ANNA UNIVERSITY
CHENNAI - 600 025

UNIVERSITY DEPARTMENTS

REGULATIONS 2012

CURRICULA AND SYLLABI FOR
I TO VIII SEMESTERS

B.TECH. CHEMICAL ENGINEERING
(FULL TIME)

Attested

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Centre For Academic Courses
Anna University, Chennai-600 025.

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UNIVERSITY DEPARTMENT

R - 2012

B. TECH. CHEMICAL ENGINEERING

I – VIII SEMESTERS CURRICULA AND SYLLABI

SEMESTER I

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
HS8151	Technical English – I	3	1	0	4
MA8151	Mathematics – I	3	1	0	4
PH8151	Engineering Physics	3	0	0	3
CY8151	Engineering Chemistry	3	0	0	3
GE8151	Computing Techniques	3	0	0	3
GE8152	Engineering Graphics	2	0	3	4
PRACTICAL					
PH8161	Physics Laboratory	0	0	2	1
CY8161	Chemistry Laboratory	0	0	2	1
GE8161	Computer Practices Laboratory	0	0	3	2
GE8162	Engineering Practices Laboratory	0	0	3	2
	TOTAL	**17**	**2**	**13**	**27**

SEMESTER II

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
HS8251	Technical English – II	3	1	0	4
MA8251	Mathematics - II	3	1	0	4
PH8255	Physics of Materials	3	0	0	3
CY8253	Chemistry for Technologists	3	0	0	3

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GE8251	Engineering Mechanics	3	1	0	4
CH8201	Principles of Chemical Engineering	3	0	0	3
EE8252	Principles of Electrical and Electronics Engineering	3	0	0	3
PRACTICAL					
CY8261	Applied Chemistry Lab	0	0	2	1
CH8261	Unix Programming Lab	0	0	4	2
	TOTAL	**21**	**3**	**6**	**27**

SEMESTER III

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
MA8356	Probability and Statistics	3	1	0	4
CY8301	Organic Chemistry	3	0	0	3
CY8351	Instrumental Methods of Analysis	3	0	0	3
CH8351	Solid Mechanics for Technologists	3	0	0	3
CH8301	Fluid Mechanics for Chemical Engineers	3	0	0	3
CH8302	Process Calculations	3	0	0	3
ME8351	Basic Mechanical Engineering	3	0	0	3
PRACTICALS					
CH8311	Electrical Engineering Lab for Technologists	0	0	4	2
CH8312	Organic Chemistry Lab	0	0	4	2
	TOTAL	**21**	**1**	**8**	**26**

SEMESTER IV

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
MA8353	Numerical Methods	3	1	0	4
CY8401	Physical Chemistry	3	0	0	3
CH8401	Chemical Engineering Thermodynamics I	3	0	0	3

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CH8402	Heat Transfer	3	0	0	3
CH8403	Material Science and Technology	3	0	0	3
CH8404	Mechanical Operations	3	0	0	3
PRACTICALS					
CH8411	Fluid Mechanics Lab	0	0	4	2
CH8412	Technical Analysis Lab	0	0	4	2
ME8361	Mechanical Engineering Lab	0	0	3	2
	TOTAL	**18**	**1**	**11**	**25**

SEMESTER V

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
GE8351	Environmental Science and Engineering	3	0	0	3
CH8501	Chemical Engineering Thermodynamics II	3	0	0	3
CH8502	Chemical Reaction Engineering I	3	1	0	4
CH8503	Chemical Technology	3	0	0	3
CH8504	Mass Transfer-I	3	0	0	3
	Elective I	3	0	0	3
PRACTICALS					
HS8561	Employability Skills	0	0	2	1
CH8511	Heat Transfer Lab	0	0	3	2
CH8512	Mechanical Operations Lab.	0	0	4	2
	TOTAL	**19**	**1**	**10**	**24**

SEMESTER VI

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
CH8601	Chemical Reaction Engineering II	3	0	0	3
CH8602	Mass Transfer-II	3	1	0	4

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CH8603	Plant safety and risk analysis	3	0	0	3
CH8651	Process Instrumentation Dynamics and Control	3	0	0	3
	Elective II	3	0	0	3
PRACTICALS					
CH8611	Chemical Reaction Engineering Lab	0	0	3	2
CH8612	Computational Chemical Engineering Lab	0	0	4	2
	TOTAL	**15**	**1**	**7**	**20**

SEMESTER VII

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
CH8701	Chemical Process Design	3	0	0	3
CH8702	Process Economics	3	0	0	3
CH8703	Process Equipment Design	3	1	0	4
CH8751	Transport Phenomena	3	1	0	4
	Elective III	3	0	0	3
	Elective IV	3	0	0	3
PRACTICALS					
CH8711	Mass Transfer Lab	0	0	4	2
CH8712	Process Control Lab for Chemical Engineers	0	0	4	2
	TOTAL	**18**	**2**	**8**	**24**

SEMESTER VIII

CODE NO	COURSE TITLE	L	T	P	C
	Electives V	3	0	0	3
	Electives VI	3	0	0	3
PRACTICALS					
CH8811	Project work	0	0	12	6
	TOTAL	**6**	**0**	**12**	**12**

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LIST OF ELECTIVES FOR CHEMICAL ENGINEERING

CODE NO	COURSE TITLE	L	T	P	C
MA8001	Statistics and Linear Programming	3	1	0	4
CH8001	Drugs and Pharmaceutical Technology	3	0	0	3
CH8002	Electrochemical Engineering	3	0	0	3
CH8003	Energy Technology	3	0	0	3
CH8004	Frontiers of Chemical Engineering	3	0	0	3
CH8005	Modern Separation Techniques	3	0	0	3
CH8006	Optimization of Chemical Processes	3	0	0	3
CH8007	Petroleum Refining and Petrochemicals	3	0	0	3
CH8008	Polymer Technology	3	0	0	3
CH8009	Process Modeling and Simulation	3	0	0	3
CH8010	Process Plant Utilities	3	0	0	3
GE8751	Engineering Ethics and Human Values	3	0	0	3
CH8011	Supply Chain Management	3	0	0	3
FT8551	Biochemical Engineering	3	0	0	3
GE8072	Disaster Management	3	0	0	3
GE8073	Human Rights	3	0	0	3

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HS8151	TECHNICAL ENGLISH I (For all branches of B.E / B.Tech programmes) (SEMESTER I)	L T P C 3 1 0 4

OBJECTIVE

To impart basic communication skills and develop the habit of reading

OUTCOME

- To enable all students of engineering and technology develop their basic communication skills in English.
- To give special emphasis to the development of speaking skills amongst the students of engineering and technology students.
- To ensure that students use the electronic media such as internet and supplement the learning materials used in the classroom.
- To inculcate the habit of reading for pleasure.

