AFFILIATED INSTITUTIONS

ANNA UNIVERSITY, CHENNAI

R - 2008

B.TECH. PETROCHEMICAL TECHNOLOGY

II TO VIII SEMESTERS CURRICULUM AND SYLLABI

SEMESTER II

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	HS2161	Technical English – II*	3	1	0	4
2.	MA2161	Mathematics – II*	3	1	0	4
3.	PH2161	Engineering Physics – II*	3	0	0	3
4.	CY2161	Engineering Chemistry – II*	3	0	0	3
5. a	ME2151	Engineering Mechanics **(For non-circuit branches)**	3	1	0	4
5. b	EE2151	Circuit Theory **(For branches under Electrical Faculty)**	3	1	0	4
5. c	EC2151	Electric Circuits and Electron Devices **(For branches under I & C Faculty)**	3	1	0	4
6. a	GE2151	Basic Electrical & Electronics Engineering **(For non-circuit branches)**	4	0	0	4
6. b	GE2152	Basic Civil & Mechanical Engineering **(For circuit branches)**	4	0	0	4
PRACTICAL						
7.	GE2155	Computer Practice Laboratory-II*	0	1	2	2
8.	GS2165	Physics & Chemistry Laboratory - II*	0	0	3	2
9. a	ME2155	Computer Aided Drafting and Modeling Laboratory **(For non-circuits branches)**	0	1	2	2
9. b	EE2155	Electrical Circuits Laboratory **(For branches under Electrical Faculty)**	0	0	3	2
9. c	EC2155	Circuits and Devices Laboratory **(For branches under I & C Faculty)**	0	0	3	2
				TOTAL : 28 CREDITS		
10.	-	English Language Laboratory[+]	0	0	2	-

*   **Common to all B.E. / B.Tech. Programmes**

+ Offering English Language Laboratory as an additional subject (with no marks) during 2nd semester may be decided by the respective Colleges affiliated to Anna University Chennai.

A. <u>CIRCUIT BRANCHES</u>

I   Faculty of Electrical Engineering

   1. B.E. Electrical and Electronics Engineering
   2. B.E. Electronics and Instrumentation Engineering
   3. B.E. Instrumentation and Control Engineering

II   Faculty of Information and Communication Engineering

   1. B.E. Computer Science and Engineering
   2. B.E. Electronics and Communication Engineering
   3. B.E. Bio Medical Engineering
   4. B.Tech. Information Technology

B. <u>NON – CIRCUIT BRANCHES</u>

I   Faculty of Civil Engineering

   1. B.E. Civil Engineering

II   Faculty of Mechanical Engineering

   1. B.E. Aeronautical Engineering
   2. B.E. Automobile Engineering
   3. B.E. Marine Engineering
   4. B.E. Mechanical Engineering
   5. B.E. Production Engineering

III   Faculty of Technology

   1. B.Tech. Chemical Engineering
   2. B.Tech. Biotechnology
   3. B.Tech. Polymer Technology
   4. B.Tech. Textile Technology
   5. B.Tech. Textile Technology (Fashion Technology)
   6. B.Tech. Petroleum Engineering

SEMESTER III

S.NO.	SUBJECT CODE	SUBJECT	L	T	P	C
THEORY						
1	MA2211	Transforms and Partial Differential Equation	3	1	0	4
2	CH3220	Organic Chemistry	3	0	0	3
3	GE2021	Environmental Science and Engineering	3	0	0	3
4	PC3204	Industrial Chemical Technology	3	0	0	3
5	ME2205	Electrical Drives and Control	3	0	0	3
6	CS3206	Data Structures	3	0	0	3
PRACTICAL						
7	CH3207	Organic Chemistry Laboratory	0	0	3	2
8	PC3208	Electrical Machines Laboratory	0	0	3	2
9	CS3209	Data Structures Laboratory	0	0	3	2
		TOTAL	**18**	**1**	**9**	**25**

SEMESTER IV

S.NO.	SUBJECT CODE	SUBJECT	L	T	P	C
THEORY						
1	MA3021	Numerical Methods	3	1	0	4
2	CH3211	Physical Chemistry	3	0	0	3
3	CH3212	Material Technology	3	0	0	3
4	PC3213	Process Calculations	4	0	0	4
5	CE3214	Fluid Flow Operations	3	0	0	3
6	CH3215	Mechanical Operations	3	0	0	3
PRACTICAL						
7	CH3216	Physical Chemistry Laboratory	0	0	3	2
8	CE3217	Fluid Flow Operations Laboratory	0	0	3	2
9	CH3218	Mechanical Operations Laboratory	0	0	3	2
		TOTAL	**19**	**1**	**9**	**26**

SEMESTER V

S.NO.	SUBJECT CODE	SUBJECT	L	T	P	C
THEORY						
1	PC3301	Special Functions	3	1	0	4
2	PC3318	Heat Transfer	3	1	0	4
3	PC3303	Mass Transfer Fundamentals	4	0	0	4
4	PC3304	Engineering Thermodynamics	4	0	0	4
5	PE3305	Natural Gas Engineering	4	0	0	4
6	PC3306	Petroleum Exploration and Exploitation Techniques	4	0	0	4
PRACTICAL						
7	CH3307	Heat Transfer Laboratory	0	0	3	2
8	CH3308	Technical Analysis Laboratory	0	0	3	2
9	GE3318	Communication Skills Laboratory	0	0	4	2
		TOTAL	**22**	**2**	**10**	**30**

SEMESTER VI

S.NO.	SUBJECT CODE	SUBJECT	L	T	P	C
THEORY						
1	PC3310	Process Dynamics and Control	3	1	0	4
2	PC3311	Mass Transfer Operations	3	1	0	4
3	PC3312	Principles of Chemical Kinetics	4	0	0	4
4	PC3313	Equipment Design and Drawing I	2	0	2	4
5	PC3314	Petrochemical Unit Processes	4	0	0	4
6	PC3315	Petroleum Crude Processing Technology	4	0	0	4
PRACTICAL						
7	PC3316	Process Dynamics and Control Laboratory	0	0	3	2
8	PC3317	Petroleum Physical Properties Testing Laboratory	0	0	3	2
9	CH3318	Mass Transfer Laboratory	0	0	3	2
		TOTAL	**21**	**2**	**11**	**30**

SEMESTER VII

S.NO.	SUBJECT CODE	SUBJECT	L	T	P	C
THEORY						
1	PC3401	Equipment Design and Drawing II	2	0	2	4
2	PC3402	Chemical Reaction Engineering	3	1	0	4
3	PC3403	Petrochemical Derivatives	4	0	0	4
4	PC3404	Petroleum Secondary Processing Technology	4	0	0	4
5	PC3405	Water Treatment and Management	4	0	0	4
6		Elective I	3	0	0	3
Practical						
7	PC3406	Petrochemical Analysis Laboratory	0	0	3	2
8	PC3407	Petroleum Product Testing Laboratory	0	0	3	2
9	PC3408	Chemical Reaction Engineering Laboratory	0	0	3	2
		TOTAL	**20**	**1**	**11**	**29**

SEMESTER VIII

S.NO.	SUBJECT CODE	SUBJECT	L	T	P	C
THEORY						
1	GE2022	Total Quality Management	3	0	0	3
2	PC3410	Safety and Risk Management	4	0	0	4
3		Elective II	3	0	0	3
PRACTICAL						
4	PC3411	Project Work	0	0	12	6
		TOTAL	**10**	**0**	**12**	16

LIST OF ELECTIVES

ELECTIVE FOR SEMESTER VII

S.NO.	SUBJECT CODE	SUBJECT	L	T	P	C
THEORY						
1	CH3002	Process Modelling and Simulation	3	0	0	3
2	CH3003	Transport Phenomena	3	1	0	4
3	PC3003	Process Instrumentation	3	0	0	3
4	CH3004	Fluidization Engineering	3	0	0	3
5	PC3005	Petroleum Process Equipment Auxiliaries	3	0	0	3
6	PC3006	Industrial Management	3	0	0	3

ELECTIVES FOR SEMESTER VIII

S.NO.	SUBJECT CODE	SUBJECT	L	T	P	C
THEORY						
1	PC3007	Energy Management in Chemical Industries	3	0	0	3
2	PC3008	Novel Separation Process	3	0	0	3
3	CH2032	Fertilizer Technology	3	0	0	3
4	PC3010	Multicomponent Distillation	3	0	0	3
5	PC3011	Combustion and Furnace Design	3	0	0	3
6	PC3012	Polymer Technology	3	0	0	3

HS2161   **TECHNICAL ENGLISH II**   **L T P C**
                                                                           3 1 0 4

AIM:
To encourage students to actively involve in participative learning of English and to help them acquire Communication Skills.

OBJECTIVES:
- To help students develop listening skills for academic and professional purposes.
- To help students acquire the ability to speak effectively in English in real-life situations.
- To inculcate reading habit and to develop effective reading skills.
- To help students improve their active and passive vocabulary.
- To familiarize students with different rhetorical functions of scientific English.
- To enable students write letters and reports effectively in formal and business situations.

UNIT I   **12**
Technical Vocabulary - meanings in context, sequencing words, Articles- Prepositions, intensive reading& predicting content, Reading and interpretation, extended definitions, Process description

Suggested activities:
1. Exercises on word formation using the prefix 'self' - Gap filling with preposition.
2. Exercises - Using sequence words.
3. Reading comprehension exercise with questions based on inference – Reading headings
4. and predicting the content – Reading advertisements and interpretation.
5. Writing extended definitions – Writing descriptions of processes – Writing paragraphs based on discussions – Writing paragraphs describing the future.

UNIT II   **12**
Phrases / Structures indicating use / purpose – Adverbs-Skimming – Non-verbal communication - Listening – correlating verbal and non-verbal communication -Speaking in group discussions – Formal Letter writing – Writing analytical paragraphs.

Suggested activities:
1. Reading comprehension exercises with questions on overall content – Discussions analyzing stylistic features (creative and factual description) - Reading comprehension exercises with texts including graphic communication - Exercises in interpreting non-verbal communication.
2. Listening comprehension exercises to categorise data in tables.
3. Writing formal letters, quotations, clarification, complaint – Letter seeking permission for Industrial visits– Writing analytical paragraphs on different debatable issues.

UNIT III   **12**
Cause and effect expressions – Different grammatical forms of the same word - Speaking – stress and intonation, Group Discussions - Reading – Critical reading - Listening, - Writing – using connectives, report writing – types, structure, data collection, content, form, recommendations .

Suggested activities:
1. Exercises combining sentences using cause and effect expressions – Gap filling exercises using the appropriate tense forms – Making sentences using different grammatical forms of the same word. (Eg: object –verb / object – noun)

2. Speaking exercises involving the use of stress and intonation – Group discussions–analysis of problems and offering solutions.
3. Reading comprehension exercises with critical questions, Multiple choice question.
4. Sequencing of jumbled sentences using connectives – Writing different types of reports like industrial accident report and survey report – Writing recommendations.

UNIT IV   **12**

Numerical adjectives – Oral instructions   – Descriptive writing   – Argumentative paragraphs –   Letter of application - content, format (CV /   Bio-data) - Instructions, imperative forms - Checklists, Yes/No question form – E-mail communication.

Suggested Activities:
1. Rewriting exercises using numerical adjectives.
2. Reading comprehension exercises with analytical questions on content – Evaluation of content.
3. Listening comprehension – entering information in tabular form, intensive listening exercise and completing the steps of a process.
4. Speaking - Role play – group discussions – Activities giving oral instructions.
5. Writing descriptions, expanding hints – Writing argumentative paragraphs – Writing formal letters – Writing letter of application with CV/Bio-data – Writing general and safety instructions – Preparing checklists – Writing e-mail messages.

UNIT V   **9**

Speaking - Discussion of Problems and solutions - Creative and critical thinking – Writing an essay, Writing a proposal.

Suggested Activities:
1. Case Studies on problems and solutions
2. Brain storming and discussion
3. Writing Critical essays
4. Writing short proposals of 2 pages for starting a project, solving problems, etc.
5. Writing advertisements.

TOTAL: 60 PERIODS

TEXT BOOK:
1. Chapters 5 – 8. Department of Humanities & Social Sciences, Anna University, 'English for Engineers and Technologists' Combined Edition (Volumes 1 & 2), Chennai: Orient Longman Pvt. Ltd., 2006. Themes 5 – 8 (Technology, Communication, Environment, Industry)

REFERENCES:
1. P. K. Dutt, G. Rajeevan and C.L.N Prakash, 'A Course in Communication   Skills', Cambridge University Press, India 2007.
2. Krishna Mohan and Meera Banerjee, 'Developing Communication Skills', Macmillan India Ltd., (Reprinted 1994 – 2007).
3. Edgar Thorpe, Showick Thorpe, 'Objective English', Second Edition,   Pearson Education, 2007.

EXTENSIVE READING:
1. Robin Sharma**, '**The Monk Who Sold His Ferrari', Jaico Publishing House, 2007
NOTE:
The book listed under Extensive Reading is meant for inculcating the reading habit of the students. They need not be used for testing purposes.

MA2161   **MATHEMATICS – II**   **L T P C**
                                                                      3 1 0 4
UNIT I   ORDINARY DIFFERENTIAL EQUATIONS   12
Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients.

UNIT II   VECTOR CALCULUS   12
Gradient Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelpipeds.

UNIT III   ANALYTIC FUNCTIONS   12
Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy – Riemann equation and Sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping : w= z+c, cz, 1/z, and bilinear transformation.

UNIT IV   COMPLEX INTEGRATION   12
Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor and Laurent expansions – Singular points – Residues – Residue theorem – Application of residue theorem to evaluate real integrals – Unit circle and semi-circular contour(excluding poles on boundaries).

UNIT V   LAPLACE TRANSFORM   12
Laplace transform – Conditions for existence – Transform of elementary functions – Basic properties – Transform of derivatives and integrals – Transform of unit step function and impulse functions – Transform of periodic functions.

Definition of Inverse Laplace transform as contour integral – Convolution theorem (excluding proof) – Initial and Final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

                                                    TOTAL: 60 PERIODS
TEXT BOOKS:
1. Bali N. P and Manish Goyal, "Text book of Engineering Mathematics", 3rd Edition, Laxmi Publications (p) Ltd., (2008).
2. Grewal. B.S, "Higher Engineering Mathematics", 40th Edition, Khanna Publications, Delhi, (2007).

REFERENCES:
1. Ramana B.V, "Higher Engineering Mathematics",Tata McGraw Hill Publishing Company, New Delhi, (2007).
2. Glyn James, "Advanced Engineering Mathematics", 3rd Edition, Pearson Education, (2007).
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 7th Edition, Wiley India, (2007).
4. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", 3rd Edition, Narosa Publishing House Pvt. Ltd., (2007).

PH2161   **ENGINEERING PHYSICS – II**   **L T P C**
                                                                             3 0 0 3

UNIT I   CONDUCTING MATERIALS   9
Conductors – classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.

UNIT II   SEMICONDUCTING MATERIALS   9
Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – extrinsic semiconductors – carrier concentration derivation in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration – compound semiconductors – Hall effect –Determination of Hall coefficient – Applications.

UNIT III   MAGNETIC AND SUPERCONDUCTING MATERIALS   9
Origin of magnetic moment – Bohr magneton – Dia and para magnetism – Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – anti – ferromagnetic materials – Ferrites – applications – magnetic recording and readout – storage of magnetic data – tapes, floppy and magnetic disc drives.
Superconductivity : properties - Types of super conductors – BCS theory of superconductivity(Qualitative) - High Tc superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

UNIT IV   DIELECTRIC MATERIALS   9
Electrical susceptibility – dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – internal field – Claussius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – uses of dielectric materials (capacitor and transformer) – ferroelectricity and applications.

UNIT V   MODERN ENGINEERING MATERIALS   9
Metallic glasses: preparation, properties and applications.
Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, advantages and disadvantages of SMA
Nanomaterials: synthesis –plasma arcing – chemical vapour deposition – sol-gels – electrodeposition – ball milling - properties of nanoparticles and applications.
Carbon nanotubes: fabrication – arc method – pulsed laser deposition – chemical vapour deposition - structure – properties and applications.

                                                                  TOTAL: 45 PERIODS
TEXT BOOKS:
1. Charles Kittel ' Introduction to Solid State Physics', John Wiley & sons, 7th edition, Singapore (2007)
2. Charles P. Poole and Frank J.Ownen, 'Introduction to Nanotechnology', Wiley India(2007) (for Unit V)

 REFERENCES:
1. Rajendran, V, and Marikani A, 'Materials science'Tata McGraw Hill publications, (2004) New delhi.
2. Jayakumar, S. 'Materials science', R.K. Publishers, Coimbatore, (2008).
3. Palanisamy P.K, 'Materials science', Scitech publications(India) Pvt. LTd., Chennai, second Edition(2007)
4. M. Arumugam, 'Materials Science' Anuradha publications, Kumbakonam, (2006).

CY2161   **ENGINEERING CHEMISTRY – II**   **L T P C**
                                                                         3 0 0 3

AIM

To impart a sound knowledge on the principles of chemistry involving the different application oriented topics required for all engineering branches.

OBJECTIVES
- The student should be conversant with the principles electrochemistry, electrochemical cells, emf and applications of emf measurements.
- Principles of corrosion control
- Chemistry of Fuels and combustion
- Industrial importance of Phase rule and alloys
- Analytical techniques and their importance.

UNIT I   ELECTROCHEMISTRY   9
Electrochemical cells – reversible and irreversible cells – EMF – measurement of emf – Single electrode potential – Nernst equation (problem) – reference electrodes –Standard Hydrogen electrode -Calomel electrode – Ion selective electrode – glass electrode and measurement of pH – electrochemical series – significance – potentiometer titrations (redox - Fe^{2+} vs dichromate and precipitation – Ag^+ vs Cl^- titrations) and conduct metric titrations (acid-base – HCl vs, NaOH) titrations,

UNIT II   CORROSION AND CORROSION CONTROL   9
Chemical corrosion – Pilling – Bedworth rule – electrochemical corrosion – different types – galvanic corrosion – differential aeration corrosion – factors influencing corrosion – corrosion control – sacrificial anode and impressed cathodic current methods – corrosion inhibitors – protective coatings – paints – constituents and functions – metallic coatings – electroplating (Au) and electroless (Ni) plating.

