater Management	3	0	0	3
CSE255	Data Structures	3	0	0	3

ECE304	Microprocessors and its Applications	3	0	0	3
EEE409	Industrial Automation	3	0	0	3
EEE410	Neural Network and Fuzzy Logic Control	3	0	0	3
EIE319	Piping and Instrumentation Diagrams	3	0	0	3
MEC313	Turbo Machinery	3	0	0	3
MEC318	Refrigeration and Air Conditioning	3	0	0	3
MEC326	Composite Materials Science	3	0	0	3
MEC405	Vibration Analysis and Noise Monitoring	3	0	0	3
MEC412	Micro Electro Mechanical Systems	3	0	0	3
MEC417	Work Study	3	0	0	3

HUMANITIES ELECTIVES

Code	Subject	L	T	P	C
HSS001	Total Quality Management	3	0	0	3
HSS002	Engineering Management	3	0	0	3

HSS004	Industrial Psychology	3	0	0	3
HSS005	Consumer Psychology	3	0	0	3
HSS006	Professional Ethics	3	0	0	3
HSS007	Operations Management	3	0	0	3
HSS008	Introduction to Economics	3	0	0	3
HSS010	International Trade and Finance	3	0	0	3
HSS011	Information Systems for Managerial Decision Making	3	0	0	3
HSS013	Cost Analysis and Control	3	0	0	3
HSS014	Introduction to Marketing Management	3	0	0	3
HSS017	International Economics	3	0	0	3
HSS018	Communication Skills	3	0	0	3
HSS016	Organizational Psychology	3	0	0	3
HSS023	Entrepreneurship Development	3	0	0	3
HSS025	Science Fiction: An Appreciation	3	0	0	3
HSS026	German I	3	0	0	3
HSS028	French I	3	0	0	3
HSS030	Science Technology and Medicine in India: A Historical Perspective	3	0	0	3
HSS022	Banking Theory and Practice	3	0	0	3

HSS033	Modern Science in India	3	0	0	3
HSS035	History of Science and Technology	3	0	0	3

SEMESTER I

HSS101	ENGLISH FOR TECHNICAL COMMUNICATION I (Common to all branches)	L	T	P	C
		2	0	0	2

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

READING SKILLS

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
5. Martin Cutts, Plain English Guide - How to Write Clearly and Communicate Better, Oxford University Press, 1999

MAT101	MATHEMATICS I (Common to all branches)	L	T	P	C
		3	0	0	3

MATRICES

Review of Linear algebra-Matrix operations - Addition, Scalar Multiplication, Multiplication, Transpose, Adjoint 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 Echelon form

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 - Involute - envelopes - Partial differentiation - Euler's theorem for homogeneous functions-total differential - Taylor's expansion (two variables) - Maxima / 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, 8th Edition, 2001
2. Arumugam, S., Thangapandi Isaac, A., Somasundaram, A., Engineering Mathematics Volume I, Scitech Publications (India) Pvt. Ltd., Chennai, 2nd Edition, Reprint 2000, 1999

REFERENCES

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

PHY101	PHYSICS I (Common to all branches)	L	T	P	C
		3	0	0	3

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, Engineering and medical applications - Introduction of fiber optics- classification of fiber, Engineering and medical applications

QUANTUM PHYSICS

Inadequacy of classical mechanics - Black body radiation, Planck's law, Photoelectric effect, Compton effect, Einstein's photoelectric equation, Schrödinger wave equation, particle in one, three dimensional box

NON DESTRUCTIVE TESTING, NEW ENGINEERING MATERIALS

Ultrasonics, Ultrasonics flaw detectors - X-ray photography - Fluoroscopy - Thermography, Gamma ray spectroscopy - Characterization technique - Nanophase materials - biomaterials - non linear materials - polymer materials

DIGITAL ELECTRONICS

Introduction - Analog to digital circuits, conversion of numbers one's complement - 2's complement - Logic gates - Boolean algebra, DeMorgan's theorem - Karnaugh's maps

TEXT BOOK

1. Gaur, R. K., and Gupta, S. L., Engineering Physics, Dhanpat Rai Publishers, New Delhi, 2001

REFERENCES

1. Murthy, V. S. R., Jena, A. K., Gupta, K. P., Structures and Properties of Engineering Materials, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003
2. Ali Omar, M., Elementary Solid State, Pearson Education (Singapore), Indian Branch, New Delhi, First Edition, 2006
3. William F. Smith, Foundations of materials science and Engineering, McGrawHill, New York, 3rd Edition, 2003

4. Mathews. P.M., Venkatesan. K., Text Book of Quantum Mechanics, Tata McGraw Hill company, Delhi, 2003
5. Gupta S.L., Kumar.V., Hand book of Electronics, Pragati Prakashan, Meerut, 28th Edition, 2001

CHY102	CHEMISTRY (Chemical Engineering)	L	T	P	C
		3	0	0	3

WATER

Water Quality Parameter (Industry and Drinking Water) - Hardness, Definition, Classifications, Expressions, Units of Hardness of Water with respect to CaCO₃, Problems -Estimation of Hardness by EDTA Method (Theory Only) - Definition of Alkalinity (Theory Only) - Boiler feed water - Requirements, Disadvantages of using hard water in boilers, Removal of boiler scales and sludges - Water Softening - Zeolite Process, Demineralization (Ion - Exchange Process), Desalination

CORROSION SCIENCE AND CONTROL ENGINEERING

Corrosion, definitions - Electrode potential - Principles of Dry and Wet Corrosion, Factors Influencing rate of corrosion, Types of Corrosion - Corrosion Control - Impressed Current Cathodic Protection and Sacrificial Anodic Protection Method - Corrosion Inhibitors - Protective Coatings, Surface conversion coatings, organic coatings (paints)

POLYMERS

Introduction, Classification, Difference Between Thermoplastic and Thermosetting Plastics - Properties of Plastic - Degree of Polymerization - Types of Polymerization (Mechanism) - Phenol Formaldehyde Resin, Epoxy Resin, polyurethanes, Teflon - Amino Resins (Urea Formaldehyde, Nylon.11, Nylon.66 and Nylon 6), PET, PVC - Composites - Definition, characteristics, Constituent. Types - Fibre reinforced plastics (FRP), Metal Matrix Composites (MMC), Ceramic Matrix Composites (CMMC), Properties and Applications