UNIT I

Listening - Introducing learners to GIE - Types of listening - Listening to audio (verbal & sounds); Speaking - Speaking about one's place, important festivals etc. – Introducing oneself, one's family / friend; Reading - Skimming a reading passage – Scanning for specific information - Note-making; Writing - Free writing on any given topic (My favourite place / Hobbies / School life, etc.) - Sentence completion - Autobiographical writing (writing about one's leisure time activities, hometown, etc.); Grammar - Prepositions - Reference words - Wh-questions - Tenses (Simple); Vocabulary - Word formation - Word expansion (root words / etymology); E-materials - Interactive exercises for Grammar & Vocabulary - Reading comprehension exercises - Listening to audio files and answering questions.

UNIT II

Listening - Listening and responding to video lectures / talks; Speaking - Describing a simple process (filling a form, etc.) - Asking & answering questions - Telephone skills – Telephone etiquette; Reading – Critical reading - Finding key information in a given text - Sifting facts from opinions; Writing - Biographical writing (place, people) - Lab descriptions (general/specific description of laboratory experiments) - Definitions - Recommendations; Grammar - Use of imperatives - Subject-verb agreement; Vocabulary - Compound words - Word Association; E-materials - Interactive exercises for Grammar and Vocabulary - Listening exercises with sample telephone conversations / lectures – Picture-based activities.

UNIT III

Listening - Listening to specific task - focused audio tracks; Speaking - Role-play – Simulation

- Group interaction - Speaking in formal situations (teachers, officials, foreigners); Reading

- Reading and interpreting visual material; Writing - Jumbled sentences - Coherence and cohesion in writing - Channel conversion (flowchart into process) - Types of paragraph (cause

& effect / compare & contrast / narrative / analytical) - Informal writing (letter/e-mail/blogs) - Paraphrasing; Grammar - Tenses (Past) - Use of sequence words - Adjectives; Vocabulary - Different forms and uses of words, Cause and effect words; E-materials - Interactive exercises for Grammar and Vocabulary - Excerpts from films related to the theme and follow up exercises - Pictures of flow charts and tables for interpretations.

UNIT IV

Listening - Watching videos / documentaries and responding to questions based on them; Speaking - Responding to questions - Different forms of interviews - Speaking at different types of interviews; Reading - Making inference from the reading passage - Predicting the content of a reading passage; Writing - Interpreting visual materials (line graphs, pie charts etc.) - Essay writing – Different types of essays; Grammar - Adverbs – Tenses – future time reference; Vocabulary - Single word substitutes - Use of abbreviations & acronyms; E-materials - Interactive exercises for Grammar and Vocabulary - Sample interviews - film scenes - dialogue writing.

UNIT V

Listening - Listening to different accents, Listening to Speeches / Presentations, Listening to broadcast & telecast from Radio & TV; Speaking - Giving impromptu talks, Making presentations on given topics; Reading - Email communication - Reading the attachment files having a poem/joke/proverb - Sending their responses through email Writing - Creative writing, Poster making; Grammar - Direct and indirect speech; Vocabulary - Lexical items (fixed / semi fixed expressions); E-materials - Interactive exercises for Grammar & Vocabulary - Sending emails with attachment – Audio / video excerpts of different accents, - Interpreting posters

TOTAL : 60 PERIODS

TEXT BOOKS

1. Mindscapes: English for Technologists and Engineers, Orient Black Swan, 2012.
2. S.P. Dhanavel, English and Communication Skills for Students of Science and Engineering. Orient Black Swan, Chennai, 2011.

Attested

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REFERENCE BOOKS

1. Pickett, Nell Ann, Ann A.Laster and Katherine E.Staples. Technical English: Writing, Reading and Speaking. New York: Longman, 2001.
2. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
3. Morgan, David and Nicholas Regan. Take-Off: Technical English for Engineering. Reading: Garnet Publishing Limited, 2008.
4. Thorn, Michael and Alan Badrick. An Introduction to Technical English. Harlow: Prentice Hall Europe, 1993.
5. Rizvi, M.Ashraf. Effective Technical Communication. New Delhi: Tata McGraw-Hill PublishingCompany, 2007.

EXTENSIVE READERS

1. Murthy, Sudha. Wise & Otherwise. New Delhi: Penguin Books India, 2006.
2. Gates, Bill and Collins Hemingway. Business @ the Speed of Thought: Succeeding in the Digital Economy. New York: Warner Business Books, 2000.

Website Resources

1. www.uefap.com
2. www.eslcafe.com
3. www.listen-to-english.com
4. www.owl.english.purdue.edu
5. www.chompchomp.com

MA8151	MATHEMATICS – I	L T P C
	(Common to all branches of B.E. / B.Tech. Programmes)	3 1 0 4
	(I SEMESTER)	

OBJECTIVE

To impart the fundamental knowledge about matrices, infinite series, partial derivatives, improper and multiple integrals

OUTCOME

- To develop the use of matrix algebra techniques this is needed by engineers for practical applications.
- To make the student knowledgeable in the area of infinite series and their convergence so that he/ she will be familiar with limitations of using infinite series approximations for

solutions arising in mathematical modeling.

- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To introduce the concepts of improper integrals, Gamma, Beta and Error functions which are needed in engineering applications.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I MATRICES **9+3**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II INFINITE SERIES **9+3**

Sequences – Convergence of series – General properties – Series of positive terms – Tests of convergence (Comparison test, Integral test, Comparison of ratios and D'Alembert's ratio test) – Alternating series – Series of positive and negative terms – Absolute and conditional convergence – Power Series – Convergence of exponential, logarithmic and Binomial Series.

UNIT III FUNCTIONS OF SEVERAL VARIABLES **9+3**

Limits and Continuity – Partial derivatives – Homogeneous functions and Euler's theorem – Total derivative – Differentiation of implicit functions – Change of variables –Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Errors and approximations – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT IV IMPROPER INTEGRALS **9+3**

Improper integrals of the first and second kind and their convergence – Evaluation of integrals involving a parameter by Leibnitz rule – Beta and Gamma functions – Properties – Evaluation of integrals using Beta and Gamma functions – Error functions.

UNIT V MULTIPLE INTEGRALS **9+3**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of Solids – Change of variables in double and triple integrals – Area of a curved surface.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 40th Edition, 2007.
2. Ramana B.V., “Higher Engineering Mathematics”, Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.