UNIT III   FUELS AND COMBUSTION   9
Calorific value – classification – Coal – proximate and ultimate analysis metallurgical coke – manufacture by Otto-Hoffmann method – Petroleum processing and fractions – cracking – catalytic cracking and methods-knocking – octane number and cetane number – synthetic petrol – Fischer Tropsch and Bergius processes – Gaseous fuels-water gas, producer gas, CNG and LPG, Flue gas analysis – Orsat apparatus – theoretical air for combustion.

UNIT IV   PHASE RULE AND ALLOYS   9
Statement and explanation of terms involved – one component system – water system – condensed phase rule – construction of phase diagram by thermal analysis – simple eutectic systems (lead-silver system only) – alloys – importance, ferrous alloys – nichrome and stainless steel – heat treatment of steel, non-ferrous alloys – brass and bronze.

UNIT V   ANALYTICAL TECHNIQUES   9
Beer-Lambert's law (problem) – UV-visible spectroscopy and IR spectroscopy – principles – instrumentation (problem) (block diagram only) – estimation of iron by colorimetry – flame photometry – principle – instrumentation (block diagram only) – estimation of sodium by flame photometry – atomic absorption spectroscopy – principles – instrumentation (block diagram only) – estimation of nickel by atomic absorption spectroscopy.

TOTAL: 45 PERIODS

TEXT BOOKS:
1. P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2002).
2. S.S.Dara "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2006).

REFERENCES:
1. B.Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).
2. B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).

| ME2151 | ENGINEERING MECHANICS | L T P C |
| | | 3 1 0 4 |

OBJECTIVE

At the end of this course the student should be able to understand the vectorial and scalar representation of forces and moments, static equilibrium of particles and rigid bodies both in two dimensions and also in three dimensions. Further, he should understand the principle of work and energy. He should be able to comprehend the effect of friction on equilibrium. He should be able to understand the laws of motion, the kinematics of motion and the interrelationship. He should also be able to write the dynamic equilibrium equation. All these should be achieved both conceptually and through solved examples.

UNIT I   BASICS & STATICS OF PARTICLES   12

Introduction – Units and Dimensions – Laws of Mechanics – Lame's theorem, Parallelogram and triangular Law of forces – Vectors – Vectorial representation of forces and moments – Vector operations: additions, subtraction, dot product, cross product – Coplanar Forces – Resolution and Composition of forces – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility – Single equivalent force.

UNIT II   EQUILIBRIUM OF RIGID BODIES   12

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions – Examples

UNIT III   PROPERTIES OF SURFACES AND SOLIDS   12

Determination of Areas and Volumes – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section, - Angle section, Hollow section by using standard formula – second and product moments of plane area – Rectangle, triangle, circle from integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia – Principal moments of inertia of plane areas – Principal axes of inertia – Mass moment of inertia – Derivation of mass moment of inertia for rectangular section, prism, sphere from first principle – Relation to area moments of inertia.

UNIT IV   DYNAMICS OF PARTICLES   12
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.

UNIT V   FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS   12
Frictional force – Laws of Coloumb friction – simple contact friction – Rolling resistance – Belt friction.
Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion.

TOTAL: 60 PERIODS

TEXT BOOK:
1. Beer, F.P and Johnson Jr. E.R. "Vector Mechanics for Engineers", Vol. 1 Statics and Vol. 2 Dynamics, McGraw-Hill International Edition, (1997).

REFERENCES:
1. Rajasekaran, S, Sankarasubramanian, G., "Fundamentals of Engineering Mechanics", Vikas Publishing House Pvt. Ltd., (2000).
2. Hibbeller, R.C., "Engineering Mechanics", Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., (2000).
3. Palanichamy, M.S., Nagam, S., "Engineering Mechanics – Statics & Dynamics", Tata McGraw-Hill, (2001).
4. Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", IV Edition – Pearson Education Asia Pvt. Ltd., (2003).
5. Ashok Gupta, "Interactive Engineering Mechanics – Statics – A Virtual Tutor (CDROM)", Pearson Education Asia Pvt., Ltd., (2002).

EE2151	**CIRCUIT THEORY**	**L T P C**
	(Common to EEE, EIE and ICE Branches)	**3 1 0 4**

UNIT I   BASIC CIRCUITS ANALYSIS   12
Ohm's Law – Kirchoffs laws – DC and AC Circuits – Resistors in series and parallel circuits – Mesh current and node voltage method of analysis for D.C and A.C. circuits.

UNIT II   NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS: 12
Network reduction: voltage and current division, source transformation – star delta conversion.
Thevenins and Novton & Theorem – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem.

UNIT III   RESONANCE AND COUPLED CIRCUITS   12
Series and paralled resonance – their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

UNIT IV   TRANSIENT RESPONSE FOR DC CIRCUITS   12
Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. with sinusoidal input.

UNIT V   ANALYSING THREE PHASE CIRCUITS   12
Three phase balanced / unbalanced voltage sources – analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – phasor diagram of voltages and currents – power and power factor measurements in three phase circuits.

TOTAL: 60 PERIODS

TEXT BOOKS:
1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis",Tata McGraw Hill publishers, 6th edition, New Delhi, (2002).
2. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis",Tata McGraw Hill, (2007).

REFERENCES:
1. Paranjothi SR, "Electric Circuits Analysis," New Age International Ltd., New Delhi, (1996).
2. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series, Tata McGraw-Hill, New Delhi (2001).
3. Chakrabati A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, (1999).
4. Charles K. Alexander, Mathew N.O. Sadik, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, (2003).

EC2151   ELECTRIC CIRCUITS AND ELECTRON DEVICES   L T P C
                 (For ECE, CSE, IT and Biomedical Engg. Branches)   **3 1 0 4**

UNIT I   CIRCUIT ANALYSIS TECHNIQUES   12
Kirchoff's current and voltage laws – series and parallel connection of independent sources – R, L and C – Network Theorems – Thevenin, Superposition, Norton, Maximum power transfer and duality – Star-delta conversion.

UNIT II   TRANSIENT RESONANCE IN RLC CIRCUITS   12
Basic RL, RC and RLC circuits and their responses to pulse and sinusoidal inputs – frequency response – Parallel and series resonances – Q factor – single tuned and double tuned circuits.

UNIT III   SEMICONDUCTOR DIODES   12
Review of intrinsic & extrinsic semiconductors – Theory of PN junction diode – Energy band structure – current equation – space charge and diffusion capacitances – effect of temperature and breakdown mechanism – Zener diode and its characteristics.

UNIT IV   TRANSISTORS   12
Principle of operation of PNP and NPN transistors – study of CE, CB and CC configurations and comparison of their characteristics – Breakdown in transistors – operation and comparison of N-Channel and P-Channel JFET – drain current equation – MOSFET – Enhancement and depletion types – structure and operation – comparison of BJT with MOSFET – thermal effect on MOSFET.

UNIT V   SPECIAL SEMICONDUCTOR DEVICES (Qualitative Treatment only) 12
Tunnel diodes – PIN diode, varactor diode – SCR characteristics and two transistor equivalent model – UJT – Diac and Triac – Laser, CCD, Photodiode, Phototransistor, Photoconductive and Photovoltaic cells – LED, LCD.

TOTAL: 60 PERIODS

TEXT BOOKS:
1. Joseph A. Edminister, Mahmood, Nahri, "Electric Circuits" – Shaum series,Tata McGraw Hill, (2001)
2. S. Salivahanan, N. Suresh kumar and A. Vallavanraj, "Electronic Devices and Circuits",Tata McGraw Hill, 2nd Edition, (2008).
3. David A. Bell, "Electronic Devices and Circuits", Oxford University Press, 5th Edition, (2008).

REFERENCES:
1. Robert T. Paynter, "Introducing Electronics Devices and Circuits", Pearson Education, 7th Education, (2006).
2. William H. Hayt, J.V. Jack, E. Kemmebly and steven M. Durbin, "Engineering Circuit Analysis",Tata McGraw Hill, 6th Edition, 2002.
3. J. Millman & Halkins, Satyebranta Jit, "Electronic Devices & Circuits",Tata McGraw Hill, 2nd Edition, 2008.

GE2151   BASIC ELECTRICAL AND ELECTRONICS ENGINEERING   L T P C
        (Common to branches under Civil, Mechanical and Technology faculty)   **4 0 0 4**

UNIT I   ELECTRICAL CIRCUITS & MEASURMENTS   12
Ohm's Law – Kirchoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – Waveforms and RMS Value – Power and Power factor – Single Phase and Three Phase Balanced Circuits.

Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.

UNIT II   ELECTRICAL MECHANICS   12
Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single Phase Transformer, single phase induction Motor.

UNIT III   SEMICONDUCTOR DEVICES AND APPLICATIONS   12
Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation.

Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier.

UNIT IV   DIGITAL ELECTRONICS   12
Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – A/D and D/A Conversion (single concepts)

UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING 12

Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations.

Communication Systems: Radio, TV, Fax, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

TOTAL: 60 PERIODS

TEXT BOOKS:
1. V.N. Mittle "Basic Electrical Engineering",Tata McGraw Hill Edition, New Delhi, 1990.
2. R.S. Sedha, "Applied Electronics" S. Chand & Co., 2006.

REFERENCES:
1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical, Electronics and Computer Engineering",Tata McGraw Hill, Second Edition, (2006).
2. Nagsarkar T K and Sukhija M S, "Basics of Electrical Engineering", Oxford press (2005).
3. Mehta V K, "Principles of Electronics", S.Chand & Company Ltd, (1994).
4. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, (2002).
5. Premkumar N, "Basic Electrical Engineering", Anuradha Publishers, (2003).

GE2152   **BASIC CIVIL & MECHANICAL ENGINEERING**   **L T P C**
(Common to branches under Electrical and I & C Faculty)   **4 0 0 4**

A – CIVIL ENGINEERING

UNIT I SURVEYING AND CIVIL ENGINEERING MATERIALS 15

Surveying: Objects – types – classification – principles – measurements of distances – angles – leveling – determination of areas – illustrative examples.

Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel sections.

UNIT II BUILDING COMPONENTS AND STRUCTURES 15
[
Foundations: Types, Bearing capacity – Requirement of good foundations.

Superstructure: Brick masonry – stone masonry – beams – columns – lintels – roofing – flooring – plastering – Mechanics – Internal and external forces – stress – strain – elasticity – Types of Bridges and Dams – Basics of Interior Design and Landscaping.

TOTAL: 30 PERIODS

B – MECHANICAL ENGINEERING

UNIT III   POWER PLANT ENGINEERING   10
Introduction, Classification of Power Plants – Working principle of steam, Gas, Diesel, Hydro-electric and Nuclear Power plants – Merits and Demerits – Pumps and turbines – working principle of Reciprocating pumps (single acting and double acting) – Centrifugal Pump.

UNIT IV   IC ENGINES   10
Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Boiler as a power plant.

UNIT V   REFRIGERATION AND AIR CONDITIONING SYSTEM   10
Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system – Layout of typical domestic refrigerator – Window and Split type room Air conditioner.

TOTAL: 30 PERIODS

REFERENCES:
1. Shanmugam G and Palanichamy M S, "Basic Civil and Mechanical Engineering",Tata McGraw Hill Publishing Co., New Delhi, (1996).
2. Ramamrutham. S, "Basic Civil Engineering", Dhanpat Rai Publishing Co. (P) Ltd. (1999).
3. Seetharaman S. "Basic Civil Engineering", Anuradha Agencies, (2005).
4. Venugopal K and Prahu Raja V, "Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam, (2000).
5. Shantha Kumar S R J., "Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai, (2000).

GE2155   COMPUTER PRACTICE LABORATORY – II   L T P C
                                                            0 1 2 2

LIST OF EXPERIMENTS

1. UNIX COMMANDS   15

   Study of Unix OS - Basic Shell Commands - Unix Editor

2. SHELL PROGRAMMING   15

   Simple Shell program - Conditional Statements - Testing and Loops

3. C PROGRAMMING ON UNIX   15

   Dynamic Storage Allocation-Pointers-Functions-File Handling

TOTAL: 45 PERIODS

HARDWARE / SOFTWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS

Hardware

- 1 UNIX Clone Server
- 33 Nodes (thin client or PCs)
- Printer – 3 Nos.

Software
- OS – UNIX Clone (33 user license or License free Linux)
- Compiler - C

			L T P C
GS2165	**PHYSICS LABORATORY – II**		**0 0 3 2**

LIST OF EXPERIMENTS

1. Determination of Young's modulus of the material – non uniform bending.

2. Determination of Band Gap of a semiconductor material.

3. Determination of specific resistance of a given coil of wire – Carey Foster Bridge.

4. Determination of viscosity of liquid – Poiseuille's method.

5. Spectrometer dispersive power of a prism.

6. Determination of Young's modulus of the material – uniform bending.

7. Torsional pendulum – Determination of rigidity modulus.

- **A minimum of FIVE experiments shall be offered.**
- **Laboratory classes on alternate weeks for Physics and Chemistry.**
- **The lab examinations will be held only in the second semester.**

			L T P C
GS2165	**CHEMISTRY LABORATORY – II**		**0 0 3 2**

LIST OF EXPERIMENTS

1. Conduct metric titration (Simple acid base)

2. Conduct metric titration (Mixture of weak and strong acids)

3. Conduct metric titration using $BaCl_2$ vs Na_2SO_4

4. Potentiometric Titration (Fe^{2+} / $KMnO_4$ or $K_2Cr_2O_7$)

5. PH titration (acid & base)

6. Determination of water of crystallization of a crystalline salt (Copper sulphate)

7. Estimation of Ferric iron by spectrophotometry.

   • **A minimum of FIVE experiments shall be offered.**

   • **Laboratory classes on alternate weeks for Physics and Chemistry.**

   • **The lab examinations will be held only in the second semester.**

ME2155   COMPUTER AIDED DRAFTING AND MODELING LABORATORY   L T P C
0 1 2 2

List of Exercises using software capable of Drafting and Modeling

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using Bspline or cubic spline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
9. Drawing isometric projection of simple objects.
10. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.

Note: Plotting of drawings must be made for each exercise and attached to the records written by students.
List of Equipments for a batch of 30 students:

   1. Pentium IV computer or better hardware, with suitable graphics facility -30 No.
   2. Licensed software for Drafting and Modeling. – 30 Licenses
   3. Laser Printer or Plotter to print / plot drawings – 2 No.

TOTAL: 45 PERIODS

EE2155   **ELECTRICAL CIRCUIT LABORATORY**   **L T P C**
                          (Common to EEE, EIE and ICE)   **0 0 3 2**

LIST OF EXPERIMENTS

1. Verification of ohm's laws and kirchoff's laws.

2. Verification of Thevemin's and Norton's Theorem

3. Verification of superposition Theorem

4. Verification of maximum power transfer theorem.

5. Verification of reciprocity theorem

6. Measurement of self inductance of a coil

7. Verification of mesh and nodal analysis.

8. Transient response of RL and RC circuits for DC input.

9. Frequency response of series and parallel resonance circuits.

10. Frequency response of single tuned coupled circuits.

TOTAL: 45 PERIODS

EC2155   **CIRCUITS AND DEVICES LABORATORY**   **L T P C**
                                                                   0 0 3 2

1. Verification of KVL and KCL
2. Verification of Thevenin and Norton Theorems.

3. Verification of superposition Theorem.

4. Verification of Maximum power transfer and reciprocity theorems.

5. Frequency response of series and parallel resonance circuits.

6. Characteristics of PN and Zener diode

7. Characteristics of CE configuration

8. Characteristics of CB configuration

9. Characteristics of UJT and SCR

10. Characteristics of JFET and MOSFET

11. Characteristics of Diac and Triac.

12. Characteristics of Photodiode and Phototransistor.

TOTAL: 45 PERIODS

ENGLISH LANGUAGE LABORATORY (Optional)   L T P C
                                                      0 0 2 -

1. Listening: **5**

Listening & answering questions – gap filling – Listening and Note taking- Listening to telephone conversations

2. Speaking: **5**

Pronouncing words & sentences correctly – word stress – Conversation practice.

Classroom Session   **20**

1. Speaking: Introducing oneself, Introducing others, Role play, Debate-Presentations: Body language, gestures, postures.
   Group Discussions etc
2. Goal setting – interviews – stress time management – situational reasons

Evaluation

(1) Lab Session – 40 marks
    Listening   – 10 marks
    Speaking   – 10 marks
    Reading   – 10 marks
    Writing   – 10 marks

(2) Classroom Session – 60 marks
    Role play activities giving real life context – 30 marks
    Presentation   – 30 marks

Note on Evaluation

1. Examples for role play situations:
   a. Marketing engineer convincing a customer to buy his product.
   b. Telephone conversation – Fixing an official appointment / Enquiry on availability of flight or train tickets / placing an order. etc.
2. Presentations could be just a Minute (JAM activity) or an Extempore on simple topics or visuals could be provided and students could be asked to talk about it.

REFERENCES:

1. Hartley, Peter, Group Communication, London: Routledge, (2004).
2. Doff, Adrian and Christopher Jones, Language in Use – (Intermediate level), Cambridge University Press, (1994).
3. Gammidge, Mick, Speaking Extra – A resource book of multi-level skills activities , Cambridge University Press, (2004).
4. Craven, Miles, Listening Extra - A resource book of multi-level skills activities, Cambridge, Cambridge University Press, (2004).
5. Naterop, Jean & Rod Revell, Telephoning in English, Cambridge University Press, (1987).