INSTRUMENTAL METHODS OF ANALYSIS

Electro Magnetic Radiation - Absorption of Radiation , Beer - Lambert's Law - UV-VIS. Spectroscopy - IR Spectroscopy - Principle and Instrumentation (Block Diagram Only) Estimation of Iron by Colorimetry - Flame Photometry, Principle and Instrumentation (Block Diagram Only), Estimation of Na by Flame Photometry - Atomic Absorption Spectroscopy, Principle and Instrumentation (Block Diagram Only), Quantitative Estimation of Nickel by Atomic Absorption Spectroscopy

INDUSTRIAL ORGANIC SYNTHESIS AND NANOTECHNOLOGY

Introduction - Raw Material and Basic Process, Chemical Process used in Industrial Organic Synthesis - Synthesis of Ethanol, Methanol, Formaldehyde, Acetic acid, Acetaldehyde, Ethylene glycol, Glycerin, Acetone and Phenol - Nanotechnology - Introduction, Preparation, Characterization and Application

TEXT BOOKS

1. Jain, P.C and Monika Jain, Engineering Chemistry, Dhanpat Rai Publishing company (P) Ltd., New Delhi, 14th Edition 2002
2. Sharma, B.K., Industrial Chemistry, Goel Publishing House, Meerut, 12th edition 2001

REFERENCES

1. Puri B.R.and Sharma L.R. Principles of Physical Chemistry, Shoban Lal Nagin Chand and Co., Jalandhar, 40th edition 2003
2. Vogel A.I., A text book of Quantitative Inorganic Analysis, ELBS, London, 3rd edition 2000
3. Mick Wilson and Kamali Kannangara, Nanotechnology: Basic science and emerging technology, Overseas India Pvt. Ltd. Press, New Delhi, 1st edition 2005
4. Bandyopadhyay, A.K., Nano Materials, New Age International Publishers, New Delhi, 1st edition 2007

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

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 - 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 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. Section of above solids in simple 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 – prism and cylinder, cylinder and cylinder with axes at right angles with no offset.

ISOMETRIC AND PERSPECTIVE PROJECTION

Principles of isometric projection – isometric view and projections of simple solids, truncated prisms, pyramids, cylinders and cones.

Perspective projection of prisms, pyramids and cylinders by visual ray and vanishing point methods.

TEXT BOOK

1. Bhatt, N.D., Engineering Drawing, Charotar publishing House, New Delhi, 46th Edition, 2003.

REFERENCES

1. Natarajan, K.V., A text book of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 2006.
2. Shah, M.B., and Rana, B.C., Engineering Drawing, Pearson Education, New Delhi, 2005.
3. Gopalakrishnana, K.R., Engineering Drawing (Vol. I and II), Subhas Publications, 1998.
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.

CIV101	BASIC CIVIL AND MECHANICAL ENGINEERING (Common to all branches)	L	T	P	C
		4	0	0	4

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.

REFERENCES

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, Kumbakonam, 2000.
4. Shanmugam G., Basic Mechanical Engineering, Tata McGraw Hill Publishing Co., New Delhi, 2001

MEC181	WORK SHOP (Common to all branches)	L	T	P	C
		0	0	3	1

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.

CHY181	CHEMISTRY LABORATORY (Common to all branches)	L	T	P	C
		0	0	3	1

1. Preparation of standard and buffer solutions.
2. Estimation of hardness of water sample by EDTA method
3. Determination of dissolved oxygen in a sample of water.
4. Estimation of chloride ion in water sample.
5. Determination of alkalinity of water sample.
6. Estimation of hydrochloric acid by pH titration
7. Estimation of ferrous ion by potentiometric titration
8. Estimation of mixture of acid by conductometric titration
9. Estimation of iron by spectrophotometric method.
10. Flame photometry - Determination of Na and K

SEMESTER II

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

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 - Extemporaneous 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. Rutherford Andrea J, Basic Communication Skills for Technology, Pearson Education, 2002
- 3.

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 and AV Martinet, A Practical English Grammar, OUP, 4th Edition, 1986
5. Tom Hutchinson, Alan Waters, English for Specific Purpose, Cambridge University Press, 1987

MAT102	MATHEMATICS II (Common to all branches)	L	T	P	C
		3	0	0	3

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 - $w = z+a$, az , $1/z$, e^z , $\sin z$, $\cos z$ and bilinear transformation - 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

REFERENCES

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

PHY102	PHYSICS II (Common to Biotechnology and Chemical Engineering)	L	T	P	C
		3	0	0	3

CONDUCTING MATERIALS

Electron theory of solids - Classical free electron theory, quantum free electron theory, band theory of solids

SEMI CONDUCTING AND SUPER CONDUCTING MATERIALS

Introduction semi conducting materials, types of semi conducting materials, carrier concentration - Hall effect - Determination of Hall coefficient - Superconducting phenomena - Properties of superconductors, Type I and Type II superconductors, High T_c superconductors, application of super conductors

MAGNETIC MATERIALS

Classical theory of magnetism, quantum theory of paramagnetism, ferromagnetism, ferrites, applications of magnetic materials

NEW ENGINEERING MATERIALS

Metallic glasses as transformer core material, nanophase materials, shape memory alloys, bio materials (metals and alloys, ceramics), fibre reinforced plastics (FRP) and fiber reinforce metals (FRM) Properties - Thermal, mechanical electrical and chemical ceramic fibres

MEDICAL PHYSICS

Medical application in ultrasound, ultrasonic scanning device, source of radioactivity for nuclear medicine, clinical applications Nuclear medicine imaging devices

TEXT BOOK

1. Avadhanulu M.N., Kshirsagar P.G., A Text Book of Engineering Physics, S.Chand and Company Ltd., New Delhi, 6th edition, 2003