REFERENCES

1. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 3rd Edition, 2007.
2. Bali N., Goyal M. and Watkins C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
3. Greenberg M.D., “Advanced Engineering Mathematics”, Pearson Education, New Delhi, 2nd Edition, 5th Reprint, 2009.
4. Peter V.O’Neil, “Advanced Engineering Mathematics”, Cengage Learning India Pvt., Ltd, New Delhi, 2007.

PH8151 ENGINEERING PHYSICS L T P C
(COMMON TO ALL BRANCHES OF B.E./B.TECH. PROGRAMMES) 3 0 0 3

OBJECTIVE

To introduce the basic physics concepts relevant to different branches of Engineering and Technology.

OUTCOME

On completion of the course the students are expected to have a thorough knowledge on the basic physic concepts relevant to different branches of Engineering and Technology.

UNIT I PROPERTIES OF MATTER 9

Elasticity - Poisson’s ratio and relationship between moduli (qualitative) - Stress-strain diagram

- factors affecting elasticity - bending of beams - cantilever - bending moment - theory and experiment of Young’s modulus determination - Uniform and non-uniform bending - I shaped girders - twisting couple - hollow cylinder - shaft - torsion pendulum - determination of rigidity modulus- moment of inertia of a body (regular and irregular).

UNIT II ACOUSTICS AND ULTRASONICS 9

Classification of sound - loudness and intensity - Weber-Fechner Law - standard intensity and intensity level - decibel - reverberation - reverberation time - rate of growth and decay of sound intensity - derivation of Sabine's formula - absorption coefficient and its determination - factors affecting acoustics of buildings : focussing, interference, echo, Echelon effect, resonance - noise and their remedies. Ultrasonics - production - magnetostriction and piezoelectric methods - detection of ultrasound - acoustic grating - industrial applications - NDT - Ultrasonic method: scan modes and practice.

UNIT III THERMAL PHYSICS 9

Thermal expansion - thermal stress - expansion joints - bimetallic strips - thermal conductivity

- conductions in solids - Forbe's and Lees' disc methods - Rectilinear flow of heat through a rod - flow of heat through a compound materials - radical flow of heat through a spherical shell - thermal insulation of buildings – Laws of blackbody radiation: Kirchoffs law, Stephens law, Wiens law, Raleigh-Jean law and Planks law (derivation). Laws of thermodynamics - Otto and diesel engines and their efficiency - entropy - entropy of Carnot's cycle - reverse Carnot's cycle - refrigerator.

UNIT IV APPLIED OPTICS 9

Interference - Michelson interferometer: construction, working, determination of wave length and thickness - anti-reflection coating - air wedge and its application - Lasers - Einstein's coefficients - CO2, Nd:YAG and semiconductor lasers - homo junction and hetro junction - construction and working - applications - Optical fibres - classification (index & mode based)

- principle and propagation of light in optical fibres - acceptance angle and numerical aperture
- fibre optic communication system - active and passive sensors.

UNIT V SOLID STATE PHYSICS 9

Nature of bonding - growth of single crystals (qualitative) - crystal systems - crystal planes and directions - expressions for interplanar distance - coordination number and packing factor for simple structures: SC, BCC, FCC and HCP - structure and significance of NaCl, ZnS, diamond and graphite - crystal imperfections: point defects, dislocations and stacking faults - unit cell, Bravais space lattices - miller indices.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Gaur R.K., and Gupta, S.L., Engineering Physics, Dhanpat Raj Publications, 2003.
2. Palanisamy, P.K., Engineering Physics, Scitech Publications (P) Ltd, 2006.
3. Arumugam, M., Engineering Physics, Anuradha Publications, 2000.

REFERENCE BOOKS

1. Sankar, B.N., Pillai.S.O., Engineering Physics, New Age International (P) Ltd., 2007.
2. Rajendran.V Engineering Physics, Tata McGraw-Hill, 2009.

CY8151 ENGINEERING CHEMISTRY LTPC

(Common to all branches of Engineering and Technology) 3 0 0 3

OBJECTIVE

To introduce the basic chemistry concepts relevant to different branches of Engineering and Technology.

OUTCOME

On completion of the course the students are expected to have a thorough knowledge on thermodynamics, polymers, catalysis, spectroscopy and nanochemistry.

UNIT I CHEMICAL THERMODYNAMICS 9

Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function: Helmholtzand Gibbs free energy functions; Criteria of spontaneity; Gibbs-Helmholtz equation; Clausius- Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore. Chemical potential; Gibbs-Duhem equation – variation of chemical potential with temperature and pressure.

UNIT II POLYMER CHEMISTRY 9

Introduction: Classification of polymers – Natural and Synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerisation. Types and mechanism of polymerisation: Addition (Free Radical, cationic, anionic and living); condensation and copolymerisation. Properties of polymers: Tg, Tacticity, Molecular weight – weight average, number average and polydispersity index. Techniques of polymerisation: Bulk, emulsion, solution and suspension.

UNIT III KINETICS AND CATALYSIS 9

Introduction – reaction velocity, factors affecting reaction velocity, rate constant, order of reaction, molecularity, pseudo molecular reactions, zero, first, second and third order reactions, reactions of fractional orders, determination of order of reactions. Catalysis: Auto catalysis - Enzyme Catalysis: Michaelis-Menton equation; factors affecting enzyme catalysis. Heterogeneous Catalysis: Types of adsorption isotherms: Langmuir–Hinselwood and Rideal–Eley Mechanism.

UNIT IV PHOTOCHEMISTRY AND SPECTROSCOPY **9**

Photochemistry: Laws of photochemistry - Grotthuss–Draper law, Stark–Einstein law and Lambert-Beer Law. Photoprocesses - Internal Conversion, Inter-system crossing, Fluorescence, Phosphorescence, Chemiluminescence and Photo-sensitisation. Spectroscopy: Electromagnetic spectrum - Absorption of radiation – Electronic, Vibrational and rotational transitions. Width and intensities of spectral lines. Spectrophotometric estimation of iron. UV-visible and IR spectroscopy – principles, instrumentation (Block diagram) and applications.

UNIT V NANOCHEMISTRY **9**

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Nanoparticles: Nanocluster, nanorod, nanotube and nanowire. Synthesis: Precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laser ablation; Properties and Applications. Risk discussion and Future perspectives.