LAB REQUIREMENTS

    1. Teacher – Console and systems for students
    2. English Language Lab Software
    3. Tape Recorders.

MA2211   TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATION   L T P C
(Common to all branches)   3 1 0 4

OBJECTIVES
The course objective is to develop the skills of the students in the areas of Transforms and Partial Differtial Equations. This will be necessary for their effective studies in a large number of engineering subjects like heat conduction, communication systems, electro-optics and electromagnetic theory. The course will also serve as a prerequisite for post graduate and specialized studies and research.

UNIT I   FOURIER SERIES   9 + 3
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier Series – Parseval's identify – Harmonic Analysis.

UNIT II   FOURIER TRANSFORMS   9 + 3
Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT III   PARTIAL DIFFERENTIAL EQUATIONS   9 + 3
Formation of partial differential equations – Lagrange's linear equation – Solutions of standard types of first order partial differential equations - Linear partial differential equations of second and higher order with constant coefficients.

UNIT IV   APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS   9 + 3
Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) – Fourier series solutions in cartesian coordinates.

UNIT V   Z -TRANSFORMS AND DIFFERENCE EQUATIONS   9 + 3
Z-transforms - Elementary properties – Inverse Z-transform – Convolution theorem - Formation of difference equations – Solution of difference equations using Z-transform.

LECTURES: 45 TUTORIALS : 15   TOTAL : 60 PERIODS

TEXT BOOKS
1. Grewal, B.S, 'Higher Engineering Mathematics' 40th Edition, Khanna publishers, Delhi, (2007)

REFERENCES
1   Bali.N.P and Manish Goyal 'A Textbook of Engineering Mathematics', Seventh Edition, Laxmi Publications(P) Ltd. (2007)

2. Ramana.B.V. 'Higher Engineering Mathematics' Tata Mc-GrawHill Publishing Company limited, New Delhi (2007).

3. Glyn James, 'Advanced Modern Engineering Mathematics', Third edition-Pearson Education (2007).

4. Erwin Kreyszig 'Advanced Engineering Mathematics', Eighth edition-Wiley India (2007).

CH3220   **ORGANIC CHEMISTRY**   **L T P C**
                                                                        3 0 0 3

UNIT I   ALIPHATIC HYDROCARBONS AND ALCOHOLS   9

Alkanes – General methods of preparation – Physical and chemical properties – Alkenes – General methods of preparation – Physical and chemical properties – Markovnikov's rule – Peroxide effect – Bayer's test – Alkynes – General methods of preparation and properties monohydric alcohols – Saytzeff rule – Methods of distinguishing the three classes of alcohols – Lucas test – Dichromate test.

UNIT II   ALDEHYDES, KETONES AND ACIDS   9

General methods of preparation – Physical and chemical properties – Aldol condensation – Clemmensen reduction – Wolf-Kishner reduction – Haloform reaction – Cannizzaro reaction – Reformatsky reaction – Wittig reaction – Saturated monocarbozylic acids – Methods of preparation – Physical and chemical properties – Hell-Volhard-Zelinsky reaction – Amino acids – Methods of preparation – Physical and chemical properties.

UNIT III   CARBOHYDRATES   9

Classification of carbohydrates – Monosaccharides – Reactions of glucose and fructose – Open chain and cyclic structures of glucose and fructose – Mutarotation – Epimerization – Killiani-Fisher synthesis – Ruff degradation – Conversion of aldoses to ketoses and ketoses to aldoses – Disaccharides – Properties and structure of sucrose – Polysaccharides – Properties and structure of starch and cellulose – Derivatives of cellulose – Carboxy methyl cellulose and gun cotton.

UNIT IV   AROMATIC HYDROCARBON, AMINE AND DIAZONIUM SALT   9

Benzene – Aromaticity – Huckel rule – General methods of preparation of benzene – Electrophilic substitution reactions – Directive effects of substituents – Aromatic amino compounds – General methods of preparation – Physical and chemical properties – Carbylamines reaction – Aryldiazonium salts – Preparation and synthetic applications.

UNIT V   DYES AND DYEING   9

Colour and constitution – Synthesis – Azodyes – Methyl orange – Methyl red and congo red – Triphenylmethane dyes – Malachite green – Para-rosaniline – Alizarin – Eosin – Introduction to natural and reactive dyes.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Morrison R.T. and Boyd R.N., "Organic chemistry", 6th Edition, Prentice Hall of India (P) Ltd., 2003.
2. Arun Bahl and Bahl B.S., "Advanced Organic Chemistry", 16th Edition, S.Chand and Company Ltd., 2002.

REFERENCES

1. March J., "March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure", 5th Edition, John Wiley, 2001.
2. Finar I.L., "Organic chemistry" Vol-I, 6th Edition, Pearson Education, 2002.
3. Sharma B.K., "Industrial Chemistry", 12th Edition, Goel Publishing house, 2001.

AIM
- The aim of this course is to create awareness in every engineering graduate about the importance of environment, the effect of technology on the environment and ecological balance and make them sensitive to the environment problems in every professional Endeavour that they participates.

OBJECTIVE
- At the end of this course the student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity. The role of government and non-government organization in environment managements.

UNIT I   ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY   14
Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.
Field study of common plants, insects, birds
Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II   ENVIRONMENTAL POLLUTION   8
Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides.
Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III   NATURAL RESOURCES   10
Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion

and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.
Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV   SOCIAL ISSUES AND THE ENVIRONMENT   7
From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment protection act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V   HUMAN POPULATION AND THE ENVIRONMENT   6
Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL: 45 PERIODS

TEXT BOOKS:
1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill,NewDelhi, (2006).

REFERENCES BOOKS:
1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press (2005)

PC3204   INDUSTRIAL CHEMICAL TECHNOLOGY   L T P C
3 0 0 3

UNIT I   ALKALIES   9
Chloro-alkali industries – Manufacture of soda ash – Caustic soda – Chlorine.

UNIT II   ACIDS   9
Manufacture of sulphuric acid – Hydrochloric acid – Phosphoric acid – Nitric acid.

UNIT III   GLASSES   9

Manufacture of glasses – Special glasses – Ceramics and refractories – Paints and pigments.

UNIT IV   INDUSTRIAL GASES   9

Manufacture of carbon dioxide – Nitrogen – Hydrogen – Oxygen and acetylene.

UNIT V   FERTILIZERS   9

Nitrogen fertilizers – Synthetic ammonia – Urea – Ammonium chloride – CAN – Ammonium sulphate – Phosphorous fertilizers – Phosphate rock – Super phosphate – Triple super phosphate – MAP and DAP – Potassium fertilizers – Potassium chloride – Potassium sulphate.

TOTAL: 45 PERIODS

TEXT BOOKS
1. Austin G.T., "Shreve's Chemical Process Industries", Fifth Edition, McGraw Hill, 1998.
2. Gopala Rao M. and Sittig M., "Dryden's Outlines of Chemical Technology for the 21st Century", 3rd Edition, Affiliated East-West press, 2007.

REFERENCES
1. Shukla S.D. and Pandey G.N., "Text book of Chemical Technology" Vol-I, Vikas publishing house (P) Ltd., 1977.
2. Sharma B.K., "Industrial Chemistry", Twelfth Edition, Goel Publishing house, 2001.
3. Pandey G.N., "Text Book of Chemical Technology" Vikas publishing house (P) Ltd., 1992.

ME 2205   **ELECTRICAL DRIVES AND CONTROL**   **L T P C**
(Common to Mechanical, Production &Technology Faculty)   **3 0 0 3**

OBJECTIVES
- To understand the basic concepts of different types of electrical machines and their performance.
- To study the different methods of starting D.C motors and induction motors.
- To study the conventional and solid-state drives

UNIT I   INTRODUCTION   8

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

UNIT II   DRIVE MOTOR CHARACTERISTICS   9

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.

UNIT III   STARTING METHODS   8

Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors.

UNIT IV   CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C.
**   DRIVES   10**

Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers –applications.

UNIT V   CONVENTIONAL AND SOLID STATE SPEED CONTROL
**   OF A.C. DRIVES   10**

Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications.

**   TOTAL: 45 PERIODS**

TEXT BOOKS
1. Vedam Subrahmaniam, "Electric Drives (concepts and applications)", Tata McGraw-Hill, 2001
2. Nagrath .I.J. & Kothari .D.P, "Electrical Machines", Tata McGraw-Hill, 1998

REFERENCES
1. Pillai.S.K "A first course on Electric drives", Wiley Eastern Limited, 1998
2. M.D.Singh, K.B.Khanchandani, "Power Electronics", Tata McGraw-Hill, 1998
3. H.Partab, "Art and Science and Utilisation of electrical energy", Dhanpat Rai and Sons, 1994

CS3206   DATA STRUCTURES   L T P C
**   3 0 0 3**

UNIT I   FUNDAMENTALS OF ALGORITHMS   8

Algorithm – Analysis of algorithm – Best case and worst case complexities –   Analysis of algorithm using data structures – Performance analysis – Time complexity – Space complexity – Amortized time complexity – Asymptotic notation.

UNIT II   FUNDAMENTALS OF DATA STRUCTURES   9

Arrays – Structures – Stacks – Definition and examples – Representing stacks – Queues and lists – Queue and its representation – Applications of stack – Queue and linked lists.

UNIT III   TREES   10

Binary trees – Operations on binary tree representations – Node representation – Internal and external nodes – Implicit array representation – Binary tree traversal – Huffman algorithm – Representing lists as binary trees – Sorting and searching techniques – Tree searching – Hashing.

UNIT IV   GRAPHS AND THEIR APPLICATIONS   9

Graphs – An application of graphs – Representation – Transitive closure – Warshall's algorithm – Shortest path algorithm – A flow problem – Dijikstra's algorithm – Minimum spanning trees – Kruskal and Prim's algorithm – An application of scheduling – Linked representation of graphs – Graph traversals.

UNIT V   STORAGE MANAGEMENT   9

General lists – Operations – Linked list representation – Using lists – Freeing list nodes – Automatic list management : Reference count method – Garbage collection – Collection and compaction.

TOTAL: 45 PERIODS

TEXT BOOKS

 1. Cormen T. H.., Leiserson C. E, and Rivest R.L., "Introduction to Algorithms", Prentice Hall of India, 2007.
 2. M.A.Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 2005.

REFERENCES

1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "Computer Algorthims/C++", Universities Press (India) Private Limited, 2nd Edition, 2007.
2. Aho, A. V., Hopcroft, J. E. and Ullman, J. D., "Data Structures and Algorithms", 1st Edition, Pearson Education, 2003.
3. Gilberg, R. F. and Forouzan, B. A., "Data Structures", 2nd Edition, Thomson India Edition, 2005.
4. Kruse, R.L, Leung, B. P. and Tondo, C. L., "Data Structures and Program Design in C", Pearson Education, 2004.
5. Tanaenbaum A. S. Langram, Y. Augestein M.J, "Data Structures using C", Pearson Education, 2004.

CH3207	ORGANIC CHEMISTRY LABORATORY	L	T	P	C
		0	0	3	2

1.   Estimation of Alcohol
2.   Estimation of Aldehydes & Ketones
3.   Estimation of Phenol
4.   Pigment Analysis
5.   Ore/Alloys analysis
6.   Estimation of Amines
7.   Estimation of Glucose
8.   Preparation of Asprin
9.   Preparation of Methyl orange
10.   Preparation of Schiff's base
11.   Synthesis of Porphyrin
12.   Qualitative analysis of simple Organic compounds.
13.   Polymer Analysis
14.   Hydrolysis of Sucrose.
15.   Industrial Waste Water analysis

TOTAL: 45 PERIODS

PC3208　　　　　**ELECTRICAL MACHINES LABORATORY**　　　**L　T　P　C**
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　0　0　3　2

1. Open circuit and load characteristics of separately excited and self excited D.C. generator
2. Load test on D.C. shunt motor
3. Load test on D.C. series motor
4. Speed control of D.C. shunt motor
5. Load test on single phase transformer and open circuit and short circuit test on single phase transformer
6. Regulation of three phase alternator by E.M.F. and M.M.F. methods
7. Load test on three phase induction motor
8. No load and blocked rotor tests on three phase induction motor (Determination of equivalent circuit parameters)
9. Load test on single- phase induction motor
10. Study of D.C. motor and induction motor starters

TOTAL: 45 PERIODS

CS3209　　　　　**DATA STRUCTURES LABORATORY**　　　**L　T　P　C**
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　0　0　3　2

LIST OF EXPERIMENTS
1. Implement singly and doubly linked lists.
2. Represent a polynomial as a linked list and write functions for polynomial addition.
3. Implement stack and use it to convert infix to postfix expression
4. Implement a double-ended queue (dequeue) where insertion and deletion operations are possible at both the ends.
5. Implement an expression tree. Produce its pre-order, in-order, and post-order traversals.
6. Implement binary search tree.
7. Implement insertion in AVL trees.
8. Implement priority queue using binary heaps
9. Implement hashing with open addressing.
10. Implement Prim's algorithm using priority queues to find MST of an undirected graph.

TOTAL: 45 PERIODS

MA3021 **NUMERICAL METHODS** **L T P C**
3 1 0 4

UNIT I   **SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS**   **(10 +3)**
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton-Raphson method- Solution of linear system of equations - Gauss Elimination method – Pivoting - Gauss-Jordan methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel - Matrix Inversion by Gauss-Jordan method - Eigenvalues of a matrix by Power method and by Jacobi's method.

UNIT II   **INTERPOLATION AND APPROXIMATION**   **(8 + 3)**
Interpolation with unequal intervals - Lagrange interpolation – Newton's divided difference interpolation – Cubic Splines - Interpolation with equal intervals - Newton's forward and backward difference formulae.

UNIT III   **NUMERICAL DIFFERENTATION AND INTEGRATION**   **(9 + 3)**
Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 and Simpson's 3/8 rules – Romberg's method – Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's rules.

UNIT IV   **INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS**   **(9 + 3)**
Single step-methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first and second order equations – Multistep methods - Milne's and Adams-Bashforth predictor-corrector methods for solving first order equations.

UNIT V   **BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS**   **(9 + 3)**
Finite difference methods for solving two-point linear boundary value problems. Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat-flow equation by explicit and implicit (Crank Nicholson) methods - One dimensional wave equation by explicit method.

L: 45 T: 15 TOTAL : 60 PERIODS

TEXT BOOKS
1. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", 6th Edition, Khanna Publishers, New Delhi, 2004.
2. Sankara Rao, K. "Numerical methods for Scientists and Engineers', 3rd Edition Prentice Hall of India Private Ltd., New Delhi, 2007.

REFERENCES
1. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 5th Edition, Tata McGraw-Hill, New Delhi, 2007.
2. Gerald, C. F. and Wheatley, P. O., "Applied Numerical Analysis", 6th Edition, Pearson Education Asia, New Delhi, 2006.
3. Brian Bradie, "A friendly introduction to Numerical analysis", Pearson Education Asia, New Delhi, 2007.
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CH3211 **PHYSICAL CHEMISTRY**

L	T	P	C
3	0	0	3

UNIT I **GASEOUS STATE** **9**

Van der Waals equation – Law of equipartition principle – Translational, rotational and vibrational energies of molecules – Joule-Thomson effect – Liquefication of gases – Critical constants.

UNIT II **CHEMICAL REACTION EQULIBRIA** **9**

Law of mass action – Van't Hoff reaction isotherm – Standard free energy change – Le Chatelier's principle – Application to selected systems – Biological activity – The thermodynamics of ATP.

UNIT III **CHEMICAL KINETICS** **9**

Rate of reaction – Order – Molecularity – Integrated rate law – Kinetics of parallel and opposing reactions – Concept of activation energy – Arrhenius equation – Theory of absolute reaction rates – Kinetics of enzyme catalyzed reactions.

UNIT IV **SOLUTIONS** **9**

Ideal and non-ideal solutions – Solubility of gases in liquids – Henry's law – Completely miscible liquids – Raoult's law – Vapour pressure and boiling point diagrams – Partially miscible liquids – Critical solution temperature – Completely immiscible liquids – Nernst distribution law – Dilute solution and their colligative properties – Molecular weight determination using these properties.

UNIT V **ELECTRICAL CONDUCTANCE** **9**

Electrolytes – Strong electrolytes and weak electrolytes – Arrhenius theory of electrolytic dissociation – Debye-Huckel Onsager theory – Ostwald's dilution law – Solubility of electrolytes and solubility product – Common ion effect – Acids – Bases – Definitions based on proton transference – Dissociation constant – Amphoteric electrolyte – pH – Buffer solutions.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Atkins, P.W. and Paula, J.D., "Physical Chemistry", 8th Edition, W.H Freeman and Company, 2006.
2. Puri, B.R.and Sharma, L.R., "Principles of Physical Chemistry", S.Chand and Company Ltd., 1998.

REFERENCES

1. Mortimer, R.G., "Physical Chemistry", 2nd Edition, Academic press, 2000.
2. Soni, P.L., "Text Book of Physical Chemistry ", S.Chand and Company Ltd., 1970.
3. Bahl, B.S, Tuli, G.D. and Arun Bahl., "Essentials of Physical Chemistry", S.Chand and Company Ltd., 1998.

CH3212　　　　　　　　**MATERIAL TECHNOLOGY**

	L	T	P	C
	3	0	0	3

UNIT I　　　NATURE OF MATERIALS　　　　　　　　　　9

Micro and macro structures – Properties and definitions – Mechanical, thermal, chemical, electrical and magnetic properties – Processing of metals and alloys – Casting – Hot and cold rolling – Extrusion – Forging – Deep drawing – Plastic deformation of metal – Single crystals and poly crystalline metals – Recovery and recrystallization of plastically deformed metals.

UNIT II　　　FERROUS AND NON-FERROUS METALS　　　　9

Pure iron – Cast iron – Mild steel – Stainless steels – Special steels and alloys – High temperature steels – Iron carbide phase diagram – Heat treatment of plain steels – Carbon steels – Manufacture – Properties and application in chemical industries – Lead, tin and magnesium – Manufacturing methods – Properties and application in process industries.