REFERENCES

1. Srivastava C.M., Srinivasan .C., Science of Engineering Materials, New Age International (P) Ltd., Pub. New Delhi, 2nd Edition, 1997
2. Wahab M.A., Solid State Physics, Narosa Publishing House, New Delhi, 1999
3. Arumugam.M., Materials Science, Anuradha Agencies, Kumbakonam, 3rd Edition, 2003
4. Pillai S.O., Solid State Physics, New Age International Publication, New Delhi, 5th Edition, 2003
5. Ali Omar.M, Elementary Solid State Physics, Pearson Education (Singapore) Pvt. Ltd., Indian Branch, New Delhi, 2002

EEE101	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING (Common to all branches)	L	T	P	C
		4	0	0	4

ELECTRICAL CIRCUITS

Introduction to electric circuits – laws of electric circuits– Ohm’s Law, Kirchoff’s Laws– analysis of DC circuits–mesh, nodal –introduction to AC circuits– average Value, RMS value, power and power factor– analysis of 3 phase AC circuits – balanced and unbalanced circuits

ELECTRICAL MACHINES

DC Machines –principle of operation–DC generators–emf equation, characteristics, types– DC motors–shunt, series, compound– single phase transformer – principle of operation, emf equation, phasor diagram –induction motors–single phase, three phase–alternators–principle of operation, emf equation , characteristics

ELECTRICAL MEASUREMENTS

Moving coil –ammeter, voltmeter – moving iron instruments –ammeter, voltmeter – dynamometer – wattmeter, energy meter

BASIC ELECTRONICS

Semiconductor devices – introduction, construction, types – pn junction diode –working principle, characteristics– zener diode– working principle, characteristics uni–junction transistor– operation, characteristics –field effect transistor– operation, characteristics– bipolar junction transistor– operation, characteristics–applications– half wave and full wave rectifiers

DIGITAL ELECTRONICS

Introduction to binary number system–logic gates –AND, OR, NOT, NAND, NOR, exclusive OR–boolean algebra– combinational circuits – half adder, full adder, half subtractor, full subtractor

INTEGRATED CIRCUITS

Operational amplifier–introduction, DC characteristics, AC characteristics–types of operational amplifier–inverting, non–inverting–applications– scalar, adder, Subtractor, differentiator, and integrator

TEXT BOOKS

1. Edward Hughes., Electrical and Electronics Technology, Pearson Education ltd, 9th edition, 2005.
2. Kothari.D.P., and Nagrath.I.J., Basic Electrical Engineering, Tata McGraw Hill, 2nd Edition.

REFERENCES

1. Malvino,A P., Electronic Principles, Tata McGraw Hill International, 1998.
2. Vincent Del tora., Electrical Engineering fundamentals, Prentice hall of India , 2nd edition 2003.
3. Muraleedharan.K.A., Muthusubramanian .R., and Salivahanan .S., Basic Electrical and Electronics and Computer Engineering, Tata McGraw Hill, 1997.

CHY101	ENVIRONMENTAL SCIENCES (Common to all branches)	L	T	P	C
		2	0	0	2

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 nuclear Pollution

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 and 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 and Science, Prentice Hall, New Delhi, 2nd edition 1997
5. Henry, J. G. and Heike, G. W. Environmental Science and Engineering, Prentice Hall International Inc., New Jersey, 1st edition 2005

CSE102	PROGRAMMING LANGUAGES (Common to all Branches)	L	T	P	C
		2	0	0	2

BASIC ELEMENTS OF C AND CONTROL STATEMENTS

Introduction to C- Structure of C language – Lexical elements of C- 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 - switch statement – Looping Control Structure - the break statement - ? : operator - Continue statement - goto statement – Problems using Control Structures.

FUNCTIONS, PROGRAM STRUCTURES AND ARRAYS

Prototypes and Functions – Declaring, defining and accessing Functions- Parameter passing methods-Recursion - Storage Classes - Automatic Variables -External Variables – Static and Register Variables – Programs using functions. 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.

POINTERS, STRUCTURES AND UNIONS

Pointer Fundamentals - Pointer Declarations - Passing Pointers to Functions - Arrays and Pointers - Pointers and One-Dimensional Arrays - Pointers and Multidimensional Arrays - Operations on Pointers - Pointers and Structures - Dynamic Memory Allocation – Command Line Arguments – Programs using Pointers with Functions, Arrays and Structures. Defining a Structure - Processing a Structure - User-Defined Data Types – Union – Nested structure - Structures and Pointers - Passing Structures to Functions - Self Referential Structures.

DATA FILES AND DATA STRUCTURES

Opening and Closing a Data File - Creating a Data File - High Level File Operations - Processing and Updation of Data Files - Unformatted Data Files - Low Level Programming – File Handling Programs. Linked List – Creation, Insertion and Deletion of elements - Stack and Queue implementation using Linked List.

UNIX BASICS AND SHELL PROGRAMMING

Shell Fundamentals - Shell Commands - Shell Decisions and Repetitions - Command line usage - Wildcard expansion - Redirection of I/O, pipes and filters. Shell Programming - Simple scripts - Specifying the interpreter - Shell variables - The Environment - Control flow; test, if, for, while, case - Command substitution - Signal catching - Shell functions - Aliases - Reading from the Standard I/P - Startup Files - basename and dirname - Expression evaluation.

TEXT BOOKS

1. Byron S. Gottfried, Theory and Problems of Programming with C, Tata McGraw Hill, Second Edition, 1996.
2. Lowell Jay Arthur and Ted Burns, UNIX Shell Programming, John Wiley and Sons Canada, Ltd, Fourth Edition, 1997.
3. Deshpande P.S, Kakde O.G, C and Data Structures , Dreamtech Press, First edition, 2004

REFERENCES

1. Brian Kernighan W, Dennis Richie M, The C Programming language, Pearson Education, 2005.
2. Johnsonbaugh R. and Kalin M, Applications Programming in ANSI C, Pearson Education, Third Edition, 2003.
3. Behrouz A. Forouzan and Richard Gilberg F, A Structured Programming Approach Using C, Brooks-Cole Thompson Learning Publications, Second Edition, 2001.
4. Bruce Molay, Understanding UNIX/LINUX Programming: A Guide to Theory and Practice, Prentice Hall, First Edition, 2002.
5. Glass, G., Ables, K. UNIX for Programmers and Users, Prentice

Hall, 1999.