TOTAL : 45 PERIODS

TEXT BOOKS

1. P. Kannan and A. Ravikrishnan, “Engineering Chemistry”, Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2009.
2. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India, 2011

REFERENCE BOOKS

1. P.W. Atkins and de Paula Julio, “Physical Chemistry”, Oxford University Press, 8th Ed., (Indian Student Edition) (2009).
2. K. K. Rohatgi-Mukherjee, “Fundamental of Photochemistry” New Age International (P) Ltd., New Delhi, 1986.
3. G.A. Ozin and A.C. Arsenault, “Nanochemistry: A Chemical Approach to Nanomaterials”, RSC Publishing, 2005.
4. V.R.Gowariker, N.V.Viswanathan and Jayadev Sreedhar, “Polymer Science”, New Age International P (Ltd.,), Chennai, 2006

GE8151 **COMPUTING TECHNIQUES** **L T P C**
3 0 0 3

OBJECTIVE
To introduce the basic knowledge about computers and fundamentals of C programming.

OUTCOME
On completion of the course the students are expected to have a thorough knowledge on computers and C programming.

UNIT I INTRODUCTION **8**

Generation and Classification of Computers- Basic Organization of a Computer –Number System – Binary – Decimal – Conversion – Problems. Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart.

UNIT II C PROGRAMMING BASICS **10**

Problem formulation – Problem Solving - Introduction to ' C' programming –fundamentals – structure of a 'C' program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in 'C' – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.

UNIT III ARRAYS AND STRINGS **9**

Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations.

UNIT IV FUNCTIONS AND POINTERS **9**

Function – definition of function – Declaration of function – Pass by value – Pass by reference– Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays-
Example Problems.

UNIT V STRUCTURES AND UNIONS **9**

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

TOTAL : 45 PERIODS

Attested

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TEXTBOOKS

1. Pradip Dey, Manas Ghosh, “Fundamentals of Computing and Programming in C”, First Edition, Oxford University Press, 2009
2. Ashok N. Kamthane, “Computer programming”, Pearson Education, 2007.
3. Yashavant P. Kanetkar. “ Let Us C”, BPB Publications, 2011.

REFERENCES

1. Kernighan,B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2006
2. Byron S Gottfried, “ Programming with C”, Schaum’s Outlines, Second Edition, Tata McGraw-Hill, 2006.
3. R.G. Dromey, “How to Solve it by Computer”, Pearson Education, Fourth Reprint, 2007

GE8152 ENGINEERING GRAPHICS LTPC

2 0 3 4

OBJECTIVE

To develop in students, graphic skills for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings.

OUTCOME

On completion of the course the students are expected to have a thorough knowledge on design of various engineering products and technical drawings.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION) 1

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREE HAND SKETCHING **14**

Basic Geometrical constructions, Curves used in engineering practices

Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves, Scales: Construction of Diagonal and Vernier scales.

Visualization concepts and Free Hand sketching : Visualization principles – Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES **14**

Orthographic projection- principles-Principal planes-First angle projection-Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces

Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS **14**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method and auxiliary plane method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **14**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS **15**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method and vanishing point method.

COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY) **3**

Introduction to drafting packages and demonstration of their use.

TOTAL: 75 PERIODS

TEXT BOOKS

1. N.D.Bhatt and V.M.Panchal, “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2010

REFERENCES

1. K.R.Gopalakrishna., “Engineering Drawing” (Vol I&II combined) Subhas Stores, Bangalore, 2007
2. Luzzader, Warren.J., and Duff,John M.,,’’ Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production”, Eastern Economy Edition, Prentice Hall of India Pvt Ltd, New Delhi, 2005
3. M.B.Shah and B.C.Rana, “Engineering Drawing”, Pearson, 2nd Edition, 2009
4. K.Venugopal and V.Prabhu Raja, “Engineering Graphics”, New Age International (P) Limited ,2008.
5. K. V.Natrajan, “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.
6. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi,2008.

PUBLICATION OF BUREAU OF INDIAN STANDARDS:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

SPECIAL POINTS APPLICABLE TO UNIVERSITY EXAMINATIONS ON ENGINEERING GRAPHICS:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

PH8161	PHYSICS LABORATORY	LTPC
	(Common to all branches of B.E./B.Tech. Programmes)	0 0 2 1

OBJECTIVE

To make the students understand and get hands-on in the basic concepts of practical Physics.

OUTCOME

Familiarizes the basic concept in experiments and provide strong platform to apply hands-on experience gained here for experimenting higher level concepts

1.	Torsional pendulum	–	Determination of rigidity modulus of wire and moment of inertia of disc
2.	Non – uniform bending	–	Determination of young's modulus
3.	Lee's disc	–	Determination of thermal conductivity of a bad conductor
4.	Potentiometer	–	Determination of thermo e.m.f. of thermocouple
5.	Air wedge	–	Determination of thickness of a thin sheet of paper
6.	i. Optical fibre	–	Determination of Numerical Aperture and acceptance angle
	ii. Compact disc	–	Determination of width of the groove using laser
7.	Acoustic grating	–	Determination of velocity of ultrasonic waves in liquids
8.	Post office box	–	Determination of Band gap of a semiconductor
9.	Spectrometer	–	Determination of wavelength using grating
10.	Viscosity of liquids	–	Determination of co-efficient of viscosity of a liquid by Poiseuille's flow

TOTAL : 30 PERIODS

CY8161	CHEMISTRY LABORATORY	L T P C
	(Common to all branches of Engineering and Technology)	0 0 2 1

OBJECTIVE

To provide hands-on experience in using PH meter, potentiometry, titration methods and estimating the strength of given solutions.

OUTCOME

Ability to perform all kinds of titrations and estimate the unknown chemical samples

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in

water sample.

2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1,10- phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of poly vinyl alcohol using Ostwald viscometer.
12. Pseudo first order kinetics – ester hydrolysis.
13. Corrosion experiment – weight loss method.
14. Determination of CMC.
15. Phase change in a solid.

TOTAL : 30 PERIODS

REFERENCE BOOKS

1. A text of quantitative inorganic analysis, A. L. Vogel , ELBS London. 1995.
2. Experiments in physical chemistry, D.P. Shoemarker and C.W. Gardad, McGraw Hill, London, 2001.
3. American Public Health Association.

GE8161 COMPUTER PRACTICES LABORATORY L T P C

0 0 3 2

OBJECTIVE

- To enable the student to learn and use the major components of a computer system
- To make the students write programs and solve problems
- To learn to use office automation tools

OUTCOME

At the end of the lab session student will be able to use MS office and generate data, solve simple problems with C-Programming Language.

LIST OF EXPERIMENTS:

1. Search, generate, manipulate data using MS office/ Open Office

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2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions
9. Program using Recursive Function and conversion from given program to flow chart.
10. Program using structures and unions.