UNIT III　　　POLYMERIC AND CERAMIC MATERIALS　　　　9

Polymeric Materials – Polymerization reactions – Industrial polymerization methods – Crystallinity and stereo-isomerism in same thermoplastics – Thermosetting elastomers – Creep and fracture of polymeric materials – Composite Materials – Fibre – Reinforced – Plastic composite materials – Manufacturing methods – Concrete – Asphalt and asphalt mixtures – Wood – Sandwich structures – Ceramic materials – Ceramic crystal and silicate structures – Processing of ceramics – Properties of glasses and enamels.

UNIT IV　　　INORGANIC MATERIALS　　　　　　　　9

Manufacture of cement and its properties – Special cement – Cement concrete – Reinforced and prestressed concrete – Properties and applications – Mixing and curing.

UNIT V　　　CORROSION AND COATING　　　　　　　9

Basic theories and mechanism of corrosion – Types of corrosion – Application of corrosion theories in equipment design and fabrication – Anti-corrosion methods – Organic paints and coatings – Metal coatings – Ceramic coatings – Lining.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Van Vlack, L.H., "Elements of Material Science and Engineering", 6th Edition, Prentice Hall, 1989.
2. Raghavan V., "Materials Science and Engineering: A First Course", 5th Edition, Prentice Hall of India (P) Ltd., 2004.

REFERENCES

1. William, D. and Callister, J.R., "Materials Science and Engineering: An Introduction", 7th Edition, John Wiley and Sons, 2007.
2. Smith, W F. and Hashemi J., "Foundations of Materials Science and Engineering" 3rd Edition, McGraw-Hill, 2003.
3. Clauster, H.R., "Industrial and Engineering Materials ", McGraw-Hill, 1975.

PC3213   **PROCESS CALCULATIONS**

L	**T**	**P**	**C**
4	**0**	**0**	**4**

UNIT I   BASIC CHEMICAL CALCULATIONS   5
Units and Dimensions

Basic and derived units – Use of model units in calculations – Methods of expression – Compositions of mixture and solutions.

Gas Calculations   7

Ideal and real gas laws – Gas constant – Calculations of pressure, volume and temperature using ideal gas law – Use of partial pressure and pure component volume in gas calculations – Applications of real gas relationship in gas calculation.

UNIT II   MATERIAL BALANCE   12

Stoichiometric principles – Application of material balance to unit operations like distillation – Evaporation, crystallisation, drying etc., – Material balance with chemical reaction – Limiting and excess reactants – Recycle – Bypass and purging – Unsteady state material balances.

UNIT III   HUMIDITY AND SATURATION   12

Properties of atmospheric air – Humidity of air – Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity – Use of humidity in condensation and drying – Psychrometric chart, dew point – Wet and dry bulb thermometry.

UNIT IV   FUELS AND COMBUSTION   12

Determination of composition by Orsat analysis of products of combustion of solid, liquid and gas fuels – Calculation of excess air from Orsat technique, problems on sulphur and sulphur burning compounds – Theoretical flame temperature.

UNIT V   ENERGY BALANCE
Thermo Physics   6

Heat capacity of solids, liquids, gases and solutions – Use of mean heat capacity in heat calculations – Problems involving sensible heat and latent heats – Evaluation of enthalpy.

Thermo Chemistry   7

Standard heat of reaction, heats of formation, combustion, solution, mixing etc., – Calculation of standard heat of reaction – Effect of pressure and temperature on heat of reaction – Energy balance for systems with and without chemical reaction – Unsteady state energy balances.

                                            TOTAL: 60 PERIODS

TEXT BOOKS

1. Bhatt, B.I. and Vora, S. M., "Stoichiometry", 4th Edition, Tata McGraw Hill Publishers Ltd., 2005.
2. Hougen, O.A., Watson, K.M. and Ragatz, R.A., "Chemical Process Principles", Vol. I, CBS Publishers and Distributors, 1995.

REFERENCES

1. Venkataramani, V. and Anantharaman, N., "Process calculations", Prentice Hall of India (P) Ltd., 2003.
2. Himmelblau, D., "Basic Principles and Calculations in Chemical Engineering", 6th Edition, Prentice Hall of India (P) Ltd., 2000.
3. Chopey, N.P. and Hicks, T.G., "Handbook of Chemical Engineering Calculations", 2nd Edition, McGraw Hill Inc., 1984.

CE3214	FLUID FLOW OPERATIONS	L	T	P	C
		3	0	0	3

UNIT I   PROPERTIES OF FLUIDS AND CONCEPT OF PRESSURE   9

Introduction – Physical properties of fluids – Types of   fluids – Fluid statics and its applications - Pressure – Density – Height relationships – Pressure measurement – Units and dimensions – Dimensional analysis – Dimensionless numbers.

UNIT II   MOMEMTUM BALANCE AND ITS APPLICATIONS   9

Kinematics of fluid flow – Stream line – Stream tube – Velocity potential – Newtonian and non-newtonian fluids – Time dependent fluids – Reynolds number experiment and significance –Continuity Equation – Momentum balance –   Potential flow – Bernoulli's equation – Correction for fluid friction – Correction for pump work.

UNIT III   FLOW OF INCOMPRESSIBLE FLUIDS THROUGH DUCTS   9

Flow of incompressible fluids in pipes – Laminar and turbulent flow through closed conduits –Velocity profile and friction factor for smooth and rough pipes – Heat loss due to friction in pipes and Fittings – Introduction to compressible flow – Isentropic flow through convergent and divergent nozzles and sonic velocity.

UNIT IV   FLOW OF FLUIDS THROUGH SOLIDS   9

Form drag – Skin drag – Drag co-efficient – 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 – Applications.

UNIT V   TRANSPORTATION AND METERING   9

Measurement of fluid flow – Orifice meter – Venturi meter – Pitot tube – Rotameter – Weirs and notches – Hot wire anemometers – Transportation of fluids – Positive displacement pumps – Rotary and Reciprocating pumps – Centrifugal pumps – Performance and characteristics – Air lift and diaphragm pumps.

TOTAL: 45 PERIODS

TEXT BOOKS

1. McCabe, W.L., Smith, J.C. and Harriott, P., "Unit operations of Chemical Engineering", Seventh Edition, McGraw-Hill, 2004.
2. Coulson, J.M., and Richardson, J.F., "Coulson and Richardson's Chemical Engineering", Vol. I, 3rd Edition, Butterworth Heinemann Publishers, 2004.

REFERENCES

1. Bansal, R.K., "Fluid Mechanics and Hydraulic machines", Laxmi Publications (P) Ltd., 1995.
2. Nevers, N.D., "Fluid Mechanics for Chemical Engineers", McGraw-Hill, 1991.
3. De Nevers, L., "Fluid Mechanics for Chemical Engineers", McGraw-Hill, 1994.

CH3215	MECHANICAL OPERATIONS	L	T	P	C
		3	0	0	3

UNIT I   CHARACTERISTICS OF PARTICULATE SOLIDS, SIZE REDUCTION AND SCREENING   9

Properties and characterization of particulate solids – Analysis, technical methods for measurement of size and surface area distribution of powder – Introduction to size reduction equipment – Determination of energy and power requirement in milling operations – Computer simulation techniques for mill performance – Mechanical classifiers – Screening equipment – Capacity and effectiveness.

UNIT II   FILTRATION   9

Filtration equipments – Filtration media and filter aids – Principles of filtration and clarification – Estimation of filtration parameters for compressible and incompressible cakes and calculations – Centrifugal filtration equipment and principles of operation.

UNIT III   SETTLING AND SEDIMENTATION   9

Separation based on the motion of particles through fluids – Gravity settling processes – Sedimentation – Kynch theory of sedimentation – Sedimentation thickeners – Rate of sedimentation and sedimentation zones in continuous thickeners – Design of thickeners and clarifiers – Principles of centrifugal sedimentation.

UNIT IV   AGITATION AND MIXING   9

Agitation and mixing of liquids – Agitation equipment – Axial and radial flow impellers and flow patterns in agitated vessels – Prevention of swirling – Power consumption in agitated vessels – Blending and mixing – Dispersion operations – Mixing of solids and pastes – Types of mixers.

UNIT V   STORAGE AND CONVEYING OF SOLIDS   9

Storage and conveying of solids – Bins, hoppers and silos – Flow out of bins – Design consideration of bins – Loading and unloading of solids – Bucket elevators – Apron conveyors – Belt conveyors – Types of belt conveyors – Selection considerations.

TOTAL: 45 PERIODS

TEXT BOOKS

1. McCabe, W.L., Smith, J.C. and Harriott, P., "Unit operations of Chemical Engineering", 7th Edition, McGraw Hill, 2004.
2. Badger, W.L., and Banchero, J.T., "Introduction to Chemical Engineering", Tata McGraw Hill, 1997.

REFERENCES

1. Raymond A. Kulweic., "Materials Handling Handbook", 3rd Edition, Wiley-Interscience Publications, 1985.
2. Richardson, J.F. and Harker J.H., "Coulson and Richardson's Chemical Engineering", Vol. II, 4th Edition, Butterworth Heineman, 2004.
3. Bhattacharaya., "Mechanial Operations", Khanna publishers, 2001.

CH3216   PHYSICAL CHEMISTRY LABORATORY

	L	T	P	C
	0	0	3	2

1. Molecular weight determination of Polymer by using
   a) Rast's Method
   b) Viscometer
2. Partition Coefficient Studies
   For Benzene – Water system
3. Phase rule Studies
   Simple Eutectic system
4. Conductivity Studies
   a) Precipitation Titration
   b) Mixtures of acid – Strong Base Titration
5. EMF Studies
   Estimation of Fe^{2+} by Potentiometric Titration
6. Kinetic Studies
   a) Kinetic studies of Persulphate – Iodide reaction
   b) Kinetic studies of Iodination of Acetone.
   c) Determination of Rate constant of Acid catalyst hydrolysis of an Ester.
7. Polarimetry Studies - Kinetic study of Inversion of Cane sugar.
8. Adsorption Studies - Freundlich Adsorption Isotherm
9. Determination of Transition Temperature.
10. Determination of Critical solution temperature for the Phenol - Water system.
11. Determination of Saponification value of an oil.
12. To determine the moisture & volatile contents in a given coal sample by proximate analysis.
13. pH metric measurements
    a) To prepare buffer solutions and standardization of P^Hmeter (P^H4 and 9)
    b) Determine the molarity of HCl by pH-metrically, using 0.1 M Sodium Hydroxide.

TOTAL: 45 PERIODS

CE3217	FLUID FLOW OPERATIONS LABORATORY	L	T	P	C
		0	0	3	2

1.   To verify Hagen-Poiseuille Equation.
2.   To relate Reynolds Number and Friction factor.
3.   To study the effect of coil diameter on Friction factor.
4.   To evaluate the performance of Centrifugal pump and Reciprocating Pump
5.   To verify Ergun's equation.
6.   To determine the discharge coefficient of Orifice meter, Venturimeter and Rotameter.
7.   To evaluate the performance of Weirs and Notches.
8.   To characterize the behavior of Fluidized bed.
9.   Losses due to friction in pipe lines and fittings
10. Reynold's Apparatus
11. Bernoulli's Theorem Apparatus
12. Efflux time Apparatus.
13. Calibration Test Rig for Pitot Tube
14. Flow Through Pipes, Minor Losses due to sudden expansion, Sudden Contraction

TOTAL: 45 PERIODS

CH3218	MECHANICAL OPERATIONS LABORATORY	L	T	P	C
		0	0	3	2

1.   Screen Effectiveness
2.   Jaw Crusher and Smooth roll crusher
3.   Ball Mill
4.   Vacuum Leaf Filter
5.   Plate and Frame Filter press
6.   Batch Sedimentation
7.   Cyclone Separator
8.   Terminal settling velocity - Stokes law Verification.
9.   Rod mill
10. Hammer Mill
11. Vibrating Screen
12. Continuous Thickener
13. Plate & Frame Filter press
14. Belt conveyor
15. Drop weight crusher
16. Beaker Decantation

TOTAL: 45 PERIODS

PC3301   **SPECIAL FUNCTIONS**

	L	T	P	C
	3	1	0	4

UNIT I   IMPROPER INTEGRALS AND SERIES SOLUTIONS   9

Improper integrals – Gamma and beta functions –Series solutions – Ordinary point – Regular singular point of second order linear ordinary differential equation – Series solution to a second order linear ordinary differential equation about an ordinary point and a regular singular point.

UNIT II   BESSEL FUNCTIONS   9

Bessel's equation – Bessel functions – Recurrence relations – Orthogonality property – Generating function – Equations reducible to Bessel's equation – Modified Bessel functions.

UNIT III   LEGENDRE POLYNOMIALS   9

Legendre's equation – Legendre polynomials – Rodrigue's formula generating function – Recurrence relations – Orthogonality property.

UNIT IV   HERMITE AND LAGUERRE POLYNOMIALS   9

Hermite and Leguerre equations and their solutions – Polynomials – Rodrigue's formula – Generating functions – Recurrence relations – Orthogonality property.

UNIT V   BOUNDARY VALUE PROBLEMS   9

Solution of boundary value problems involving bessel functions and legendre polynomials.

L: 45 T: 15 TOTAL: 60 PERIODS

TEXT BOOKS

1. Andrews, L.A., "Special Function for Scientist and Engineers", McGraw – Hill, 1992.
2. Narayanan, S., Manicavachagam Pillay and Ramanaiah.G, "Advanced Mathematics for Engineering Students", Vol. II, S.Viswanathan Printers Private Limited, 1985.

REFERENCES

1. Grewal, B.S., "Higher Engineering Mathematics", Khanna Publishers, 2005.
2. Jain, R.K. and Iyengar, S.R.K., "Advanced Engineering Mathematics", Narosa Publishing House, 2002.
3. Bali, N.P. and Narayana Iyengar, N.Ch., "A Textbook of Engineering Mathematics", 6th Edition, Laxmi Publications (P) Ltd., 2004.

PC3318   **HEAT TRANSFER**

L	T	P	C
3	1	0	4

UNIT I   CONDUCTION   12

Modes of heat transfer – Steady and unsteady state heat transfer – Concept of heat conduction – Fourier's law of heat conduction – General heat conduction equation in spherical coordinates – One-dimensional steady state heat conduction equation for flat plate, hollow cylinder, hollow sphere –Analogy between flow of heat and flow of electricity – Effect of temperature on thermal conductivity – Critical insulation thickness – Transient heat conduction – Lumped heat parameter model.

UNIT II   CONVECTION   12

Concept of heat transfer by convection – Natural and forced convection – Concept of LMTD – Local and overall heat transfer coefficient – Application of dimensional analysis for convection – Empirical Equations for forced convection under laminar, transient and turbulent conditions – Empirical equations for natural convection – Influence of boundary layer on heat transfer – Heat transfer through packed and fluidized beds – Heat transfer with phase change: boiling, vaporization and condensation.

UNIT III   RADIATION   12

Concept of thermal radiations – Black body concept – Stefan Boltzman's law – Emissive power – Black body radiation – Emissivity – Planck's law – Radiation between black surfaces – Gray surfaces – Radiation shields – Radiation applications – Pipe still heaters.

UNIT IV   HEAT EXCHANGERS   12

Heat exchanger types – Parallel and counter flow heat exchangers – Overall heat transfer coefficient – Log mean temperature difference for single pass – Correction factor for multi pass heat exchangers – Heat exchanger effectiveness – Number of transfer units – Chart for different configurations – Dirt factor.

UNIT V   EVAPORATORS   12

Evaporation – Single effect and multiple effect evaporation – Boiling point elevation – Effect of liquid head – Capacity and economy of multiple effect evaporators – Evaporation equipments.

                                                      TOTAL: 60 PERIODS

TEXT BOOKS

1. Kumar, D.S., "Heat and Mass Transfer", 5th Edition, S.K. Kataria and Sons, 2000.
2. McCabe,W.L. and Smith, J.C., "Unit Operations in Chemical Engineering", 5th Edition. McGraw Hill Publishing Co., 2001.

REFERENCES

1. Kern, D.Q., "Process Heat Transfer", Tata McGraw Hill Publishing Co., 1990.
2. Hollman, "Heat Transfer", 8th Edition, McGraw Hill, 1997.
3. Kreith, F., "Principles of Heat Transfer", 4th Edition, Harper and Row, 1976.

PC3303　　　　　　　**MASS TRANSFER FUNDAMENTALS**　　　　L　T　P　C
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　4　0　0　4

UNIT I　　DIFFUSION　　　　　　　　　　　　　　　　　　　　　12

Diffusion in fluids – Molecular and eddy diffusion – Measurement and calculation of diffusivities – Ordinary diffusion in multi component gaseous mixtures – Diffusion in solids – Molecular and Knudsen diffusion in solids – Theories of mass Transfer – Film theory, penetration theory and surface renewal theories of mass transfer.

UNIT II　　INTERPHASE MASS TRANSFER　　　　　　　　　12

Interphase Mass Transfer – Local and overall mass transfer coefficients – Steady state co current and counter current mass transfer process – Stage and stage efficiencies – Concept of NTU and HTU – Equilibrium and operating lines – J_D Factor – Equipments for gas-liquid contact operations – Bubble columns – Tray towers and packed towers.

UNIT III　　ABSORPTION　　　　　　　　　　　　　　　　12

Gas Absorption: Principles of absorption and desorption – Selection of solvents for absorption – Tray tower absorber – Absorption factor – Calculation of number of theoretical stages – Murphree efficiency – Point efficiency – Tray efficiency and overall tray efficiency – Calculation of actual number of trays.

Packed tower absorber – Tower packing and characteristics – Calculation of NTU, HTU, HETP and height of absorption towers – Absorption with chemical reactions.

UNIT IV　　DRYING　　　　　　　　　　　　　　　　　　12

Drying – Principle and definitions – Estimation of drying rates, drying rate curve – Critical and equilibrium moisture content – Calculation of drying time under constant drying conditions – Different types of dryers.