6. Stephen Kochan and Patrick Wood, UNIX Shell Programming, Pearson Education, Third Edition, 2003.

MEC103	ENGINEERING MECHANICS (Except BT, IT and CSE)	L	T	P	C
		3	0	0	3

STATICS OF PARTICLES

Fundamental principles and concepts - vector algebra, Newton's laws, gravitation, force external and internal, transmissibility - velocity and acceleration - Couple- Moment about point and about axis - Varignon's theorem - resultant of concurrent and non-concurrent coplanar forces - static equilibrium, free body diagram, reactions - Problem formulation concept in 2-D and 3-D statics.

TRUSSES AND FRAMES

Trusses - assumptions, rigid and non-rigid trusses- simple trusses in plane and space- analysis by method of joints and by method of sections- compound trusses-statically determinate, rigid, and completely constrained - analysis of frames and machines.

FRICTION

Frictional forces- laws of friction- simple contact friction - rolling resistance - belt friction.

PROPERTIES OF SURFACES AND SOLIDS

Centroids of lines - areas, volumes, composite bodies - center of mass - area moment of Inertia - mass moment of inertia - principal moment of inertia.

DYNAMICS OF PARTICLES

Displacements, velocity and acceleration, their relationship – relative motion – Curvilinear motion – Newton's law – work Energy equation of particles – impulse and momentum – impact of elastic bodies.

TEXT BOOK

1. Beer, F.P., and Johnson, E.R., Vector Mechanics for Engineers – Statics and Dynamics, Tata McGraw Hill, New York, 2004.

REFERENCES

1. Merriam, J.L., Engineering Mechanics, Volume I – Statics, and Volume – II, Dynamics 2/e, Wiley International, 1998.
2. Irving, H., Shames, Engineering Mechanics, Statics and Dynamics, Third Edition, Prentice Hall of India Pvt. Ltd., 1993.

PHY181	PHYSICS LABORATORY (Common to all Branches)	L	P	T	C
		0	0	3	1

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 – Lee's disc method.
5. To determine the refractive index of the material of the prism
6. To find the prominent wave length of mercury spectrum using 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 liquid using ultrasonic Interferometer

CSE181	PROGRAMMING LANGUAGES LABORATORY (Common to all branches)	L	T	P	C
		0	0	3	1

WORD PROCESSING, SPREADSHEET, POWERPOINT

1. To create an advertisement in Word.
2. To illustrate the concept of mail merging in word.
3. To create a spread sheet to analyze the marks of the students of a class and also to create appropriate charts.
4. To create the presentation for the department using Power Point.

C PROGRAMMING

5. To write a simple menu driven calculator program using switch statement
6. To write a program to print Pascal's triangle.
7. To write a program for electricity bill preparation.
8. To write a program to print the sine and cosine series.
9. To print Fibonacci series up to N numbers.

ARRAYS AND FUNCTIONS

10. To write a program to perform Matrix multiplication.
11. To write a program to sort a given set of numbers.
12. To write a program to perform string manipulation manipulations function like string concatenations, comparison, find the length and string copy without using library functions.
13. To write a program to arrange names in alphabetical order.
14. To write a C program to check whether a number is palindrome or not using functions.
15. To write a program to calculate the factorial of the given number using functions.

POINTERS, STRUCTURES AND FILES

16. To print the mark sheet of n students using structures.
17. To write a program using pointers to access the elements of an array and count the number of occurrences of the given number in the array.
18. To write a program for find the average of numbers using files.

19. To write a program to merge the given two files arguments using command line arguments.

UNIX PROGRAMMING

20. Study of Basic UNIX Commands.
21. Implement ls Command.
22. Write a shell script to determine the properties of a given file.
23. Implement grep function.
24. Write a shell script to find the factorial of given number.
25. Write a shell script to evaluate the given expression using switch-case.

SEMESTER III

MAT202	MATHEMATICS III (Common to Bio-Technology, Chemical Engineering, Civil Engineering, CSE, EEE, EIE and Mechanical Engineering)	L	T	P	C
		3	0	0	3

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 - Dirac 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 standard 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 Edition, Reprint 2000, 1999

REFERENCES

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

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

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, Prentice-Hall of India, New Delhi, 7th edition, 2004
2. Richard M. Felder, Ronald W. Rousseau, Elementary Principles of Chemical Processes, John Wiley and Sons, Singapore, 3rd Edition, 2000
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

INTRODUCTION

A study of the following chemical industries in relation to their current status (Indian and 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

PARTICULATE SOLIDS

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

COMMINUTION

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

FILTRATION

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

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

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

MIXING AND BLENDING

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

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 AND ENGINEERING	L	T	P	C
		3	1	0	4

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

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 Engineering Thermodynamics, 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

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

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

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, 6th Edition, 12th Reprint 2001

REFERENCES

1. Johnson. R. A., Miller and Freund's Probability and Statistics for Engineers, Prentice Hall of India, New Delhi, 7th Edition, 2005
2. 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

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

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, malleable 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., Budinski, 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

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

TEXT BOOKS

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 METHODS OF ANALYSIS	L	T	P	C
		3	0	0	3

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 ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ - $\text{CaC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ 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, 6th Edition, 1986.
2. Skoog, D.A. and West D.M., Fundamentals of Analytical Chemistry, Saunders-college Publishing, 1982

REFERENCES

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

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

- Gopala Rao M. and Marshall Sittig, Dryden's Outlines of Chemical Technology, East-West Press, New Delhi, 3rd Edition, 1997

REFERENCES

- Kent, J.A.(ed), Riegel's Hand Book of Industrial Chemistry, Kluwer Academic Press, New York, 10th Edition, 2003
- M. Farhat Ali and Bassam El Ali, Handbook of Industrial Chemistry, Mc Graw Hill, New York, 2004
- 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

- Thermal Conductivity of metal rod
- Thermal Conductivity of an insulating powder
- Convective heat transfer - Forced and free convection
- Transient heat conduction
- Agitated vessel heat transfer
- Heat Transfer in Jacketed Kettle
- Plate Heat Exchanger
- Double pipe Heat Exchanger
- Shell and Tube Heat exchanger
- Vertical and Horizontal Condensers
- Evaporator
- Radiation Heat Transfer