TOTAL : 45 PERIODS

GE8162	**ENGINEERING PRACTICES LABORATORY**	**LTPC**
	(Common to all Branches of B.E. / B.Tech. Programmes)	**0 0 3 2**

OBJECTIVE

To provide exposure to the students with hands-on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

OUTCOME:

- ability to fabricate carpentry components and pipe connections including plumbing
- works.
- ability to use welding equipments to join the structures.
- ability to fabricate electrical and electronics circuits

GROUP – A (CIVIL & ELECTRICAL)

1. CIVIL ENGINEERING PRACTICE **12**

Plumbing

Basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings. Preparation of plumbing line sketches.

Laying pipe connection to the suction side of a pump – inlet.

Laying pipe connection to the delivery side of a pump – out let.

Practice in mixed pipe connections: Metal, plastic and flexible pipes used in household appliances.

Wood Work

Sawing, planning and making common joints: T-Joint, Mortise and Tennon joint, Dovetail joint.

Study

Study of joints in door panels, wooden furniture

Study of common industrial trusses using models.

2. ELECTRICAL ENGINEERING PRACTICE **9**

Basic household wiring using switches, fuse, indicator – lamp etc.,

Preparation of wiring diagrams

Stair case light wiring

Tube – light wiring

Study of iron-box, fan with regulator, emergency lamp

GROUP – B (MECHANICAL AND ELECTRONICS) **15**

3. MECHANICAL ENGINEERING PRACTICE

Welding

Arc welding of butt joints, lap joints, tee joints

Gas welding Practice.

Basic Machining

Simple turning, drilling and tapping operations.

Machine assembly Practice.

Study and assembling the following:

Centrifugal pump, mixies and air conditioners. Demonstration on

(a) Smithy operations like the production of hexagonal bolt.

(b) Foundry operation like mould preparation for grooved pulley.

4. ELECTRONIC ENGINEERING PRACTICE **9**

Soldering simple electronic circuits and checking continuity. Assembling electronic components on a small PCB and testing. Study of Telephone, FM radio, low-voltage power supplies.

TOTAL: 45 PERIODS

HS8251	**TECHNICAL ENGLISH II**	**LT P C**
	(For all branches of B.E / B.Tech programmes)	**3 1 0 4**

OBJECTIVE

- To make the students acquire listening and speaking skills meant for both formal and informal contexts
- To help them develop their reading skills by exposing them to different types of reading strategies
- To equip them with writing skills needed for academic as well as workplace situations
- To make them acquire language skills at their own pace by using e-materials and language lab component

OUTCOME

On completion of the course the students are expected to acquire various linguisdics skills required for academic and work place situations.

UNIT I 9+3

Listening - Listening to informal conversations and participating; Speaking - Opening a conversation (greetings, comments on something, weather) - Turn taking - Closing a conversation (excuses, general wish, positive comment, thanks); Reading - Developing analytical skills, Deductive and inductive reasoning - Extensive reading; Writing

- Effective use of SMS for sending short notes and messages - Using 'emoticons' as symbols in email messages; Grammar - Regular & irregular verbs - Active and passive voice; Vocabulary - Homonyms (e.g. 'can') - Homophones (e.g. 'some', 'sum'); E-materials - Interactive exercise on Grammar and vocabulary – blogging; Language Lab - Listening to different types of conversation and answering questions.

UNIT II **9+3**

Listening - Listening to situation based dialogues; Speaking - Conversation practice in real life situations, asking for directions (using polite expressions), giving directions (using imperative sentences), Purchasing goods from a shop, Discussing various aspects of a film (they have already seen) or a book (they have already read); Reading - Reading a short story or an article from newspaper, Critical reading, Comprehension skills; Writing - Writing a review / summary of a story / article, Personal letter (Inviting your friend to a function, congratulating someone for his success, thanking one's friend / relatives); Grammar - modal verbs, Purpose expressions; Vocabulary - Phrasal verbs and their meanings, Using phrasal verbs in sentences; E-materials - Interactive exercise on Grammar and vocabulary, Extensive reading activity (reading stories / novels from links), Posting reviews in blogs - Language Lab - Dialogues (Fill up exercises), Recording student's dialogues.

UNIT III **9+3**

Listening - Listening to the conversation - Understanding the structure of conversations; Speaking - Conversation skills with a sense of stress, intonation, pronunciation and meaning - Seeking information – expressing feelings (affection, anger, regret etc.); Reading - Speed reading – reading passages with the time limit - Skimming; Writing - Minutes of meeting – format and practice in the preparation of minutes - Writing summary after reading the articles from the journals - Format for the journal articles – elements of technical articles (abstract, introduction, methodology, results, discussion, conclusion, appendices, references) - Writing strategies; Grammar - Conditional clauses - Cause and effect expressions; Vocabulary - Words used as nouns and verbs without any change in the spelling (e.g. 'rock', 'train', 'ring'); E-materials - Interactive exercise on Grammar & vocabulary - Speed Reading practice exercises; Language Lab - Intonation practice using EFLU materials – Attending a meeting and writing minutes.

UNIT IV **9+3**

Listening - Listening to a telephone conversation, Viewing a model interview (face-to-face, telephonic and video conferencing) and observing the practices; Speaking - Role play practice in telephone skills - listening and responding, -asking questions, -note taking – passing on messages, Role play and mock interview for grasping the interview skills; Reading - Reading the job advertisements and the profile of the company concerned – scanning; Writing - Applying for a job – cover letter - résumé preparation – vision, mission and goals of the candidate; Grammar - Numerical expressions - Connectives (discourse markers); Vocabulary - Idioms and their meanings – using idioms in sentences; E-materials - Interactive exercises on Grammar & Vocabulary - Different forms of résumés- Filling up a résumé / cover letter;

Language Lab - Telephonic interview – recording the responses - e-résumé writing.

UNIT V **9+3**

Listening - Viewing a model group discussion and reviewing the performance of each participant - Identifying the characteristics of a good listener; Speaking - Group discussion skills – initiating the discussion – exchanging suggestions and proposals – expressing dissent/ agreement – assertiveness in expressing opinions – mind mapping technique; Reading - Note making skills – making notes from books, or any form of written materials - Intensive reading Writing - Types of reports – Feasibility / Project report – report format – recommendations / suggestions – interpretation of data (using charts for effective presentation); Grammar - Use of clauses; Vocabulary – Collocation; E-materials - Interactive grammar and vocabulary exercises - Sample GD - Pictures for discussion, Interactive grammar and vocabulary exercises - Pictures for discussion; Language Lab - Different models of group discussion

TOTAL : 60 PERIODS

TEXT BOOKS

1. Mindscapes: English for Technologists and Engineers, Orient Black Swan, 2012.
2. S.P. Dhanavel, English and Communication Skills for Students of Science and Engineering. Orient Black Swan, Chennai, 2011.