UNIT V　　HUMIDIFICATION AND CRYSTALLIZATION　　12

Humidification – Definitions, psychometric charts – Wet bulb temperature – Methods of humidification – Types of cooling towers, spray chambers and spray ponds.

Crystallization – Factors governing nucleation and crystal growth – Theory of Crystallization – Classification of crystallizer and their applications – Product size distribution.

TOTAL: 60 PERIODS

TEXTBOOKS

1. McCabe,W.L., Smith, J.C. and Harriot,P., "Unit Operations of Chemical Engineering", 6th Edition, McGraw – Hill Book Co., 2001.
2. Treybal, R.E., "Mass Transfer Operations", 3rd Edition, McGraw – Hill Book Co., 1980.

REFERENCES

1. Coulson, J.M. and Richardson, J.F., "Chemical Engineering", Vol.I, II and III, Pergamon Press, 1977.
2. Bennett, C.O. and Myers, J.E., "Momentum, Heat and Mass Transfer", McGraw Hill Book Company, 3rd Edition, 1983.
3. Christie J. Geankoplis, "Transport Processes and Unit Operations", 3rd Edition, Prentice Hall of India Pvt. Ltd, 2000.

PC3304 **ENGINEERING THERMODYNAMICS** L T P C
4 0 0 4

UNIT I FUNDAMENTAL CONCEPTS AND FIRST LAW OF THERMODYNAMICS 12

Scope of thermodynamics – Basic concepts – Thermodynamic system – State and equilibrium – Process and cycles – Temperature and zeroth law of thermodynamics – Properties of pure substances – First law of thermodynamics – First law analysis of closed systems and control volumes and its application.

UNIT II ENTROPY AND THE SECOND LAW OF THERMODYNAMICS 12

The Clausius inequality – Entropy – Causes of entropy change – Entropy change of pure substances – Thermal energy reservoirs – Heat engines – Perpetual motion machines – Reversible and irreversible processes – The Carnot cycle and principles – The Carnot Heat engine – The second law efficiency – Second law analysis of open and closed systems.

UNIT III REFRIGERATION, VAPOR and COMBINED POWER CYCLES 12

Refrigerators and Heat pumps – The Carnot refrigerator and heat pumps – The reversed Carnot cycle – Ideal and Actual vapor compression Refrigeration cycle – Selection of right refrigerants – Heat pumps – Absorption refrigerator system – The Carnot vapor cycle – Rankine cycle – Cogeneration – Second law analysis of vapor power cycles.

UNIT IV PVT RELATIONS AND THERMODYNAMIC RELATIONS 12

PVT relations for gases and liquids – Equations of state – Cubic equations of state – Thermodynamic properties from equations of state – Compressibility factor – Generalized properties of fluids – Law of corresponding state – Acentric factor – gas mixtures.

Thermodynamic relations – Maxwell's relations – Estimation of thermodynamic properties– Thermodynamic properties of homogeneous mixtures – Partial molar properties, Fugacity and fugacity coefficients – Lewis and Randall rule – Property changes of mixing, activity – Excess properties, activity coefficients.

UNIT V PHASE EQUILIBRIA AND CHEMICAL REACTION EQUILIBRIA 12

Phase equilibria – Pure component and mixtures – Van Laar, Margules equation – Group contribution method – Gibb's Duhem equation – Consistency tests – Partially miscible and immiscible systems – Azeotropes – Retrograde condensation – Thermodynamic diagrams.

Chemical equilibria – Heat effects – industrial reactions – Free energy calculations – Homogeneous and heterogeneous reactions – Equilibrium composition.

TOTAL: 60 PERIODS

TEXT BOOKS

1. Smith, J.M. and Van Ness, "Introduction to Engineering Thermodynamics", 5th Edition, McGraw Hill, 1996.
2. Narayanan, K.V., "A Text Book of Chemical Engineering Thermodynamics", Prentice Hall of India, 2002.

REFERENCES
1. Hougen and Watson, "Chemical Process Principles" Vol. II, CBS Publishers, 2002.
2. Kyle, "Chemical and Process Thermodynamics", 2nd Edition, Prentice Hall of India, 2000.
3. Rao,Y.V.C., "Chemical Engineering Thermodynamics", Universities Press, 1997.

PE3305	NATURAL GAS ENGINEERING	L	T	P	C
		4	0	0	4

UNIT I   PROPERTIES AND COMPOSITION OF NATURAL GAS   12

Natural gas origin – Composition of natural gas – Sources of Natural gas – Thermodynamics properties – Compressibility factor and chart for natural gas – Heating value and flammability limit of natural gas.

UNIT II   ESTIMATION AND PRODUCTION OF NATURAL GAS   12

Estimation of gas reserves by volumetric method – Production of natural gas – Pressure decline method – Problems in the production of natural gas – Field separation.

UNIT III   GAS FROM CONDENSATE OIL FIELDS   12

Processing of condensate well fluids – Cycling of gas condensate reservoirs – Sweep patterns – Katy cycling plant.

UNIT IV   ACID GAS TREATING OF NATURAL GAS   12

Acid gas removal: Metal oxide process – Slurry process – Amine process – Carbonate washing process – Methanol based process and other process – Sulphur recovery process.

UNIT V   DEHYDRATION OF NATURAL GAS AND NGL RECOVERY   12

Dehydration: Glycol dehydration – Solid desiccant dehydration.

NGL Recovery: Refrigeration process – Lean oil absorption process – Solid bed adsorption and membrane separation process – NGL fractionation.

TOTAL: 60 PERIODS

TEXT BOOKS
1. Katz and Lee "Hand Book of Natural Gas Engineering" McGraw Hill, 1968.
2. Lyons, W.C., "Standard Handbook of Petroleum and Natural Gas Engineering", Vol. 2, Gulf Professional Publishing, Elsevier Inc., 2006.

REFERENCES
1. Katz, D. L. and Lee, R.L., "Natural Gas Engineering", McGraw Hill, 1990.
2. Dring, M.M., "The Natural Gas Industry – A Review of World Resources and Industrial Applications", Butterworth, 1974.
3. Saied Mokhatab, William A. Poe, and James G. Speight, "Handbook of Natural Gas Transmission and Processing", Gulf Professional Publishing, Elsevier Inc., 2006.

PC3306   **PETROLEUM EXPLORATION AND**   **L   T   P   C**
                         EXPLOITATION TECHNIQUES   **4   0   0   4**

UNIT I   ORIGIN AND OCCURRENCE OF PETROLEUM AND SEDIMENTRARY ENVIRONMENT   12

Origin of oil – Important factors that control petroleum occurrence – Migration and accumulation – Source and reservoir rocks – Oil bearing rocks – Continental environment – Transitional environment – Marine environment.

UNIT II   EXPLORATION METHODS, WELL PROGNOSIS AND ECONOMIC ANALYSIS   9

Geological exploration methods – Geophysical exploration methods – Geochemical methods prognostication – Classification of drilling locations – Economic analysis – Well programme – Geotechnical order.

UNIT III   GEOLOGICAL STRUCTURE AND GEOLOGGING   12

Various traps – Anticline – Fracturing – Well logging – Geological control – Gas logging – Drilling control important formation evaluation using wireline logging data.

UNIT IV   DRILLING FLUIDS AND WORK COMPLETION   12

Drilling Fluids: Function, composition, and classification – Packer fluid – Casing packs – Solids removal – Completion methods – Various stimulation methods.

UNIT V   OFF – SHORE TECHNOLOGY   12

Seismic technology – Sniffer survey – Drilling technology – Off-share rigs – Primary and secondary enhanced oil recovery techniques and methods – Major well complication and Remedies.

L: 45 T: 15 TOTAL: 60 PERIODS

TEXT BOOKS
1. Bhagwan Sahay "Petroleum Exploration and Exploitation Practices" Allied Publishers Ltd., Chennai, 1994.
2. Richard Dawe, "Modern Petroleum Technology", Vol.I, Upstream, 6th Edition, John and Wiley Sons Ltd, 2000.

REFERENCES
1. Howard B. Bradley, "Petroleum Engineering Handbook", Society of Petroleum Engineers, 1987.
2. Norman J. Hyne., "Nontechnical Guide to Petroleum Geology, Exploration, Drilling and Production", 2nd Edition, Pennwell Books, 2001.
3. Shay B., "Wellsite Geological Techniques for Petroleum Exploration" Allied Publishers Ltd., 1991.

CH3307   **HEAT TRANSFER LABORATORY**

		L	T	P	C

1.   Determination of heat transfer coefficient using composite wall.   **0   0   3   2**

2.   Determination of heat transfer coefficient using convection apparatus.

3.   Determination of Stefan Boltzman constant using Stefan Boltzman apparatus.

4.   Determination of condensing Heat transfer coefficient using vertical condenser.

5.   Determination of condensing heat transfer coefficient using horizontal condenser.

6.   Study the effect of coil diameter on heat transfer coefficient.

7.   Determination of overall heat transfer coefficient using shell and tube heat

      exchanger.

8.   Determination of overall heat transfer coefficient using double pipe heat
      exchanger.

9.   Determination of overall heat transfer coefficient using plate type heat exchanger.

10.   Study the effect of evaporation using jacketed pan evaporator and open pan
      evaporator.

TOTAL: 45 PERIODS

CH3308   **TECHNICAL ANALYSIS LABORATORY**   **L   T   P   C**

1.   Oil Analysis: **0   0   3   2**
      a) Acid value
      b) Saponification value
      c) Iodine value

2.   Soap Analysis:
      a) Moisture and Volatile matter
      b) Fatty acid content of Soap
      c) Total Alkali
      d) Free alkali or free fatty acid

3.   Determination of CaO in the given sample of commercial lime.

4. Analysis of water:
   a) Total solids including suspended matter
   b) pH
   c) Conductivity
   d) Alkalinity
   e) Permanent Harness
   f) Temporary Hardness

5. Cement Analysis
   a) Loss on ignition
   b) Insoluble residue
   c) Estimation of SO_3, Silica (Sio_2), Lime (CaO), Magnesia (MgO), Iron and Aluminium
      Oxides (R_2O_3).

6. Estimation of Nitrogen by Kjeldahl method

7. Estimation of metal ions (Copper, Nickel, Chromium).

8. Effluent water Analysis (COD, BOD, DO, TDS, TSS)

9. Estimation of available chlorine in the given bleaching powder

TOTAL: 45 PERIODS

GE3318 **COMMUNICATION SKILLS LABORATORY** **L T P C**
0 0 4 2

Globalisation has brought in numerous opportunities for the teeming millions, with more focus on the students' overall capability apart from academic competence. Many students, particularly those from non-English medium schools, find that they are not preferred due to their inadequacy of communication skills and soft skills, despite possessing sound knowledge in their subject area along with technical capability. Keeping in view their pre-employment needs and career requirements, this course on Communication Skills Laboratory will prepare students to adapt themselves with ease to the industry environment, thus rendering them as prospective assets to industries. The course will equip the students with the necessary communication skills that would go a long way in helping them in their profession.

OBJECTIVES:

▪ To equip students of engineering and technology with effective speaking and listening skills in English.
▪ To help them develop their soft skills and interpersonal skills, which will make the transition from college to workplace smoother and help them excel in their job.
▪ To enhance the performance of students at Placement Interviews, Group Discussions and other recruitment exercises.

I. PC based session periods	(Weightage 40%)	24

A. ENGLISH LANGUAGE LAB   (18 Periods)

1. LISTENING COMPREHENSION: (6)
Listening and typing – Listening and sequencing of sentences – Filling in the blanks - Listening and answering questions.

2. READING COMPREHENSION: (6)
Filling in the blanks - Close exercises – Vocabulary building - Reading and answering questions.

3. SPEAKING: (6)
Phonetics: Intonation – Ear training - Correct Pronunciation – Sound recognition exercises – Common Errors in English.

Conversations: Face to Face Conversation – Telephone conversation – Role play activities (Students take on roles and engage in conversation)

B.   DISCUSSION OF AUDIO-VISUAL MATERIALS   (6 PERIODS)

(Samples are available to learn and practice)

1.   RESUME / REPORT PREPARATION / LETTER WRITING   (1)

Structuring the resume / report - Letter writing / Email Communication - Samples.

2.   PRESENTATION SKILLS: (1)
Elements of effective presentation – Structure of presentation - Presentation tools – Voice Modulation – Audience analysis - Body language – Video samples

3.   SOFT SKILLS: (2)
 Time management – Articulateness – Assertiveness – Psychometrics – Innovation and Creativity - Stress Management & Poise - Video Samples

4.   GROUP DISCUSSION: (1)
Why is GD part of selection process ? - Structure of GD – Moderator – led and other GDs - Strategies in GD – Team work - Body Language - Mock GD -Video samples

5.   INTERVIEW SKILLS: (1)
Kinds of interviews – Required Key Skills – Corporate culture – Mock interviews- Video samples.

II. Practice Session	(Weightage – 60%)	24

1.	**Resume / Report Preparation / Letter writing**: Students prepare their own resume and report.	**(2)**
2.	**Presentation Skills:** Students make presentations on given topics.	**(8)**
3.	**Group Discussion**: Students participate in group discussions.	**(6)**
4.	**Interview Skills**: Students participate in Mock Interviews	**(8)**

TEXT BOOKS

1. Anderson, P.V, **Technical Communication**, Thomson Wadsworth, Sixth Edition, New Delhi, 2007.
2. Prakash, P, **Verbal and Non-Verbal Reasoning**, Macmillan India Ltd., Second Edition, New Delhi, 2004.

REFERENCES

1. John Seely, **The Oxford Guide to Writing and Speaking**, Oxford University Press, New Delhi, 2004.
2. Evans, D, **Decisionmaker**, Cambridge University Press, 1997.
3. Thorpe, E, and Thorpe, S, **Objective English**, Pearson Education, Second Edition, New Delhi, 2007.
4. Turton, N.D and Heaton, J.B, **Dictionary of Common Errors**, Addison Wesley Longman Ltd., Indian reprint 1998.

LAB REQUIREMENT

1. Teacher console and systems for students.
2. English Language Lab Software
3. Career Lab Software

Requirement for a batch of 60 students

Sl.No.	Description of Equipment	Quantity required
1.	**Server** o PIV system o 1 GB RAM / 40 GB HDD o OS: Win 2000 server o Audio card with headphones (with mike) o JRE 1.3	1 No.
2.	**Client Systems** o PIII or above o 256 or 512 MB RAM / 40 GB HDD o OS: Win 2000 o Audio card with headphones (with mike) o JRE 1.3	60 No.
3.	Handicam Video Camera (with video lights and mic input)	1 No.

4.	Television - 29"	1 No.
5.	Collar mike	1 No.
6.	Cordless mikes	1 No.
7.	Audio Mixer	1 No.
8.	DVD Recorder / Player	1 No.
9.	LCD Projector with MP3 /CD /DVD provision for audio / video facility - **Desirable**	1 No.

PC3310 **PROCESS DYNAMICS AND CONTROL**

L	T	P	C
3	1	0	4

UNIT I   FIRST ORDER SYSTEMS   12

Linear open to loop systems – Laplace transformation – Transform of standard functions – First order and linearised first order systems – Response to various disturbances – Inversion – Theorems in laplace transformation – Applications.

UNIT II   HIGHER ORDER SYSTEMS   12

First order in series – Linearization and its application in process control – Higher order systems – Second order and Transportation lag – Response to various disturbances.

UNIT III   CLOSED LOOP CONTROL SYSTEMS   12

Closed loop control systems – Development of block diagram for feed – back control systems – Servo and regulator problems – Transfer function for controllers and final control element – Principles of pneumatic and electronic controllers – Transient response of closed-loop control systems and their stability.

UNIT IV   FREQUENCY RESPONSE   12

Introduction to frequency response of closed-loop systems – Routh analysis – Control system design by frequency – Bode diagram – Stability criterion – Tuning of controller settings.

UNIT V   SPECIAL CONTROLS   12

Cascade – Feed forward and ratio control – Dead time compensation – Internal model control – Control valves – Process identification.

TOTAL: 60 PERIODS

TEXT BOOKS

1. Coughnowr, D.P., "Process Systems Analysis and Control", 2nd Edition, McGraw Hill , 1991.
2. Smith, C.A. and Corripio, A.B., "Principles and Practice of Automatic Process Control", 2nd Edition, John Wiley, 1997.

REFERENCES

1. Harriot, P., "Process Control", Tata McGraw Hill, 1984.
2. George Stephanopolous., "Chemical Process Control", Prentice – Hall of India Pvt. Ltd., 1990.
3. Patranabis, D., "Principles of Process control", 2nd Edition, Tata McGraw – Hill Publishing Co. Ltd., 1981.

PC3311   **MASS TRANSFER OPERATIONS**

	L	T	P	C
	3	1	0	4

UNIT I   DISTILLATION   9

Basic concepts of distillation: Vapour- liquid equilibrium pressure – Temperature-concentration – phase diagram – Isothermal and isobaric equilibrium – Relative volatility – Ideal solutions – Raoult's law – Henry's law – Deviations from ideality – Minimum and maximum boiling azeotropes.

Different Methods of distillation: flash, steam, vacuum, molecular, azeotropic and extractive distillations.

UNIT II   CONTINUOUS FRACTIONATION   9

Multistage tray tower : Material and enthalpy balance of a fractionator – Mccabe - Thiele Method – Introduction of feed – Influence on operating lines – q-lines and location of feed tray – Effect of reflux ratio – Total reflux, minimum reflux, optimum reflux – Lewis-Sorel method – Ponchon- Savarit method – Reboiler arrangements – Use of open steam – Feed conditions.

UNIT III   LIQUID – LIQUID EXTRACTION   9

Description of liquid extraction – Terminologies – Application of ternary liquid equilibrium – Representation in equilateral triangular co-ordinate of different type systems – Effect of temperature – Criteria for selection of solvent – Stage wise and continuous contact extractors – Types of extractors and their brief description – Stage wise contact – Cross and counter current extraction – Graphical method of determining number of stages – composition and minimum solvent requirement.