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

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 INSTRUMENTATION DYNAMICS AND CONTROL	L	T	P	C
		3	1	0	4

INSTRUMENTATION

Principles of measurements and classification of process control instruments - Measurements of temperature - Pressure - Fluid flow - Liquid weight and weight flow rate - Viscosity and consistency - pH - Concentration - Electrical and thermal conductivity - Humidity of gases - Composition by physical and chemical properties - Spectroscopy

LAPLACE TRANSFORM AND CONTROL ENGINEERING

Importance of process control in chemical plants and systems, importance of dynamic behavior of processes in process control - Physical and block diagram representation of control system - Use of Laplace Transformation in analysis of control systems - Laplace transformation, transform of standard functions, derivatives and integrals, inversion, theorems in Laplace transformation - Applications

OPEN LOOP TRANSFER 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 - Transfer function for chemical reactors and dynamics - Transportation lag - Response of second order and higher order systems - Linearization of non-linear systems - Pade' approximation.

LINEAR CLOSED LOOP SYSTEMS

Study of various control system and their components and their transfer functions viz., controllers, final control elements, measuring instruments - Closed loop transfer functions - Transient response of simple control system - Stability criterion and analysis (Routh's Criterion) - Servo and

Regulatory problems - Root Locus, application of root locus to control system

FREQUENCY RESPONSE

Frequency response analysis - Design of control system by frequency response - Closed loop response by frequency response - Bode diagram - Stability criterion - Nyquist stability criterion - Tuning of controller settings - Introduction to advanced control systems - Cascade control - Feed forward control

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. Doebelin 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

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

- Fogler, H. S., Elements of Chemical Reaction Engineering, 4th edition, Prentice Hall of India Private limited, 2006

REFERENCES

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

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

TEXTBOOKS

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, Andrzej 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

CHE302	NUMERICAL METHODS FOR CHEMICAL ENGINEERS	L	T	P	C
		3	1	0	4

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 INTEGRAION

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

- Gerald, C.F., Wheatley, P.O., Applied Numerical Analysis, Pearson Education Asia, New Delhi, 6th Edition, Reprint 2002

REFERENCES

- 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
- 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

- ON-OFF control of thermal process
- Simulation of Proportional Controller
- Flow control, Level Control, and Pressure control loop
- Control valve characteristics
- Flow co-efficient of control valve and Rangeability of control valve
- Verifying the response of Non-Interacting level System
- Verifying the response of Interacting level System
- Effect of PI controller on flow control System
- The effect of a P controller on level process for set point and load changes
- Effect of P, PI, PID Controller on Pressure Control Loop
- Optimum controller setting using Ziegler's Nichols Method
- Optimum Controller Tuning on Level Process Station

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

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

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
2. Bruce, N., Handbook of Chemical Reactor Design Optimization and Scaleup, Mc Graw Hill, New York, 2002

CHE306	TRANSPORT PHENOMENA	L	T	P	C
		3	1	0	4

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

TEXTBOOKS

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

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 - Tricarboxylic 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

TEXTBOOKS

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 of Fermentation 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

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., Sinnott, 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

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

TEXTBOOKS

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

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

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

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

1. Solution of a single nonlinear algebraic equation by Newton Raphson method.
2. Solution of a single nonlinear algebraic equation by Regula Falsi method
3. Solution of two simultaneous nonlinear algebraic equations by Newton Raphson method
4. Solution of linear simultaneous equations by Gauss Jordan method.
5. Solution of linear simultaneous equations by Gauss Elimination method.
6. Solution of linear simultaneous equation by Gauss Seidel and Successive over Relaxation method.
7. Solution of single first order ordinary differential equation by 4th order Runge Kutta method.
8. Solution of second order ordinary differential equation by 4th order Runge Kutta method.
9. Solution of simultaneous first order ordinary differential equations by 4th order Runge Kutta method.
10. Solution of Boundary value problem by finite difference techniques.
11. Solution of Boundary value problem by finite element techniques.
12. MATLAB Exercises for Monte Carlo Simulation.
13. Wegstein's Search Method.

MAJOR ELECTIVES

CHE310	FERTILIZER TECHNOLOGY	L	T	P	C
		3	0	0	3

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

PRODUCTION, CHARACTERISTICS AND SPECIFICATION

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, 2nd Edition, 1981

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

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

REFERENCES

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

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,CuCl₂, 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
2. Geoffrey, A., Electrochemical Engineering Principles, Prentice Hall, New Jersey, 1st Edition, 1997
3. 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

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

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

CHE315	THIN FILMS	L	T	P	C
		3	0	0	3

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 - Incorporation 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 Spectroscopy, 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

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 specially drugs 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

CHE317	FOOD ENGINEERING AND TECHNOLOGY	L	T	P	C
		3	0	0	3

FUNDAMENTALS OF FOOD PROCESS ENGINEERING

Food Process Engineering - Fundamentals of food process engineering, application of quantitative methods of material and energy balances in food engineering practices

UNIT OPERATIONS IN FOOD INDUSTRIES

Unit Operations in food Industries fluid flow- Thermal process calculations, refrigeration, evaporation and dehydration operations in food processing

FOOD CANNING TECHNOLOGY

Fundamentals of food canning technology - Heat sterilization of canned food, containers - Metal, glass and flexible packaging - Canning

procedures for fruits, vegetables, meats, poultry, marine products

MECHANICAL OPERATIONS IN FOOD PROCESSING

Mechanical Operations in Food Processing Conversion operations - Size reduction and screening of solids, mixing and emulsification, filtration and membrane separation, centrifugation, crystallization, extraction

FOOD BIO TECHNOLOGY

Food Biotechnology - Dairy and cereal products, Beverages and food ingredients, High fructose corn syrup, Single cell protein

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. Bernman,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

CHE318	SAFETY IN CHEMICAL INDUSTRIES	L	T	P	C
		3	0	0	3

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

CHE319	PAPER AND PULP TECHNOLOGY	L	T	P	C
		3	0	0	3

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

Hand made 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 ENGINEERING	L	T	P	C
		3	0	0	3

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 TECHNIQUES	L	T	P	C
		3	0	0	3