REFERENCE BOOKS

1. Laws, Anne. Presentations. Hyderabad: Orient BlackSwan, 2000.
2. Lewis, Hedwig. Body Language: A Guide for Professionals. New Delhi: Sage Publications, 1998.
3. Naterop, Jean B. and Rod Revell. Telephoning in English. Cambridge: Cambridge University Press, 1987.
4. Rutherford, Andrea J. Basic Communication Skills for Technology. New Delhi: Pearson Education, 2001.
5. Ur, Penny. Teaching Listening Comprehension. Cambridge: Cambridge University Press, 1984.

Extensive Readers

1. Abdul Kalam, A P J. Ignited Minds: Unleashing the Power within India. New Delhi: Penguin Books India, 2002.
2. Parameswaran, Uma. C.V.Raman: A Biography. New Delhi: Penguin Books India, 2011.

Attested

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Web Resources

1. www.esl-lab.com
2. www.englishgrammar.org
3. www.englishclub.com
4. www.mindtools.com
5. www.esl.about.com

MA8251 MATHEMATICS II L T P C

(Common to all branches of B.E. / B.Tech. Programmes in II Semester) 3 1 0 4

OBJECTIVE

To impart the fundamental knowledge about differential equations, vector calculus, analytic functions, complex integration and Laplace transforms.

OUTCOME

- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I DIFFERENTIAL EQUATIONS 9+3

Method of variation of parameters – Method of undetermined coefficients – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients.

UNIT II VECTOR CALCULUS 9+3

Gradient and directional derivative – Divergence and Curl – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral and volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III ANALYTIC FUNCTION 9+3

Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION 9+3

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour with no pole on real axis.

UNIT V LAPLACE TRANSFORMS 9+3

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – – Transform of periodic functions – Application to solution of linear ordinary differential equations with constant coefficients.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2007.

2. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2010.

REFERENCES

1. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education,New Delhi, 2007.

2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.

3. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics",Firewall Media

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(An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.

4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

PH8255	PHYSICS OF MATERIALS (Common to Chemical, Ceramic, Food, Leather, Industrial Biotechnology and Pharmaceutical)	L T P C 3 0 0 3

OBJECTIVE

To introduce the physics of various materials relevant to different branches of technology.

OUTCOME

On completion of the course the students are expected to have a thorough knowledge on the various materials and their physical properties.

UNIT I PREPARATION AND PROCESSING OF MATERIALS 9

Phases - Phase rule – binary systems – tie line rule – lever rule – phase diagram – invariant reactions – diffusion Fick's law - Nucleation – homogeneous and heterogeneous nucleation– Free energy of formation of a critical nucleus – crystal growth – Czochralski, Bridgman, Solution methods - Thin films – preparation: PVD method - Sol-gel method – heat treatment and hardening processes..

UNIT II PROPERTIES OF CONDUCTING AND SUPERCONDUCTING MATERIALS 9

Classical free electron theory of metals –Fermi function - Schrödinger wave equation - Time independent and time dependent equations. Physical significance of wave function, particle in a box (in one dimension) – electrons in a metal - Density of energy states – effect of temperature on Fermi energy – carrier concentration in metals - Superconducting Phenomena, Properties of superconductors – Meissner effect and Isotope effect. Type I and Type II superconductors, High Tc superconductors – Magnetic levitation and SQUIDS.

UNIT III ELECTRONIC MATERIALS 9

Elemental and compound semiconductors - Origin of band gap in solids (qualitative) - Concept of effective mass of electron and hole – carrier concentration in an intrinsic semiconductor (derivation) – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – carrier concentration in n-type and p-type semiconductors (derivation) – variation of Fermi level with temperature and impurity concentration – Compound

semiconductors – Hall effect – Determination of Hall coefficient – LED and Solar cells.

UNIT IV INSULATING AND MAGNETIC MATERIALS 9

Dielectric, paraelectric and ferroelectric materials - Electronic, Ionic, Orientational and space charge polarization – Internal field and deduction of Clausius Mosotti equation – dielectric loss – different types of dielectric breakdown – classification of insulating materials and their applications - Introduction to magnetic materials - Domain theory of ferromagnetism, Hysteresis, Soft and Hard magnetic materials – Anti-ferromagnetic materials – Ferrites, Giant Magneto Resistance materials. Magnetic bubbles.

UNIT V CERAMIC AND NEW MATERIALS 9

Introduction to Ceramics and its applications - Ceramic Fibres - Fibre reinforced Plastics – Fibre reinforced Metal – Metallic glasses – Shape memory alloys – Copper base alloys – Nickel – Titanium alloys – Relaxor- Ferroelectric materials – Electro and magneto rheological fluids - Sensors and Actuators – polymer semiconductos – photoconducting polymers – liquid crystals - Bio-sensors - Scintillation detectors (Position sensitive) –Bio materials – hydroxyapatite – PMMA – Silicone.

TOTAL : 45 PERIODS

REFERENCES

1. Raghavan. V. Materials Science and Engineering, Prentice Hall of India, 2002.
2. Kumar.J, Moorthy Babu. S and Vasudevan. S., Engineering Physics, Vijay Nicole Imprints, 2006
3. Palanisamy.. P.K., Materials Science, Scitech., 2003.
4. Calister, W.D., Materials Science and Engineering an Introduction, John Wiley, 2003.
5. Raghavan, V., Physical Metallurgy, Prentice Hall of India, 2002.

CY8253 CHEMISTRY FOR TECHNOLOGISTS L T P C
3 0 0 3

OBJECTIVE

To introduce the chemistry involved in various technology.

OUTCOME

On completion of the course the students are expected to have a thorough knowledge on the chemistry of water, interfaces, oils, fats, chemicals and colorants.

UNIT I WATER **9**

Water quality parameters- determination of hardness (EDTA method), TDS, BOD, COD and iron and their significance. Softening – Zeolite and demineralization processes. Boiler troubles and remedies – removal of oils and silica, internal conditioning. Desalination by electro-dialysis and reverse osmosis. Water quality parameters and standards for textile wet processing.

UNIT II CHEMISTRY OF INTERFACES **9**

Interface region-curved interfaces-thermodynamics of surfaces - Surface film on liquids-Adsorption of gases on Solids-adsorption isotherms. Applications of adsorption studies-detergency, wetting, foaming , defoaming, spreading, water repellency.