UNIT IV   ADSORPTION   9

 Types of adsorption – Nature of adsorbents – Adsorption equilibria – Adsorption hysteresis adsorption isotherms – Effect of temperature and pressure – Freundlich equation – Stage wise adsorption: Single and multistage crosscurrent adsorption – Multistage countercurrent adsorption – Break through curves and rates of adsorption – Calculations of composition and number of stages.

UNIT V   LEACHING   b9

Solid liquid extraction: Description of leaching operations and technologies – Applications of leaching – Preparation of solid – Methods of Operation and classification of equipment – Solid – Liquid Equilibrium in leaching – Multi stage cross and counter current leaching – Calculation of composition and number of stages.

L: 45 T: 15 TOTAL: 60 PERIODS

TEXT BOOKS
1. Mccabe, W.L., Smith, J.C. and Harriot, P., "Unit Operations in Chemical Engineering",   6th Edition, McGraw Hill Book Co., 2001.
2. Treybal, R.E., "Mass Transfer Operations", 3rd Edition, McGraw Hill Book Co., 1980.

REFERENCES
1. Coulson, M. and Richardson, J.F., "Chemical Engg.", Vol-II, 3rd Edition, Pergamon Press, 1987.
2. Alan S. Foust., Leonard A. Wenzel., Curtis W. Clump., Louis Maus., and L.Bryce Andersen, "Principles of Unit Operations", 2nd Edition, John Wiley and Sons (Asia) Pvt. Ltd,1994.
3. Geankopolis, C.J., "Transport Processes in Chemical Operations", 3rd Edition, Prentice Hall of India, 1996.

PC3312	PRINCIPLES OF CHEMICAL KINETICS	L	T	P	C
		4	0	0	4

UNIT I   REACTION KINETICS   12

Chemical kinetics – Classification of chemical reactions – Concentration and temperature dependent term of rate equation – Arrhenius, collision and transition state theory – Searching for a mechanism.

UNIT II   INTERPRETATION OF BATCH REACTOR DATA   12

Integral and differential methods of analysis – Half-life method – Zero-order reaction – Empirical rate equation of nth order – Irreversible first and second order reactions for variable and constant volume systems.

UNIT III   VARIOUS TYPES OF REACTOR DESIGN   12

Ideal Reactors – Batch Reactor – Plug flow reactor – Mixed flow reactor – Space time – Space velocity – Performance equations and their graphical representation.

UNIT IV   HEAT EFFECTS   12

Temperature and pressure effects on single and multiple reactions – Adiabatic – Non-adiabatic – Isothermal and non-isothermal operations.

UNIT V   DESIGN OF REACTOR FOR SINGLE and MULTIPLE REACTIONS 12

Single reactions – Size comparison of single reactors – Recycle reactor – Autocatalytic reactions. Multiple reactions – Irreversible reactions in series and parallel.

TOTAL: 60 PERIODS

TEXT BOOKS
1. Levenspiel, O., "Chemical Reaction Engineering", 3rd Edition, John Wiley, 1999.
2. Fogler, W., "Chemical Reaction Engineering", 3rd Edition, Prentice Hall of India, 1999.

REFERENCES

1. Smith, J.M., "Chemical Engineering Kinetics", 3rd Edition, McGraw Hill, ,, 1981.
2. Dawande, S.D., "Principles of Reaction Engineering", 1st Edition, Central Techno Publications, 2001.
3. Richardson, J.F. and Peacock, D.G., "Coulson Richardson, Chemical Engineering." Vol. III, 3rd Edition, Asian Books (P) Ltd.

PC3313	EQUIPMENT DESIGN AND DRAWING I	L	T	P	C
	(To Consider as Practical Subject for Examination Purpose)	2	0	2	4

UNIT I   DESIGN OF PIPE FITTINGS AND JOINTS   9

Design and schematic of simple bolts and screws – Riveted joints – Design and drawing of shafts and couplings.

UNIT II   DESIGN OF REACTION VESSEL AND STORAGE TANK   9

Design and schematic of storage tank, (vertical and horizontal) supports, agitated vessel.

UNIT III   DESIGN OF HIGH PRESSURE SYSTEMS   9

Design of high pressure vessels and reactors.

UNIT IV   DESIGN OF PHASE SEPARATION EQUIPMENT   9

Design of physical separation equipments such as cyclones, centrifuges, thickeners, filtration equipment

UNIT V   DRAWING OF HEAT EXCHANGERS AND COLUMNS   9

Drawing of physical process equipments such as double pipe heat exchangers – Shell and tube heat exchangers – Plate and frame heat exchangers – Distillation columns and reactors.

L: 45 P: 15 TOTAL: 60 PERIODS

TEXT BOOKS

1. Dawande, S.D., "Process Design of Equipments" Central Techno Publishers.
2. Perry, R. H., "Chemical Engineers Handbook", 7th Edition, McGraw Hill, 1998.

REFERENCES

1. Coulson, J. M. and Richardson, J. F., "Chemical Engineering", Vol 6, Butterworth Heinmann, 2000.
2. Walas, S.M., "Chemical Process Equipment" Butterworth Heinmann, 1998.
3. Joshi, M. V., "Process Equipment Design", 2nd Edition, Mac Millan Press, 1996.
4. Brownell, L. E. and Young, E.H., "Process Equipment Design", John Wiley, 1968.

Note: Necessary Data Book is to be issued while conducting Practical Examination

PC3314 **PETROCHEMICAL UNIT PROCESSES** **L T P C**

4 0 0 4

UNIT I **FEED STOCK AND SOURCE OF PETROCHEMICALS** **12**

Overview of Petrochemical Industry – The key growth area of India, Economics – Feed stock selections for Petrochemicals – Steam cracking of Gas and Naphtha to produce Olefins, Diolefins and Production of Acetylene – Cracker product separation and BTX separation.

UNIT II **NTHESIS GAS PRODUCTION** **12**

Steam reforming of Natural gas – Naphtha and Heavy distillate to produce Hydrogen and Synthesis gas – Production of Methanol – Oxo process.

UNIT III **UNIT PROCESSES I** **12**

Fundamental and Technological principled involved in Alkylation – Oxidation – Nitration and Hydrolysis.

UNIT IV **UNIT PROCESSES II** **12**

Fundamental and Technological principled involved in Sulphonation, Sulfation and Isomerisation.

UNIT V **UNIT PROCESSES III** **12**

Fundamental and Technological principles involved in Halogenation and Esterification

TOTAL: 60 PERIODS

TEXT BOOKS
1. Bhaskara Rao, B.K., "A Text on Petrochemicals", Khanna Publishers, 2000.
2. Sukumar Maiti, "Indroduction to Petrochemicals", 2nd Edition, Oxford and IBH Publishers, 2002.

REFERENCES
1. Margaret Wells, "Handbook of Petrochemicals and Processes", 2nd Edition, Ash Gate Publishing Limited, 2002.
2. Sami Matar, and Lewis F. Hatch., "Chemistry of Petrochemical Processes", 2nd Edition, Gulf Publishing Company, 2000.
3. Dryden, C.E., "Outlines of Chemical Technology", 2nd Edition, Affiliated East-West Press, 1993.

PC3315	**PETROLEUM CRUDE PROCESSING**	**L**	**T**	**P**	**C**
	TECHNOLOGY	**4**	**0**	**0**	**4**

UNIT I   GENERAL   12

Origin – Exploration and production of petroleum – Types of crudes, crude composition –Characteristics and classification – Crude oil properties – Indigenous and imported crudes – Crude availability Vs demands.

UNIT II   TESTING OF PETROLEUM PRODUCTS   12

IS 1448: Standard – Testing of Petroleum crude – Products: Specifications and their Significance.

UNIT III   CRUDE PROCESSING   12

Pretreatment of crude for Refining – Dehydration and desalting – Atmospheric distillation, Vacuum distillation of residue products – Types of trays, flow pattern in the trays – Reflux types and its significance.

UNIT IV   LUBE DISTILLATE TREATMENT TECHNIQUES   12

Treatment techniques for vacuum distillates with different processes like solvent extraction – Deasphalting, dewaxing, hydrofining, catalytic dewaxing and clay contact process – Production of lubricating oils.

UNIT V   BITUMEN PROCESSING and FINAL TREATMENT TECHNIQUES   12

Asphalt manufacture, Air blowing technology, Bitumen Types and their properties, Acid gas removal and sulphur removal techniques.

                                                                                      TOTAL: 60 PERIODS

TEXT BOOKS

1. Ram Prasad, "Petroleum Refining Technology", Khanna Publishers. .
2. Bhaskara Rao, B.K., "Modern Petroleum Refining Processes", 3rd edition, Oxford and IBH Publishing Company Pvt. Ltd.

REFERENCES

1. James H. Gary and Glenn E. Handwerk., "Petroleum Refining Technology and Economics", 4th Edition, Marcel Dekker Inc., 2001.
2. Nelson, W.L., "Petroleum Refinery Engineering", McGraw Hill Publishing Company Limited, 1985.
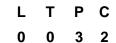3. Hobson, G.D., "Modern Petroleum Refining Technology ", 5th Edition, John Wiley Publishers, 1984

PC3316	PROCESS DYNAMICS AND CONTROL LABORATORY	L	T	P	C
		0	0	3	2

1. ON-OFF control of thermal process
2. Flow control loop and Flow Transmitter
3. Level Control loop and Level Transmitter
4. Pressure control loop and Pressure Transmitter
5. Control valve characteristics
6. Verifying the response of Non-Interacting and interacting level System
7. Optimum controller setting using Ziegler's Nichols Methods
8. Optimum Controller Tuning on Level Process Station
9. pH control system
10. First order and second order system
11. Computer controlled heat exchanger (Shell and tube and Double pipe)
12. Pneumatic control valve positioned trainer
13. Cascade control trainer
14. I/P and P/I converter

*Minimum 10 experiments shall be offered.

TOTAL: 45 PERIODS

PC3317	PETROLEUM PHYSICAL PROPERTIES TESTING LABORATORY	L	T	P	C
		0	0	3	2

1. Determination of flash point by Pensky Marten Closed Cup Apparatus

2. Determination of flash point by Abel Open cup Apparatus

3. Determination of Kinematic Viscosity by Redwood viscometer

4. Determination of Kinematic Viscosity by Saybolt viscometer

5. Determination of Kinematic Viscosity by Engler viscometer

6. Determination of Kinematic Viscosity by U tube viscometer

7. API gravity determination

8. Moisture determination by Dean and Stark Method

9. Water estimation by Karl-Fischer conductometer Apparatus

10. ASTM Distillation

11. Vacuum Distillation

12. Determination of Calorific Value by Junker's Gas Calorific meter.

13. Reid Vapor Pressure Estimation

14. Calorific value by Bomb calorimeter

15. Melting point test

TOTAL: 45 PERIODS

CH3318	MASS TRANSFER LABORATORY	L	T	P	C
		0	0	3	2

1. Simple distillation
2. Steam distillation
3. Packed column distillation
4. Bubble cap distillation
5. Diffusivity measurements
6. Liquid-liquid extraction
7. Vacuum Dryer
8. Tray dryer
9. Rotary dryer
10. Surface Evaporation
11. Stage wise Leaching
12. Vapor-Liquid Equilibrium
13. Ternary Liquid
14. Sublimation of Naphthalene
15. Wetted Wall Column

* Minimum 10 experiments shall be offered.

TOTAL: 45 PERIODS

PC3401　　　　　　　　**EQUIPMENT DESIGN AND DRAWING II**　　　**L　T　P　C**

(To Consider as Practical Subject for Examination　　**2　0　2　4**
Purpose)

UNIT I　　　THERMODYNAMIC PROPERTIES EVALUAION FOR DESIGN　　　9

Physical properties evaluation, Thermodynamic properties of gases and binary mixtures – Methods of calculations –Vapor-liquid equilibrium data for ideal and non-ideal mixtures. Bubble points and dew points, flash distillation calculation.

UNIT II　　　HEAT EXCHANGER DESIGN　　　9

Design of double pipe heat exchangers, Heat exchanger types and its selection – shell and tube heat exchangers and Condensers – Effectiveness – NTU method of heat exchanger analysis.

UNIT III　　　EVAPORATOR DESIGN　　　9

Steam – Uses of steam – Outstanding qualities of steam – BPE – Duhring's rule – Principle of multiple effect evaporation – Temperature driving force – Evaporators types and its selection – Design of single and multiple effect evaporators.

UNIT IV　　　COLUMN DESIGN　　　9

Design of distillation columns and Absorption columns.

UNIT V　　　PUMPS, FANS AND COMPRESSORS　　　9

Pumps, fans and compressors – Types and its applications – Characteristics – Piping and pressure drop calculations – Performance analysis of pumps, fans and compressors.

L: 45 P: 15 TOTAL: 60 PERIODS

TEXT BOOKS

1. Ernest E. Ludwig., "Applied Process Design for Chemical and Petrochemical Plants", Vol.I, II and III, Gulf Professional Publishing, 2002.
2. D. Q. Kern, "Process Heat Transfer", Tata McGraw Hill Publishing Co., New Delhi, 1990.

REFERENCES

1. Coulson, M. and Richardson, J.F., "Chemical Engineering", Vol.6, 3rd Edition, Pergamon Press, 1987.
2. Robert H. Perry and Don W. Green, "Perry's Chemical Engineer's Hand Book", 7th Edition,   Mc Graw Hill – International, 1997.
3. Van Winkle, "Distillation Operations", McGraw Hill Publications, 1987.

Note:　Necessary Data Book is to be issued while conducting Practical Examination

PC3402 **CHEMICAL REACTION ENGINEERING** L T P C
3 1 0 4

UNIT I NON – IDEAL REACTORS 9

Residence time distribution function and its measurement – Characteristics of tracer – Mean residence time – Conversion in non-ideal flow reactors.

UNIT II HETROGENEOUS PROCESS AND SOLID CATALYSIS 9

Rate equation for heterogeneous reactions – Nature of catalysis – Adsorption isothermal and rates of adsorption – Desorption and surface reaction analysis of rate equation – Rate controlling steps.

UNIT III GAS – SOLID CATALYTIC REACTORS 9

Characteristics of catalyzed reactions – Mechanism of solid catalyzed reactions – Pore diffusion resistance combined with surface kinetics – Performance equations for reactors containing porous catalysts.

UNIT IV GAS – SOLID NON – CATALYTIC REACTORS 9

Selection of the kinetic model – Progressive – conversion model, shrinking – core model – Shrinking-core model for spherical particles of unchanging size – Shrinking-core model for cylindrical particles of unchanging size.

UNIT V GAS – LIQUID REACTIONS 9

Various ways of carrying out gas – liquid reactions catalyzed by solids – General rate equation – Resistances in series in the gas – liquid reaction on catalyst surface.

L: 45 T: 15 TOTAL: 60 PERIODS

TEXT BOOKS
1. Levenspiel, O., "Chemical Reaction Engineering", 3rd Edition, Wiley Asian Edition, 1990.
2. Smith, J.M., "Chemical Engineering Kinetics", 2nd Edition, McGraw Hill, 1984.

REFERENCES
1. Scott Fogler, H., "Elements of Chemical Reaction Engineering", 4th Edition, Prentice Hall of India.2009
2. Gavanhe, K.A., "Chemical Reaction Engineering I", Nirali Prakashan Publishers, 2007.
3. Dawande, D., "Principles of Reaction Engineering", 1st Edition, Central Techno Publications, 2001.

PC3403   **PETROCHEMICAL DERIVATIVES**

L	T	P	C
4	0	0	4

UNIT I   FIRST GENERATION PETROCHEMICALS I   12

Alternate routes with flow diagram for production of methane, ethane, propane, ethylene, propylene, butylenes, acetylene, naphthalene. Chemicals from methane, ethane, propane, ethylene, propylene, butylenes, acetylene.

UNIT II   FIRST GENERATION PETROCHEMICALS II   12

Alternate routes with flow diagram for production of butadiene, related dienes, aromatics – Benzene, toluene, xylene – Chemicals from butadiene, related dienes, aromatics – Benzene, toluene, xylene.

UNIT III   SECOND GENERATION PETROCHEMICALS   12

Alternate routes with flow diagram for production of ethylene glycol, VCM, acrylonitrile, phenol, caprolactum, adipic acid , hexamethylene diamine, DMT , TPA, maleic anhydride, styrene.

UNIT IV   THIRD GENERATION PETROCHEMICALS I   12

Polymerization – Modes and techniques – Production of polyethylene – LDPE, HDPE, polypropylene, poly butadiene rubber, SBR, polystyrene, SAN, ABS.

UNIT V   THIRD GENERATION PETROCHEMICALS II   12

Polyacrylonitrile, polyvinyl chloride, polycarbonates, nylon 6, nylon 66, polyesters, formaldehyde resins, explosives, dyes.

TOTAL: 60 PERIODS

TEXT BOOKS
1. Bhaskara Rao, B.K., "A Text on Petrochemicals", Khanna Publishers, 2000.
2. Sukumar Maiti, "Indroduction to Petrochemicals", 2nd Edition, Oxford and IBH Publishers, 2002.

REFERENCES
1. Margaret Wells, "Handbook of Petrochemicals and Processes", 2nd Edition, Ash Gate Publishing Limited, 2002.
2. Sami Matar, and Lewis F. Hatch., "Chemistry of Petrochemical Processes", 2nd Edition, Gulf Publishing company, 2000.
3. Dryden, C.E., "Outlines of Chemical Technology", 2nd Edition, Affiliated East-West Press, 1993.

PC3404   **PETROLEUM SECONDARY PROCESSING**   L   T   P   C
                              TECHNOLOGY   4   0   0   4

UNIT I   SECONDARY PROCESSING   12

Need and significance – Types and functions of secondary processing – Visbreaking – Processes, operating parameters and advantages – Coking – Operating parameters and advantages.