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

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

REFERENCES

- Perry, R.H, Green, D.W., Perry's Chemical Engineers Hand book , McGraw Hill, New York, 6th Edition, 1990
- Schoen, H.M., New Chemical Engineering Separation Techniques, Inter Science Publications, New York, 1972

CHE322	NANOTECHNOLOGY	L	T	P	C
		3	0	0	3

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. Israelachvili, 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

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

TEXT BOOKS

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

INTRODUCTION

Problem formulation - Degree of freedom analysis - Objective functions
– Constraints and feasible region

TYPES OF OPTIMIZATION PROBLEM

Types of optimization problem - Simplex method, Barrier method -
Sensitivity analysis, examples

UNCONSTRAINED OPTIMIZATION

Convex and concave functions unconstrained NLP - Newton's method,
Quasi-Newton's method - Classical optimization techniques for
unconstrained optimization - Kuter Tucker conditions, examples

LINEAR PROGRAMMING

Linear Programming - Penalty function methods, sequential linear
programming - Feasible direction methods - Direct substitution,
quadratic programming - Penalty Barrier Augmented Lagrangian
Methods

OPTIMAL CONTROL AND DYNAMIC OPTIMIZATION

Weighted Sum of Squares method - Epsilon constrain method, goal
attainment, examples - Introduction to optimal control and dynamic
optimization

TEXT BOOKS

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

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 - Houdr 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

TEXT BOOKS

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

REFERENCES

1. Hobson, G, D and Pohl, W., Modern 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

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

REFERENCES

1. Tuncer Cebeci, Peter Bradshaw., Momentum transfer in boundary layers, Hemisphere Publishing Corporation, Washington, 1977
2. Herrmann Schlichting., Boundary Layer Theory, Springer, London, 8th Edition, 2004
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

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 Conveying, 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, lyophilisation and 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

INTRODUCTION TO 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

UNIT OPERATIONS

Unit operations for solid, liquid separation, filtration and centrifugation

PRODUCT ENRICHMENT TECHNIQUES

Adsorption - liquid, liquid extraction - aqueous two - Phase extraction, membrane separation - Ultra filtration and reverse osmosis, dialysis - Precipitation of proteins by different methods

CHROMATOGRAPHIC TECHNIQUES

Chromatography - Principles, instruments and practice - Adsorption, reverse phase, ion exchange, size exclusion, hydrophobic interaction - Bioaffinity and pseudo affinity chromatographic techniques

PRODUCT FINISHING

Crystallization, 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

CLASSIFICATION OF PARTIAL DIFFERENTIAL EQUATIONS

Classification of partial differential equations - Discretization methods, finite difference and finite volume formulations - Classification of PDES

NUMERICAL SOLUTION OF ELLIPTICAL EQUATIONS

Numerical solution of elliptical equations - Linear system of algebraic equations - Iterative solution of system of linear equation

MODEL EQUATIONS

Model Equations - Wave equations, numerical solution of parabolic equations, stability analysis - Advanced shock capturing schemes

DIFFUSION EQUATION

Solutions of convection, diffusion equation - Conservative and non-conservative schemes - Concept of artificial viscosity and numerical Diffusion

NAVIER STOKES EQUATIONS AND ALGORITHMS

Navier Stokes equations and algorithms - Basics of grid generation, numerical solution of hyperbolic equations, Burgers equation generation

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

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 CONDITION AND CONVECTION

Heat Condition and Convection - Control volume approach - Steady
and Unsteady One dimensional conduction - Two and three dimensional
- Power law scheme - Simpler 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, Griffiths, 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

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 programmes 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 Peery, 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

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), 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

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

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

REFERENCES

1. Ruthven, Douglas M., Principles of Adsorption and Adsorption Processes, Wiley, Singapore, 1984
2. Grandison., Separation Processes Principles and Applications, Ellis Harwood Ltd, Netherland, 1996

CHE410	FINITE ELEMENT METHODS	L	T	P	C
		3	0	0	3

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 elements

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

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, 1989

REFERENCES

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

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

CHE413	FERMENTATION TECHNOLOGY	L	T	P	C
		3	0	0	3

BIOMASS

Biomass, enzymes, metabolites and biotransformation - Development of fermentation industry - Component parts of a fermentation system - Microbial growth kinetics - Batch, continuous and fed batch culture - Their application in industries.

ISOLATION METHODS

The isolation, preservation and improvement of microorganisms - Isolation methods, storage methods, selection of induced mutants, recombinant systems - Selection of stable strains.

Media and Industrial formulations - Carbon and nitrogen sources, micronutrients, oxygen requirements

PREPARATION OF MEDIA AND AIR FOR PURE CULTURE FERMENTATION

Preparation of media and air for pure culture fermentation. Media sterilization, Batch and continuous sterilization processes - Design, sterilization of fibrous filters and their design.

Development of Inocula for processes involving yeast, bacteria, fungi - Aseptic inoculation of plant fermentations.

BASIC FUNCTIONS OF A FERMENTER

Basic functions of a fermenter, Aeration and agitation - Process requirements and mechanical design aspects, Maintenance of aseptic conditions, Foam control in stirred and sparged tank fermenters, Tower fermenter, Packed tower, Air lift and rotating disc fermenter - Measurement and control - Temperature, flow, agitator power, shaft power, dissolved oxygen and pH

RECOVERY AND PURIFICATION OF FERMENTATION PRODUCTS

Recovery and purification of fermentation products - Filtration and different filters for separation of particulates (cells) - Centrifuge - Cell disrupters for releasing intracellular products - Liquid extraction - Chromatography - Ultra filtration - Process technology used in production - Ethanol, butanol, acetone, citric acid, microbial enzymes, Vitamin B12, amino acids, antibiotics, Flow sheet and process description of modern processes

TEXT BOOKS

1. Stanbury, P F., Principles of Fermentation Technology, Butterworth- Heinemann, London, 2nd Edition, 1999
2. Vogel, H.C., Fermentation and Biochemical Engineering Handbook Principles, Process Design, and Equipment, Noyes Publications, 2nd Edition, 1996

REFERENCES

1. Ward, O.P., Fermentation Biotechnology Principles, Processes and Products”, John Wiley and Sons, New York, 1991
2. Tampion, J., Immobilized Cells Principles and Applications, Cambridge University Press, U.S.A, 1987

CHE414	PHARMACEUTICAL ENGINEERING	L	T	P	C
		3	0	0	3

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 - Alkylolation, 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 , 200

CHE415	BIOREACTOR DESIGN AND ANALYSIS	L	T	P	C
		3	0	0	3

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 modeling 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

MINOR ELECTIVES

CIV 367	AIR POLLUTION AND CONTROL	L	T	P	C
		3	0	0	3

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 CONTROL

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 Perelra, 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 369	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

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 Assessment Vol. I and II, Blackwell Science, 1999.