UNIT III OILS, FATS, SOAPS & LUBRICANTS **9**

Chemical constitution, Chemical analysis of oils and fats – acid, saponification and iodine values, Definitions, determinations and significance.Definition, mechanism of lubrication, preparation of petrolubes, desirable characteristics – viscosity, viscosity index, carbon residue, oxidation stability, flash and fire points, cloud and pour points, aniline point. Semisolid lubricant – greases, preparation of sodium, lithium, calcium and axle greases and uses, consistency test and drop point test. Solid lubricants – graphite and molybdenum disulphide

UNIT IV CHEMICALS AND AUXILIARIES **9**

Surfactant Chemistry, bleaching powder, sodium hypochlorite, hydrogen peroxide, chlorine dioxide, preparation, estimation of available chlorine in hypochlorite bleach liquor. determination of strength of hydrogen peroxide.

UNIT V COLORANTS **9**

Theory of color and constitution: chromophore and auxochrome,classification of dyes based on application. Chemistry and synthesis of azo dye.

TOTAL : 45 PERIODS

REFERENCES

1. Dhara S. S., “A Text Book of Engineering Chemistry”, S. Chand & Co. Ltd., New Delhi, 2002
2. Jain. P.C. and Monica Jain, “Engineering Chemistry”, Dhanpet Rai & Sons, New Delhi, 2001
3. Puri B. R., Sharma L. R. and Madhan S. Pathania, “Principles of Physical Chemistry”, Shoban Lal Nagin Chand & Co., Jalandar, 2000
4. Shore J., “Colourants and Auxiliaries: Volume I Colorants”, Wood head Publishing Ltd., 2002, ISBN 0 901956 77 5

5. Shore J., “Colourants and Auxiliaries: Volume II Auxiliaries”, Wood head Publishing Ltd., 2002, ISBN 0 901956 78 3
6. Trotman E. R., “Dyeing and Chemical Technology of Textile Fibres”, B.I Publishing Pvt. Ltd., New Delhi, 1994
7. Shenai V. A., “Chemistry of Dyes and Principles of Dyeing”, Sevak Publications, Mumbai, 1995

GE8251 ENGINEERING MECHANICS LTPC
3 1 0 4

OBJECTIVE

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering

OUTCOME

On completion of the course the students are expected to study the effect of force and motion in various design functions of engineering.

UNIT I BASICS AND STATICS OF PARTICLES 9 + 3

Introduction – Units and Dimensions – Laws of Mechanics – Lami’s theorem, Parallelogram and triangular Law of forces — Vectorial representation of forces – Vector operations of forces -additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility.

UNIT II EQUILIBRIUM OF RIGID BODIES 9 + 3

Free body diagram – Types of supports –Action and reaction forces –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 – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

UNIT III PROPERTIES OF SURFACES AND SOLIDS 9 + 3

Centroids and centre of mass– Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula –Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem –Principal moments

of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

UNIT IV DYNAMICS OF PARTICLES 9 + 3

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion -Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 9 + 3

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction –wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Beer, F.P and Johnson Jr. E.R. "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004)
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

REFERENCES

1. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education (2010).
2. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education (2006)
3. J.L.Meriam and L.G.Kraige, " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2,Third Edition, John Wiley & Sons,(1993)
4. Rajasekaran, S and Sankarasubramanian, G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., (2005).

CH8201 PRINCIPLES OF CHEMICAL ENGINEERING L T P C

3 0 0 3

AIM

To introduce and provide an overview of chemical engineering

OBJECTIVE

To enable the students to learn about the fluid flow, heat transfer and mass transfer in engineering applications.

OUTCOMES

On completion of the course, students

- Will attain knowledge in fluid behavior and solid properties
- Will understand conduction of heat and mass
- Will familiarize in equipments for distillation.

UNIT I **5**

Chemistry, Chemical Engineering and Chemical Technology; Chemical process industries: History and their role in Society; Role of Chemical Engineer; History and Personalities of Chemical Engineering; Greatest achievements of Chemical Engineering.

UNIT II **12**

Components of Chemical Engineering: Role of Mathematics, Physics, Chemistry and Biology; Thermodynamics, Transport Phenomena, Chemical Kinetics and Process dynamics, design and control.

UNIT III **12**

Concept of Unit Processes and Unit Operations; Description of different Unit Processes and Unit Operations; Designing of equipments; Flowsheet representation of process plants, Evolution of an Industry – Sulphuric acid and Soda ash manufacture. Demonstration of simple chemical engineering experiments; Plant visit to a chemical industry

UNIT IV **12**

Role of Computer in Chemical Engineering; Chemical Engineering Software; Visit to Process Simulation Lab; Relation between Chemical Engineering and other engineering disciplines; Traditional vs. modern Chemical Engineering; Versatility of Chemical Engineering: Role of Chemical Engineers in the area of Food, Medical, Energy, Environmental, Biochemical, Electronics etc. Plant visit to an allied industry.

UNIT V **4**

Paradigm shifts in Chemical Engineering; Range of scales in Chemical Engineering; Opportunities for Chemical Engineers; Future of Chemical Engineering.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Badger W.L. and Banchero J.T., “Introduction to Chemical Engineering”, 6th Edition, Tata McGraw Hill, 1997.
2. Dryden, C.E., “Outlines of Chemicals Technology”, Edited and Revised by Gopala Rao, M. and M.Sittig, 2nd Edition, Affiliated East-West press, 1993.
3. Randolph Norris Shreve, George T. Austin, “Shreve’e Chemical Process Industries”, 5th edition, McGraw Hill, 1984

REFERENCE BOOKS

1. McCabe, W.L., Smith, J. C. and Harriot, P. “Unit operations in Chemical Engineering”, McGraw Hill, 7th Edition, 2001
2. Finlayson, B. A., Introduction to Chemical Engineering Computing, John Wiley & Sons, New Jersey, 2006.

EE8252 PRINCIPLES OF ELECTRICAL AND ELECTRONICS ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To explain the basic theorems used in Electrical circuits and the different components and function of electrical machines.
- To explain the fundamentals of semiconductor and applications.
- To explain the principles of digital electronics
- To impart knowledge of communication

OUTCOMES:

- ability to identify the electrical components explain the characteristics of electrical machines.
- ability to identify electronics components and use of them to design circuits.

UNIT I ELECTRICAL CIRCUITS 9

Basic principles involved in power generation, transmission and use – Ohms Law Kirchoff’s Law – steady state solution of DC circuits – Theorem: Thevinin’s, Norton’s and Superposition Theorems.

UNIT II AC CIRCUITS 9

Introduction to AC circuits – waveforms and RMS value – power and power factor, single phase and three-phase balanced circuits, housing wiring, industrial wiring, materials of wiring.