UNIT II   CRACKING   12

Thermal cracking – Processes, operating parameters, feed stock selection and product yields – Advantages – Free radical mechanism.

Fluid catalytic cracking – processes, operating parameters, feed stock selection and product yields – Advantages – Catalyst used and regeneration – Cation mechanism.

UNIT III   HYDROCRACKING AND HYDROTREATING   12

Hydrocracking, principles, process requirements, product yields and qualities and residcracking – Hydrotreating – Sulphur removal, aromatics removal, hydrofinishing.

UNIT IV   REFORMING   12

 Reforming – Principles, processes, operating parameters – Catalyst types, performance, effects of operating parameters – Feed quality and regeneration.

UNIT V   OTHER PROCESSES   12

Isomerisation – Processes, operating parameters, advantages – Alkylation – Processes, operating parameters, advantages – Polymerization – Processes, operating parameters, advantages.

TOTAL: 60 PERIODS

TEXT BOOKS
1. Ram Prasad, "Petroleum Refining Technology", Khanna Publishers,2007
2. Bhaskara Rao, B.K., "Modern Petroleum Refining Processes", 4th Edition, Oxford and IBH Publishing Company Pvt. Ltd, 2002.

REFERENCES
1. Gary, J. H. and Handwerk, G.E., "Petroleum Refining Technology and Economics", 4th Edition, Marcel Dekker Inc., 2001.
2. Nelson, W.L., "Petroleum Refinery Engineering", McGraw Hill Publishing Company Limited, 1985.
3. Hobson, G.D., "Modern Petroleum Refining Technology", 5th Edition, John Wiley Publishers, 1984.

PC3405   **WATER TREATMENT AND MANAGEMENT**

L	T	P	C
4	0	0	4

UNIT I   INTERNAL TREATMENT PROCESS   12

Character and properties – Water problem and solution – Water Sedimentation - Coagulation – Filtration – Disinfection – Theory, necessity, process, equipment, application, location, limitation.

UNIT II   EXTERNAL TREATMENT PROCESS   12

Softening by Ion – exchange process, Demineralization – Cation exchange materials – Removal of ion, Manganese, odour, colour taste – Deaeration – Oxidation – Fluoridation – Dealkalisation – Desalination by Reverse osmosis.

UNIT III   BOILER WATER AND COOLING WATER   12

Concept – Importance – Location – Commonly used desalination process – Distillation – Electrodialysis – Reverse osmosis – Freezing – Solar distillation- Purpose – Problem associated with water quality and equipment – Steam system fundamentals – Hot water closed system – Measurement and control of pH, corrosion, fouling – Microbial analysis – Ozone control – Study of microorganism – Energy efficient operations and maintenance.

UNIT IV   WASTE WATER TREATMENT   12

Waste water in Industry- Home and Agriculture – Various waste water treatment processes –Optimization – Benefits and costs – Microbial and sanitation water treatment – Biofilm formation and removal – Microbial trend analysis – Pretreatment system and equipment.

UNIT V   WATER MANAGEMENT IN INDIA   12

Water resources and planning – Water policy – Indian scene – Main aspects of water management – Hydrological cycle – Hydrosphere – Water transport – Water exchange – Causes and problems in irrigation, rural water, urban water – Water conservation resource management – Rain Harvesting.

TOTAL: 60 PERIODS

TEXT BOOKS

1. P.C.Bansil "Water Management in India", Concept Publishing company, New Delhi, First Edition, 2004.
2. G.S.Bridie and J.S.Bridie "Water Supply and Sanitary Engineering", Dhanpat Raj Publishing company (P) Ltd., New Delhi, 7th Edition, 2003.

REFERENCES

1. Austin G.T., "Shreve's Chemical Process Industries", Fifth Edition, McGraw Hill, 1998.
2. S.C. Rangwala, "Water supply and Sanitary Engineering", Eighteenth Edition, Charotar Publishing House, 2003.
3. Pandey G.N., "Text Book of Chemical Technology", Vikas Publishing House Pvt. Ltd., New Delhi, 1992.

		L	T	P	C

PC3406   **PETROCHEMICAL ANALYSIS LABORATORY**   L T P C

                                                                0 0 3 2

1.   Sulphur content determination
2.   Flue gas Analysis – Orsat Apparatus
3.   Aromatic Content determination
4.   Hydrogen sulphide content determination
5.   Mercaptan as sulphur estimation apparatus
6.   Determination of Lead, Acid and Salt content
7.   Oil separation from lubricating Grease (Oil Separation Apparatus)
8.   Analysis of petrochemicals using UV spectrophotometer
9.   Analysis of petrochemicals using NMR with MS
10.   Analysis of petrochemicals using Gas chromatography
11.   Biodegradation of petrochemicals
12.   Bioremediation of petrochemicals
13.   Refractive index of petrochemicals
14.   Determination of moisture content – KF titrator
15.   Total acidity determination

TOTAL: 45 PERIODS

PC3407   **PETROLEUM PRODUCT TESTING LABORATORY**   L T P C

                                                                    0 0 3 2

1.   Determination of aniline point and diesel index
2.   Softening point of bitumen by ring and ball method
3.   Ductility and penetration number of bitumen
4.   Rust preventing characteristics of lube oil
5.   Drop point of greases
6.   Cloud and pour point determination
7.   Smoke point determination
8.   Copper corrosion testing of petroleum products
9.   Sediment content of crude oil and fuel oils
10.   Coking tendency of oil
11.   Saybolt color of petroleum products / loviband tintometer
12.   Water separability of petroleum products
13.   Refractive index of petroleum products
14.   Hydrocarbon types in petroleum products
15.   Carbon residue determination
16.   Oxidation stability of gasoline and ATF
17.   Bearing and grease noise characteristics

TOTAL: 45 PERIODS

PC3408   CHEMICAL REACTION ENGINEERING LABORATORY   L   T   P   C
0   0   3   2

1.   Determination of reaction rate constant for a saponification reaction in batch reactor I.
2.   Determination of reaction rate constant for a saponification reaction in batch reactor II.
3.   Determination of reaction rate constant for a saponification reaction in plug flow reactor.
4.   Determination of reaction rate constant for a saponification reaction in packed bed reactor.
5.   Determination of reaction rate constant for a saponification reaction in mixed flow reactor.
6.   Determination of reaction rate constant for a saponification reaction in semi – batch reactor I.
7.   Determination of reaction rate constant for a saponification reaction in isothermal – batch reactor.
8.   Determination of the rate frequency factor and activation energy for acetic anhydride hydrolysis using adiabatic reactor.
9.   Determination of the mean residence time by RTD studies in plug flow reactor.
10. Determination of the mean residence time by RTD studies in mixed flow reactor.
11. Determination of the mean residence time by RTD studies in packed bed reactor.
12. Determination of the rate constant for a saponification reaction in equal sized CSTR's in series.

TOTAL: 45 PERIODS

GE2022   TOTAL QUALITY MANAGEMENT   L T P C
3 0 0 3

UNIT I   INTRODUCTION   9
Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM.

UNIT II   TQM PRINCIPLES   9
Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III   TQM TOOLS & TECHNIQUES I   9
The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV   TQM TOOLS & TECHNIQUES II   9

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures.

UNIT V   QUALITY SYSTEMS   9

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Dale H.Besterfiled, et at., "Total Quality Management", Pearson Education Asia,
   Third Edition, Indian Reprint (2006).

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 6th Edition, South-Western (Thomson Learning), 2005.
2. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, 3rd Edition, 2003.
3. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd.,2006.
4. Janakiraman,B and Gopal, R.K, "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

PC3410	SAFETY AND RISK MANAGEMENT	L	T	P	C
		4	0	0	4

UNIT I   INDUSTRIAL SAFETY   15

Concepts of safety – Hazard classification chemical, physical, mechanical, ergonomics, biological and noise hazards – Hazards from utilities like air, water, steam.

UNIT II   HAZARD IDENTIFICATION AND CONTROL   15

HAZOP, job safety analysis – Fault tree analysis – Event tree analysis – Failure modes and effect analysis and relative ranking techniques – Safety audit – Plant inspection – Past accident analysis.

UNIT III   RISK MANAGEMENT   15

Overall risk analysis – Chapains model, E and FI model– Methods for determining consequences effects: Effect of fire, Effect of explosion and toxic effect – Disaster management plan – Emergency planning – Onsite and offsite emergency planning – Risk management – Gas processing complex, refinery – First aids.

UNIT IV   SAFETY PROCEDURES   7

Safety in plant design and layout – Safety provisions in the factory act 1948 – Indian explosive act 1884 – ESI act 1948 – Advantages of adopting safety laws.

UNIT V   SAFETY IN HANDLING AND STORAGE OF CHEMICALS   8

Safety measures in handling and storage of chemicals – Fire chemistry and its control – Personnel protection – Safety color codes of chemicals.

TOTAL: 60 PERIODS

TEXT BOOKS

1. Blake, R.P., "Industrial Safety", Prentice Hall, 1953.
2. Lees, F.P., "Loss Prevention in Process Industries", 2nd Edition, Butterworth Heinemann, 1996.

REFERENCES

1. Geoff Wells, "Hazard Identification and Risk Assessment", I.ChE.
2. John Ridley and John Channing, "Safety at Work", 6th Edition. Butterworth-Heinemann, 2003.
3. Raghavan, K.V. and Khan, A.A., "Methodologies in Hazard Identification and Risk Assessment", Manual by CLRI, 1990.

PC3411	**PROJECT WORK**	**L**	**T**	**P**	**C**
		0	**0**	**12**	**6**

The project may be considered as the ultimate exercise presented to the final semester student before graduation to measure accumulated engineering knowledge and experience. At the same time, the project itself should provide the students with some new skills, innovation and information, and strengthen the acquired ones.

The project programme consists of different assignment, allotted time, submission of report under internal faculty guidance and evaluation by external member along with internal faculty.

The activities performed during a project may cover one or more of the following;

• Data collection
• Critical literature review
• Laboratory experience and tests
• Mathematical modeling
• Software application
• Industrial visits
• Design and/or assembly
• Process analysis

The major project may be assigned to a group of two students. The project topic allotted may be of theoretical, experimental or industrial projects to be carried out under the supervision of internal guide and external guide (in case of industrial projects).

Major projects are to be executed strictly as per the project schedule prepared during VIII semester. A committee of departmental faculty members comprising the project guide, one more faculty member and the head of department will monitor and review the progress achieved by the student at various stages. The internal assessment will be done by the committee based on the progress achieved on completion of the project work.

On completion of the project work, each student has to prepare a project report and submit the same in triplicate to the department. The project work and the report will be evaluated by the internal assessment committee for a total of 100 marks. The external university examination, which carries a total of 100 marks, will have report evaluation and viva voce examination conducted by a committee of one external examiner and one internal examiner appointed by the university

CH3002	PROCESS MODELLING AND SIMULATION	L	T	P	C
		3	0	0	3

UNIT I   INTRODUCTION ON MODELS   9

Introduction – Models and model building – Principles of model formulation – Fundamental laws – continuity equation – Energy equation – Equations of motion – Transport equation – Equations of state – Equilibrium and kinetics – Classification of mathematical models.
Numerical solutions of model equations – Linear and non linear algebraic equations in one and more than one variables.

UNIT II   LUMPED PARAMETER MODELS   9

Formulation and solution techniques to be discussed for vapour liquid equilibrium models – Dew point and flash calculations for multicomponent systems – Doiling operations, batch and continuous distillation models – Tank models – Mixing tank – Stirred tank with heating – CSTR with multiple reactions – Non-isothermal CSTR – Multiplicity and stability control at the unsteady state – Non- ideal CSTR models – Multi-Parameter models with dead space and bypassing – Staged operation.

UNIT III   DISTRIBUTED PARAMETER MODELS(STEADY STATE)   9

Formulation and solution of split boundary value problems – Shooting technique, quasi – linerization techniques, counter current heat exchanger, tublar reactor with axial dispersion, counter current gas absorber
Pipe line gas flow – Tubular permeation process – Pipe line flasher.

UNIT IV   UNSTEADY STATE DISTRIBUTED PARAMETER MODELS   9

Solution of partial differential equations using finite difference method – Convective problems, diffusive problems – Combined convective and diffusive problems – Unsteady state conduction and diffusion, unsteady state heat exchangers – Dynamics of tubular reactor with dispersion – Transfer function models for distributed parameter systems.

UNIT V MODEL PARAMETERS ESTIMATION 9

Introduction – Method of least squares, curve fitting, parameter estimation of dynamic transfer function models – Least square and recursive least square methods – Parameter estimation of RTD models – Moments method.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Ramirez, W.F., "Computational Methods in Process Simulation", Butterworth Publishers, 1989.
2. Roger E. Franks, "Modelling and Simulation in Chemical Engineering", John Wiley and Sons, 1972.

REFERENCES

1. Luyben, W.L., "Process Modelling, Simulation and Control for Chemical Engineers", 1990.
2. Santhos Kumar Gupta, "Numerical Methods for Engineers", Tata McGraw Hill, 1995.
3. Seinfeld and Lapidus, "Mathematicals Methods in Chemical Engineering", Prentice Hall, 1974.

CH3003	TRANSPORT PHENOMENA	L	T	P	C
		3	1	0	4

UNIT I FUNDAMENTALS OF TRANSPORT PHENOMENA 12

The nature of transport phenomena: Importance, mechanism, driving force, analogous nature – Conservation laws – Method of study: differential, integral and experimental methods – Phenomenological laws of transport properties – Newtonian and non Newtonian fluids – Rheological models – Effect of pressure and temperature on viscosity.

UNIT II ONE DIMENSIONAL TRANSPORT IN LAMINAR FLOW (SHELL BALANCE) 12

General methods of shell balance approach to transfer problems – Momentum flux and velocity distribution for flow of Newtonian fluids in pipes, planes, slits and annulus – Heat flux and temperature distribution for heat sources such as electrical, viscous – Mass flux and concentration profile for diffusion in stagnant gas systems involving reaction.

UNIT III EQUATION OF CHANGE AND THEIR APPLICATIONS 12

Development of the equation of change for isothermal systems, non-isothermal systems and multicomponent system – Use of equation of change for flow in a circular pipe – Rotating liquid – Temperature distribution in a rotating cylinder with viscous dissipation and flow of a newtonian fluid with constant energy flux – Concentration profile in a tubular reactor and gas diffusion through a solid – Dimensional analysis of the equation of change – Equation of motion for forced and free convection.

UNIT IV   TRANSPORT IN TURBULENT AND BOUNDARY LAYER FLOW   12

Time smoothed equation of change for velocity and temperature distribution – Time smoothed velocity distribution near a wall and circular jet – Time smoothed temperature profile near a wall, turbulent flow in pipes and jets – Time smoothed concentration and equation of continuity with application to turbulent mixing and reaction – Boundary layer theory, thickness, velocity separation and flow around objects, flat plate, application of penetration theory for high mass transfer rate.

UNIT V   ANALOGIES BETWEEN TRANSPORT PROCESSES   12

Importance of analogy – Development and applications of analogies between momentum – Heat and mass transfer – Reynolds, Prandtl, Von Karman and Colburn analogies.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Bird, R.B., Stewart, W.E. and Light Foot, E.N., "Transport Phenomena" John Wiley and sons, 2002.
2. Welty, J.R., Wick, C.E., and Wilson, R.E., "Fundamentals of Momentum, Heat and Mass Transfer", John Wiley Sons, 2002.

REFERENCES

1. Thomson, W. J., "Introduction to Transport Phenomena", Pearson Education Asia, 2000.
2. Griskey, R.G., "Transport Phenomena and Unit Operations", Wiley-Interscience, 2002.
3. Beek, W.J., Muttzall, K.M.K. and Van Heuven,J.W., "Transport Phenomena", 2nd Edition, John Wiley and Sons, Ltd., 2000.

PC3003	**PROCESS INTRUMENTATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

UNIT I   PHYSICAL PROPERTY MEASUREMENT   9

Density and specific gravity – Viscosity and consistency – Refractive index analyzers – Boiling point – Flash point analyzers – Thermal conductivity.

UNIT II   TEMPERATURE MEASUREMENT   9

Differential expansion and fluid expansion types – Resistance thermometers – Thermoelectric pyrometers – Radiation pyrometers – Optical pyrometers – Pyrometric cones – Ultrasonic thin wire thermometer.

UNIT III   PRESSURE MEASUREMENT   9

Absolute pressure – Gauge pressure and vacuum – Liquid types and spring balanced types – Differential pressure – Manometer types – Simple U tube and inclined tube manometer and sealed bell types – Pressure transmitters.

UNIT IV   FLOW MEASUREMENT   9

Volumetric meters – Variable head meters – Orifice meter – Venturi meter – Pitot tube – Closed channel and open channel types – Variable area meters – Velocity and current meters – Anemo meter – Ultrasonic flowmeter – Mass meters.

UNIT V   LEVEL MEASUREMENT   9

Measurement of head and level – Float methods – Hydrostatic pressure methods – Gauge glass automatic detector – Ultrasonic probe – Electronic level gauge – Continuous capacitance gauge.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Nakra, B.C. and Chaudhry, K.K., "Instrumentation, Measurement and Analysis", 2nd Edition, Tata McGraw-Hill, 2004.
2. Singh, S.K., "Industrial Instrumentation and Control", 2nd Edition, Tata McGraw – Hill, 2007.

REFERENCES

1. Doebelin, E.O., "Measurement System Application and Design", 4th Edition, McGraw Hill, 1998.
2. Patranabis, D., "Principles of Industrial Instrumentation", 2nd Edition, Tata McGraw – Hill, 2007.
3. Sawhney, A.K., "A Course in Electrical, Electronics Measurement and Instrumentation", Dhanpat Rai and sons, 1999.

CH3004	FLUIDIZATION ENGINEERING	L	T	P	C
		3	0	0	3

UNIT I   BASICS OF FLUIDIZATION   9

Packed bed – Velocity – Pressure drop relations – Correlations of Ergun, Kozneykarman – On set of fluidization – Properties of fluidized beds – Development of fluidization from fixed bed.