CIV 463	SOLID WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

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 Solid Waste 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

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. Arceivala, 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

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, Yeedidiah 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

8085 PROCESSOR

Functional block diagram - signals – memory interfacing – i/o ports - data transfer concepts – timing diagram – interrupt structure - instruction format - addressing modes – assembly language format – data transfer - data manipulation - control instructions – programming - subroutine instructions stack

ARCHITECTURE OF INTEL

CPU block diagrams - pin diagrams - internal descriptions of –80286 – 386 - 486 – pentium - instruction formats - Intel x86 instruction set - assembler directives

ARITHMETIC CO-PROCESSORS

80287 architecture- pin diagram - internal architecture - status register - control register - tag register - instruction set - data transfer - arithmetic comparison - transcendental operations - constant operations - control instructions - interfacing 80287 with 80286 - introduction to 80387 – 80487 - programming examples

8051 MICROCONTROLLER

8051 Microcontroller hardware- I/O pins - ports – circuits - external memory –counters – timers - serial data I/O – interrupts - interfacing to external memory – 8255 – 8051 - instruction set – addressing modes

8051 PROGRAMMING AND APPLICATIONS

Assembly language programming – I/O port programming - timer - counter programming – serial communication – interrupt programming –8051 interfacing - LCD – ADC – sensors - stepper motors - keyboard - DAC -PIC microcontroller

TEXT BOOKS

1. Ramesh S. Goankar, Microprocessor Architecture, Programming and Applications with 8085, Penran Interational publishing house, 3rd edition.2002
2. Tabak D., Advanced Microprocessors, Tata McGraw Hill, New Delhi, 2nd edition, 2001

REFERENCES

1. Hall D.V., Microprocessors and Interfacing, Tata McGraw Hill, New Delhi,2nd edition, 1992
2. Brey B.B., The Intel Microprocessors, Prentice-Hall of India Private Ltd., New Delhi, 4th edition, 2003

EEE 259	ELECTRICAL DRIVES AND CONTROLS	L	T	P	C
		3	0	0	3

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, Tata McGraw-Hill, 1998.
4. Partab, H., Art and Science and Utilisation of electrical energy, Dhanpat Rai and Sons, 1994

EEE409	INDUSTRIAL AUTOMATION	L	T	P	C
		3	0	0	3

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 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

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

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

TEXT BOOKS

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 house, 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

FLOW SHEET DESIGN

Types of flowsheets, flow sheet presentation, flow sheet symbols, line symbols and designation, process flow diagram, synthesis of steady state flowsheet, flowsheeting 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

TEXT BOOKS

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

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

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

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.

MEC405	VIBRATION ANALYSIS AND NOISE MONITORING	L	T	P	C
		3	0	0	3

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

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.

HUMANITIES ELECTIVES

HSS001	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

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 Education, Thrid edition, (First Indian Reprints 2004)
2. Shridhara Bhat K, Total Quality Management - Text and Cases, Himalaya Publishing House, First Edition, 2002
3. William J.Kolarii, Creating quality, Mcgraw Hill, 1995
4. Poornima M.Charantimath., Total quality management, Pearson Education, First Indian Reprint, 2003

HSS002	ENGINEERING MANAGEMENT	L	T	P	C
		3	0	0	3

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 organisations - 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 Koontz and Heinz Weihrich, Essentials of Management, Tata McGraw Hill publishing company Ltd.
2. Koontz, Weihrich and 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.

HSS004	INDUSTRIAL PSYCHOLOGY	L	T	P	C
		3	0	0	3

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. Dunnette, M.D., Handbook of Industrial and Organizational Psychology.
7. Blum and Taylor, Industrial Psychology.

HSS005	CONSUMER PSYCHOLOGY	L	T	P	C
		3	0	0	3

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

LEARNING 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

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 RESPONSIBILITY 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

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. Lawson, Strategic operations Management (The new competitive advantage), Vikas Publishing House, First Indian reprint, 2003

HSS008	BASICS OF ECONOMICS	L	T	P	C
		3	0	0	3

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, Tata McGraw-Hill publishing company Ltd., New Delhi, 2001

HSS010	INTERNATIONAL TRADE AND	L	T	P	C
	FINANCE	3	0	0	3

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 Form, 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, Sultan 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

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.

HSS013	COST ANALYSIS AND CONTROL	L	T	P	C
		3	0	0	3

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 Publishers.

2. S.P. Jain and K. L. Narang, Advances Cost Accounting Kalyani Publishers.
3. Cost Management, The Institute of Chartered 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

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, labeling

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.

HSS017	INTERNATIONAL ECONOMICS	L	T	P	C
		3	0	0	3

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

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

HSS023	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
		3	0	0	3

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. Saravanel, 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.

HSS025	SCIENCE FICTION: AN APPRECIATION	L	T	P	C
		3	0	0	3

This advanced optional course aims at a close analytical study of the impact of science and technology on Man and his several institutions in society as expressed in science fiction. It introduces the students to some samples of science fiction, and through a critical discussion and

analysis helps them appreciate the creative link between scientific discoveries and technological inventions and human civilization. Finally, it will further improve the student's ability to analyse scientific concepts in extended discussions and compositions. Special emphasis will be laid on increasing ability and style.

HSS026	GERMAN I	L	T	P	C
		3	0	0	3

German for science and technology, based on the book 'German for science and Technology' by stecker/Davids, for beginners grammar, noun group; verb, prepositions, pronouns, modal verbs, compound verbs, reading and translating practice. Simple colloquial German.

HSS028	FRENCH I	L	T	P	C
		3	0	0	3

Definite and indefinite articles - Adjectives - agreement with their nouns - Conjugation of verbs; to have, to be affirmative, negative and interrogative forms - Possessive adjectives. Contraction of 'of the' 'to the' (Singular and Plural) - demonstrative adjectives - The three groups of verbs - present perfect tense with 'to have' and 'to be' - The partitive article - Future tense - immediate future recent past - Reflexive verbs - Present perfect of reflexive verbs.

HSS030	SCIENCE, TECHNOLOGY AND MEDICINE IN INDIA: A HISTORICAL PERSPECTIVE	L	T	P	C
		3	0	0	3

This course is designed to provide a broad historical overview of the growth of science, technology and medicine in India. It aims to explicate to the students the rich scientific and technological heritage of India and the positive response to the advent of modern science through the colonial agency, resulting in the emergence of a viable modern scientific community in India.

Course Contents:

1. Early Indian approaches to the universe, understandings of the physical world, theories of matter and the quest to transcend existential limitations
2. Development of science and medicine till the colonial era. Astronomy of the Vedas and Aryabata, Varmaihira and Bhaskar I, Brahmagupta, the Arab connection, Sawai Jai Singh, Mathematics and Geometry: Shulabha Sutra, the Indian numerals, the decimal notations, calendars and algebra. Medicine and Surgery: Charaka and Sushruta Samhitas, Physiology, Anatomy, Materia Medica, Unani and Ayurveda. Physical and Botanical Sciences, Antiquity of Indian Chemistry and Alchemy
3. Advancements in Technology till pre-colonial times: Metallurgy, Artillery, Gun Powder technology, Persian Wheel, textile technology, the charka, bleaching, dyeing, Architecture: Monuments, Bridges, Naval Architecture, Shipbuilding and Agricultural technologies
4. Advent of colonial science: Early colonial settlement and scientific explorations. The East India company - Surveyors, Botanists and Doctors under the company's Service, The Indian Medical Service, Encounters with Indian medicine, Introduction of steam technologies, Railways, Textiles, Mining, Telegraphs, Canals and Dams
5. Indian response to modern science, the colonial restrictions and limitation, Science and nationalism and the emergence of the Indian scientific community

REFERENCES:

1. Arnold, David, Science, Technology and Medicine in colonial India Cambridge, 1999
2. Bose, D.M.S.N. Sen, and B.V. Subarayappa, A Concise History of science in India, New Delhi. 1971

3. Chattopadhyaya, Debiprasad, Science and Society in Ancient India, Calcutta, 1979
4. Headrick, D.R., The Tools of Empire: Technology and European Imperialism in the Nineteenth Century, New York, 1981
5. Jaggi, O.P History of Science, Technology and Medicine in India, 15 volumes, Delhi, 1969-84.
6. Kumar, Deepak, Science and the Raj, Delhi, 1995
7. Lourdasamy, J.B., (forthcoming) Science and National Consciousness in Bengal, c 1870-1930, Hyderabad, (Jan 2004)
8. Macleod, Roy and Deepak Kumar, eds., Technology and Culture, Delhi, 1982
9. Qaisar, AJ The Indian Response to European Technology and culture, Delhi, 1982
10. Sen, S.N. Cultural Heritage of India, Vol vi., Calcutta, 1972

Journals:

1. Studies in History of Medicine and Science.
2. Bulletin of Indian Institute of History of Medicine.
3. Indian journal of History of Science.
4. Science and culture.
5. Journal of the Asiatic Society of Bengal
- 6.

HSS033	MODERN SCIENCE IN INDIA	L	T	P	C
		3	0	0	3

The course is deal with the advent and growth of modern science in India under the aegis of colonialism and the Indian response to it. It would delineate the many ways in which the entire process was implicated not only in the political axis of colonialism and nationalism but also in the various socio-cultural developments of the period

Course Structure:

- a) What is modern Science? - The Scientific Revolution and the rise of modern science in the [1500 - 1700]
- b) The advent of modern science in India: Early travelers, missionaries, colonial settlements and scientific explorations, The east India Company - surveyors, botanists and doctors under the company's service, The Asiatic Society [1500-1757].
- c) Institutionalized Colonial Science: The various scientific departments, the Indian medical service, Introduction of new technologies - Railways, Textiles, Mining, Telegraphs, Canals and Dams. [1757-1900]
- d) Science education in colonial India: Origins of English and western education, founding of the Universities, the content of science in the curricula, setting up of technical institutes, the restrictions and limitations of colonialism. [1980-1930]
- e) The Indian response: Response to English Education, its implications for indigenous society and culture, and the role of social and religious reformers, the taste for modern science, setting up of indigenous society for the learning and cultivation of modern science. [1830-1930]
- f) The first modern scientists of India: Ramanujam, JC Bose, PC Ray, Meghnad Saha, C V Raman, S N Bose

TEXTBOOKS:

1. Arnold David Science, Technology and Medicine in Colonial India, Cambridge: Cambridge University Press 2000
2. Headrick, D.R., The Tools of Empire: Technology and European Imperialism in the Nineteenth Century, New York, 1981
3. Kuma Deepak Eds. Science and Empire: Essays in the Indian context, Delhi: Anamika Prakashan, 1991, Science and the Raj, 1857-1905. Delhi: Oxford University Press 1995
4. Qaisar, A J., The Indian response to European technology and culture, Delhi: Oxford University Press 1982
5. Sangwan S Science, Technology and colonization: Indian Experience, Delhi: Anamika Prakashan, 1990

HSS035	HISTORY OF SCIENCE AND TECHNOLOGY	L	T	P	C
		3	0	0	3

Science and Technology in the Primitive society - Development of Science and Technology in early civilized societies - Science in classical Greece - The rise and Development of early Indian Science and Technology - European Science and the Renaissance movement - Science and the Revolutionary era (Industrial, American and French Revolution) Growth of Specific Sciences in Eighteenth and 19th centuries - Heat and Energy Chemistry and Biology - Twentieth Century Science - Physical Sciences - Organization of Indian Science - Recent advances in Indian Science