UNIT II   FLUIDIZED BED TYPES   9

Minimum fluidization conditions – Expanded bed – Elutriation – Moving solids and dilute phase – spouted bed.

UNIT III   DESIGN ASPECTS   9

Channeling – Bed expansion in liquid – Solid and gas – Solid fluidizations.   Design aspects of fluidized bed systems.

UNIT IV   HEAT AND MASS TRANSFER IN FLUIDIZED BEDS   9

Heat and mass transfer in fluidized bed systems – Industrial applications and case studies of fluidized bed systems.

UNIT V   OTHER TYPES OF FLUIDIZATION   9

Single stage and multistage fluidization – Collection of fines – Use of cyclones.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Levenspiel, "Fluidization Engineering", 2nd Edition, Butterworth – Heinmann, 1991.
2. Robert H. Perry and Don W. Green, "Perry's Chemical Engineer's Hand Book", 7th Edition,   Mc Graw Hill – International, 1997.

REFERENCES

1. Rowe and Davidson, "Fluidization", Academic Press ,1971.
2. Leva, M., "Fluidization", McGraw Hill Book Co, 1959.
3. Wen-Ching Yang., "Handbook of Fluidization and Fluid-Particle Systems", Marcel Dekker Inc, 2003.

PC3005	**PETROLEUM PROCESS EQUIPMENT AUXILIARIES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

UNIT I   ELECTRICAL MOTORS AND STARTERS   9

Electrical motors – Induction –Synchronous – Electrical Starters.

UNIT II   ROTARY EQUIPMENT   9

Pumps –Turbines – Blowers – Compressors – Fans – Concept – Working and application.

UNIT III   INDUSTRIAL VALVE   9

Needle valves – Globe, gate and ball valves – Butterfly valves – Check and needle valves – Piping system.

UNIT IV   INDUSTRIAL DRYERS   9

Rotary fluid bed – Spray and freeze dryers – Electrosmotic dryers – Rotary dryer – Case studies.

UNIT V   PROCESS UTILITY EQUIPMENTS   9

Vacuum devices – Filters – Cooling towers – Refrigeration systems – Flare system – Equipments for waste water treatment systems.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Walas, S.M., "Chemical Process Equipment", Butterworth – Heinemann Oxford Publishing Ltd., 1999.
2. Thomas, C.E., "Process Technology – Equipment and systems", Uhai Publishing, Inc., 2002.

REFERENCES

1. Ludwig, E.E., "Applied Process Design for Chemical and Petrochemical Plants", Vol.I and III, Gulf Professional Publishing, 2002.

2. Perry, R.H. and Green, D.W., "Perry's Chemical Engineer's Hand Book", 7th Edition, Mc Graw Hill – International, 1997.

3. Sahu, G.K., "Hand Book of Piping Design", New Age International Publishers, 2005.

PC3006	INDUSTRIAL MANAGEMENT	L	T	P	C
		3	0	0	3

UNIT I PERSONNEL MANAGEMENT 9

Principles and functions – Handling union – Negotiation process – Labour legislation in India – Managerial decision making process, tools and techniques – Role of employee through empowerment – Industrial management program – Public relation.

UNIT II TQM TOOLS AND TECHNIQUES 9

Bench marking process – Concept, reason, application – Quality function deployment and its benefits – Study of manufacturing costs and techniques for financial control – Tools and techniques for six sigma philosophy – Tacuchi law functions – Statistical process control.

UNIT III QUALITY AND ENVIRONMENTAL MANAGEMENT SYSTEMS 9

Philosophy of total quality management – ISO registration procedure and benefits – Concepts of ISO 9000, 14000, 18000 standards – Internal quality audit – Quality improvement and customer satisfaction – Importance of documentation procedure – Plant safety and industrial hygiene.

UNIT IV ENGINEERING ECONOMICS 9

Micro and macro economics – Accounting procedures and preparation of financial statements – Principles of lean manufacturing philosophy – Study of global market – Methods to overcome competitiveness.

UNIT V PROCESS ECONOMICS 9

Amortisation – Capital recovery – Depreciation – Economics of selecting alternatives – Rate of return and payout time – Budgeting – Operation management – Strategic analysis – Problem solving technioques – Preparation of technical reports – Process Improvement.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Peters and Timmer haus, "Plant Design and Economics for Chemical Engineering", 4th Edition, McGraw Hill Book Co., 1991.

2. Arun Monappa and Mirza S. Saiyadain, "Personnel Management", 2nd Edition, Tata McGraw – Hill Publishing Company Ltd.

REFERENCES

1. Kermath Case, J.A. and David prat., " Principle of Engineering Economics", 4th Edition, John - Wiley publishers, 1997.
2. Schwyer H.E., "Process Engineering Economics", 1st Edition, McGraw Hill Book Co., 1962.
3. Shridharan Bhat,K., " Total Quality Management", 1st Edition, Himalaya Publishing house, 2002.

PC3007	ENERGY MANAGEMENT IN CHEMICAL INDUSTRIES	L	T	P	C
		3	0	0	3

UNIT I ENERGY RESOURCES – A GLOBAL VIEW 9

Energy sources – Coal oil, natural gas – Nuclear energy – Hydro electricity – Other fossil fuels – Geothermal – Supply and demand – Depletion of resources of resources – Need for conservation – Uncertainties – National and international issues.

UNIT II ENERGY AND ENVIRONMENT 9

Energy – Various forms – Energy storage – Structural properties of environment – Bio-geo – chemical cycles – Society and environment population and technology.

UNIT III MANAGEMENT OF ENERGY CONSERVATION IN CHEMICAL INDUSTRIES 9

Chemical industries – Classification – Conservation in unit operation such as separation – Cooling tower – Drying – Conservation applied to refineries, petrochemical, fertilizers, cement, pulp and paper, food industries – Chloroalkali industries – Conservation using optimization techniques.

UNIT IV ENERGY ALTERNATIVES 9

Sources of continuous power – Wind and water – Geothermal – Tidal and solar power – MHD, fuel cells – Hydrogen as fuel.

UNIT V ECONOMIC BALANCE IN ENERGY CONSUMPTION 9

Cost analysis – Capacity – Production rate – System rate – System cost analysis – Corporate models – Production analysis and production using fuel inventories – Input-output analysis – Economics – Tariffs.

TOTAL: 45 PERIODS

TEXT BOOKS
1. Krentz, J. H., "Energy Conservation and Utilisation", Allyn and Bacur Inc., 1976.
2. Gramlay, G. M., "Energy", Macmillon Publishing Co., 1975.

REFERENCES
1. Rused C.K., "Elements of Energy Conservation", McGraw – Hill Book Co., 1985.
2. Judson King; "Separation Processes", McGraw – Hill Book Co., 1985.
3. Samir Sarkar, "Fuels and Combustion", 2nd Edition, Orient Longman Publication, 1988.

PC3008   **NOVEL SEPARATION PROCESS**   **L   T   P   C**

                                                                       3   0   0   3

UNIT I   MEMBRANE SEPARATIONS   9

Types and choice of membranes **–** Plate and frame membranes, tubular membranes, spiral wound membranes, hollow fibre membrane and their relative merits, membrane reactors, membrane permeators involving Dialysis **–** Reverse osmosis **–** Ultrafiltration **–** Donnan dialysis.

UNIT II   SEPARATIONS BY ADSORPTION TECHNIQUES   9

Types of adsorption – Nature of adsorbents – Adsorption equilibria – Adsorption hysterisis adsorption isotherms – Effect of temperature and pressure – Freundlich equation – Stagewise adsorption – Single and multistage crosscurrent adsorption – Break through curves and rates of adsorption.

UNIT III   CHROMATOGRAPHY TECHNIQUES   9

Affinity chromatography, immuno chromatography and Ion exchange chromatography – Introduction – Principles – Types of equipment – Commercial processes – Applications.

UNIT IV   IONIC SEPARATIONS   9

Electrophoresis – Introduction – Electrokinetics – The electrical double layer – Zeta potential and electrophoresis – Laboratory methods – Analytical and Preparative methods – Applications Electrodialysis – Principles and applications.

UNIT V   ZONE MELTING   9

Zone melting – Introduction – Equilibrium Diagram – Apparatus and Applications – Large scale and continuous operations – Limitations.

                                                          TOTAL: 45 PERIODS

TEXT BOOKS
1. Schoen, H.M., "New Chemical Engineering Separation Techniques", Interscience Publishers, 1972.
2. Treybal, R.E., "Mass Transfer Operations", 3rd Edition, McGraw Hill Book Co., 1980.

REFERENCES
1. Geankoplis, C.J. "Transport Processes and Unit Operations", 3rd Edition, Prentice Hall of India Pvt. Ltd, 2000.
2. Sivasankar, B., "Bioseparations Principles and Techniques", Prentice Hall India Pvt. Ltd, 2006.
3. Seader, J.D. and Henley, E.J., "Separation Process Principles", 2nd Edition, John Wiley and Sons,Inc, 2006.

CH2032   **FERTILIZER TECHNOLOGY**   **L   T   P   C**
                                                                   3   0   0   3

UNIT I   NITROGENOUS FERTILISERS   9
Methods of production of nitrogenous fertilizer-ammonium sulphate, nitrate, urea and calcium ammonium nitrate; ammonium chloride and their methods of production, characteristics and specifications, storage and handling.

UNIT II   PHOSPHATIC FERTILISERS   9
Raw materials; phosphate rock, sulphur; pyrites etc., processes for the production of sulphuric and phosphoric acids; phosphates fertilizers - ground rock phosphate; bone meal-single superphosphate, triple superphosphate, triple superphosphate, thermal phosphates and their methods of production, characteristics and specifications.

UNIT III   POTASSIC FERTILISERS   9
Methods of production of potassium chloride, potassium schoenite, their characteristics and specifications.

UNIT IV   COMPLEX AND NPK FERTILISERS   9
Methods of production of ammonium phosphate, sulphate diammonium phosphate, nitrophosphates, urea, ammonium phosphate, mono-ammonium phosphate and various grades of NPK fertilizers produced in the country.

UNIT V   MISCELLANEOUS FERTILISERS   9
Mixed fertilizers and granulated mixtures; biofertilisers, nutrients, secondary nutrients and micro nutrients; fluid fertilizers, controlled release fertilizers, controlled release fertilizers.

                                                           TOTAL : 45 PERIODS

TEXT BOOKS
1. "Handbook of fertilizer technology", Association of India, New Delhi, 1977.
2. Menno, M.G.; "Fertilizer Industry - An Introductory Survey", Higginbothams Pvt. Ltd., 1973.

REFERENCES
1. Sauchelli, V.; "The Chemistry and Technology of Fertilizers", ACS MONOGRAPH No. 148, Reinhold Publishing Cor. New York, 1980.
2. Fertiliser Manual, "United Nations Industrial Development Organisation", United Nations, New York, 1967.
3. Slack, A.V.; Chemistry and Technology of Fertilisers, Interscience, New York, 1966.

PC3010　　　　　　　**MULTICOMPONENT DISTILLATION**　　　　**L　T　P　C**

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　3　0　0　3

UNIT I　　THERMODYNAMIC PRINCIPLES　　　　　　　9

General considerations in the design of columns – Column sequencing – Heuristics for column sequencing – Key components – Distributed components – Non-Distributed components – Adjacent keys.

Fundamental Thermodynamic principles involved in the calculation of vapor – liquid equilibria and enthalpies of multi component mixtures – Use of multiple equation of state for the calculation of K values – Estimation of the fugacity coefficients for the vapor phase of polar gas mixtures – calculation of liquid – phase activity coefficients.

UNIT II　　THERMODYNAMIC PROPERTY EVALUATION　　　　9

Fundamental principles involved in the separation of multi component mixtures – Determination of bubble-point and Dew Point Temperatures for multi component mixtures – equilibrium flash distillation calculations for multi component mixtures – separation of multi component mixtures at total reflux.

UNIT III　　MINIMUM REFLUX RATIO FOR MCD SYSTEM　　　　9

Definition of minimum reflux ratio – calculation of R_m for multi component distillation – Underwood method – Colburn method.

UNIT IV　　VARIOUS METHODS OF MCD COLUMN DESIGN　　　9

Theta method of convergence – K_b method and the constant composition method – Application of the Theta method to complex columns and to system of columns – Lewis Matheson method – Stage and reflux requirements – Short cut methods and Simplified graphical procedures.

UNIT V　　VARIOUS TYPES OF MCD COLUMNS　　　　9

Design of sieve, bubble cap, valve trays and structured packing columns for multi component distillation – computation of plate efficiencies.

TOTAL: 60 PERIODS

TEXT BOOKS
1. Holland, C.D., "Fundamentals of Multi Component Distillation", McGraw Hill Book Company,1981
2. Van Winkle, "Distillation Operations", McGraw Hill Publications, 1987.

REFERENCES
1. King, C.J., "Separation Process Principles", Mc Graw Publications, 1986.
2. Treybal, R.E., "Mass Ttransfer Operations", 5th Edition, Mc Graw Hill publications. 1996.
3. Mc Cabe and Smith, J.C., Harriot, "Unit Operation of Chemical Engineering", 6th Edition, McGraw Hill, 2001.

PC3011　　　　**COMBUSTION AND FURNACE DESIGN**

L	T	P	C
3	0	0	3

UNIT I　　　　**COMBUSTION STOICHIOMETRY**　　　　**9**

Stoichiometry relations – Theoretical air required for complete combustion – Calculation of minimum amount of air required for a fuel of known composition – Calculation of dry flue gases if fuel composition is known – Calculation of the composition of fuel and excess air supplied, from exhaust gas analysis – Dew point of products – Flue gas analysis (O_2, CO_2, CO, NO_X, SO_X).

UNIT II　　　　**COMBUSTION THERMODYNAMICS AND KINETICS**　　　　**9**

Combustion reaction – Reaction kinetics – Rate of reaction – Mass and energy balance of chemical reactions – First and second law analysis of combustion system – Adiabatic flame temperature- Calculation of equilibrium composition and temperature.

UNIT III　　　　**TUBESTILL HEATERS**　　　　**9**

Types of stills – Radiant and convection heat recovery sections – Radiant absorption rate – Lobo-Evans method – distribution of radiant heat – Rate of heat absorption in the convection section – Pipe still losses – Pipe still design – Pressure drop in Pipe stills – Gas and oil fired burner design, Refractory lining – Air pre-heater and economizer design – Furnace efficiency and safety.

UNIT IV　　　　**HEAT TREATMENT FURNACE**　　　　**9**

Muffle Furnace – Bogey hearth furnace – Rotary hearth furnaces – Open hearth furnaces – Retards – Kilns – Horizontal and Vertical tube furnaces.

UNIT V　　　　**BURNER DESIGN**　　　　**9**

Ignition – Concept of ignition - Functional requirements of burners – Ignitors – Auto ignitors – Ignition temperature – Various types of ignitors. Flame propagation – Deflagration – Flammability limits – Flame blow out and flash back – Flame quenching. Various methods of flame stabilization – Incorporation in burner design – Swirl number and its significance – Basic features and types of solid, liquid and gaseous fuel burner – Design considerations of different types of coal – Oil and gas burners – Atomization for oil burners – Recuperative burners – Regenerative burners – Domestic burners – Properties of solid, liquid and gaseous fuels with reference to suitability for a given burner type – selection of an appropriate type of burner and design of the burner for a specified duty.

TOTAL: 45 PERIODS

TEXT BOOKS
1. Samir Sarkar, "Fuels and Combustion", 2nd Edition, Orient Longman Publication, 1988.
2. John Griswold, "Fuel Combustion and Furnaces", McGraw Hill, 1996.

REFERENCES
1. Bhatt, B.I. and Vora, S.M., " Stoichiometry", 3rd Edition., TMH, 1976.
2. Gupta, O.P., "Elements of Fuels, Furnaces and Refractories", Khanna Publishers,2007.
3. Rai,G.N., "Non Conventional Energy Sources," Khanna Publishers, 1999.

PC3012   **POLYMER TECHNOLOGY**

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UNIT I   CHARACTERISTICS, ANALYSIS OF POLYMERS   9
The science of large molecules – Theory of polymer solutions – Measurement of molecular weight and size – Analysis and testing of polymers.

UNIT II   POLYMER MATERIAL STRUCTURE AND PROPERTIES   9
Deformation, flow and melt characteristics – Morphology and order in crystalline polymers – Rheology and the mechanical properties of polymers – Polymer structure and physical properties.

UNIT III   POLYMER SYNTHESIS AND REACTION ENGINEERING   9
Condensation polymerization – Addition polymerization – Ionic and coordination polymerization – Copolymerisation – Polymerization conditions and polymer reactions.

UNIT IV   INDUSTRIAL POLYMERS: MANUFACTURING PROCESS AND
**   APPLICATIONS   9**
Hydrocarbon plastics and elastomers – Other carbon chain polymers – Heterochain thermoplastics, thermosetting resins.

UNIT V   PROCESSING OF POLYMERS: PLASTICS, FIBRES AND
**   ELASTOMERS   9**
Polymers developed for synthetic plastics, fibres and elastomer applications – Plastics technology – Fiber technology – Elastomer technology.

TOTAL: 45 PERIODS

TEXT BOOKS
1. Billmeyer Jr, F.W., "Text Book of Polymer Science", 3rd Edition, Wiley Inter Science, 1984.
2. Gowarikar, V.R., Viswanathan, N.V. and Heaved Sridhar, "Polymer science", 1st Edition, New Age International Ltd, 2003.

REFERENCES
1. Rodriguez, F., "Principals of Polymer Systems", 4th Edition, Taylor and Francis, 1996.
2. Mark, H. F., "Encyclopedia of Polymer Science and Technology", 3rd Edition John Wiley Inter Science, 2007
3. Ebewele, R.O., "Polymer Science and Technology", CRC Press, 2000.