UNIT III ELECTRICAL MACHINES **9**

Principles of operation and characteristics of DC machines. Transformers (single and three-phase) – synchronous machines – three-phase and single-phase induction motors – (op. Principles).

UNIT IV ELECTRONIC DEVICES & CIRCUITS **9**

Types of Materials –Silicon & Germanium- N type and P type materials – PN Junction –Forward and Reverse Bias –Semiconductor Diodes –Rectification – Bipolar Junction Transistor – Characteristics – transistor as an Amplifier –Introduction to operational Amplifier –Inverting Amplifier –Non Inverting Amplifier –DAC – ADC .

UNIT V MEASUREMENTS & INSTRUMENTATION **9**

Introduction to transducers: pressure, temperature, position, electrical measurements - Classification of instruments – moving coil and moving iron ,Ammeter and Voltmeter – multimeters – dynamometer type Wattmeter – three-phase power measurements – energy meter – megger – instrument transformer (CT and PT)

TOTAL : 45 PERIODS

REFERENCES

1. Del Toro, “Electrical Engineering Fundamentals”, Pearson Education, New Delhi, 2007
2. John Bird, “Electrical Circuit Theory and Technology”, Elsevier, First Indian Edition, 2006
3. Allan S Moris, “Measurement and Instrumentation Principles”, Elseveir, First Indian Edition, 2006
4. Rajendra Prasad, “Fundamentals of Electrical Engineering”, Prentice Hall of India, 2006
5. Thereja .B.L., “Fundamentals of Electrical Engineering and Electronics”, S. Chand & Co. Ltd., 2008
6. Sanjeev Sharma, “Basics of Electrical Engineering”, S.K International Publishers, New Delhi, 2007
7. V.K Mehta and Rohit Mehta, “Principle of Electrical Engineering”, S. Chand & Company, 2008

CY8261 APPLIED CHEMISTRY LAB **L T P C**
0 0 2 1

OBJECTIVE

- To make the student acquire practical skills in the wet chemical and instrumental methods for quantitative estimation of hardness, alkalinity, metal ion content, corrosion in metals and cement analysis.

OUTCOMES

- The students will be conversant with hands-on knowledge in the quantitative chemical analysis of water quality related parameters, corrosion measurement and cement analysis.

LIST OF EXPERIMENTS

1. Preparation of solutions with various normality and molarity.
2. Determination of Redwood / Saybolt numbers, kinematic viscosity and viscosity index of lubricating oils
3. Determination of flash point, fire point, cloud and pour point of oils
4. Determination of acid value, saponification number and iodine value of oils
5. Determination of total, temporary, permanent, calcium and magnesium hardness of water samples
6. Determination of chloride, sulphate ,and COD of water samples
7. Determination of purity of washing soda and strength of a commercial acid
8. Estimation of available chlorine in hypochlorite solution
9. Estimation of strength of hydrogen peroxide
10. Synthesis of a dye, preparation of soap and a defoamer

TOTAL : 45 PERIODS

CH8261 UNIX PROGRAMMING LAB LTPC
0 0 4 2

OBJECTIVE

To introduce working in UNIX environment.

OUTCOME

- To introduce the basic commands in UNIX.
- To teach UNIX shell programming.
- To introduce programming in C with UNIX system calls.

1. Basic Unix commands
   i) Directory Related Commands
   ii) File Related Commands.
   iii) File Compression Related Commands
   iv) Network Communication Commands
   v) Commands for sending messages between the users

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vi) Miscellaneous Commands

2. Editors for file operations.
   i) Vi Editor
   ii) Gedit
   iii) Kwrite
3. Filters and Pipes
   i) Concatenating Files
   ii) Display beginning and End of Files
   iii) Cut and Paste
   iv) Sorting
   v) Translating Characters
   vi) Count Characters, words, Lines
   vii) Comparing Files
4. Grep Operations – Grep, Fast Grep, Extended Grep
5. Sed Operations – Sed Scripts,Addresses,Commands
6. Awk
7. Input Redirection and Out Redirection Commands
8. Simple shell programming.
9. Shell programming using complex control structures
   i) if - fi
   ii) if-else-fi
   iii) if-elif
   iv) case-esac
   v) while- do- done
   vi) For-do-done
10. Shell Programming using Arrays & Functions .
11. C Programs using file system related system calls.
12. C Programs using process related system calls.
13. Programs for inter process communication using pipes, FIFOs.
14. Programs using signals.
15. Programs using shared memory.

TOTAL : 60 PERIODS

Attested

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TEXT BOOK

1. Brain W. Kernighan and Rob Pike, “The programming Environment”, PHI, 2002.

REFERENCE

1. Neil Matthew,Richard Stones, “”Linux Programming”,3rd Edition,2004.

MA8356 PROBABILITY AND STATISTICS L T P C
3 1 0 4

OBJECTIVES

- To make the students acquire a sound knowledge in statistical techniques that model engineering problems.
- The Students will have a fundamental knowledge of the concepts of probability.

OUTCOME:
Understand the fundamentals of probability concepts
Apply different probability test to the experiential work and research work
Apply statistical tool to the different real process.

UNIT I RANDOM VARIABLES 9+3

Discrete and Continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, Weibull and Normal distributions - Functions of a random variable.

UNIT II TWO-DIMENSIONAL RANDOM VARIABLES 9+3

Joint distributions – Marginal and Conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTS OF SIGNIFICANCE 9+3

Sampling distributions - Tests for single mean, proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – ψ^2-test for goodness of fit – Independence of attributes – Non-parametric tests: Test for Randomness and Rank-sum test (Wilcoxon test).

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UNIT IV DESIGN OF EXPERIMENTS 9+3

Completely randomized design – Randomized block design – Latin square design - 22 - factorial design - Taguchi's robust parameter design.

UNIT V STATISTICAL QUALITY CONTROL 9+3

Control charts for measurements (and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Milton, J. S. and Arnold, J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, New Delhi, 4th Edition, 3rd Reprint, 2008.
2. Johnson, R.A. and Gupta, C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2011.

REFERENCES

1. Devore, J.L., "Probability and Statistics for Engineering and the Sciences", Thomson Brooks/Cole, International Student Edition, New Delhi, 7th Edition, 2008.
2. Walpole, R.E., Myers, R.H., Myers, S.L. and Ye, K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", Elsevier, New Delhi, 3rd Edition, 2004.
4. Spiegel, M.R., Schiller, J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill, New Delhi, 2004.

CY8301 ORGANIC CHEMISTRY L T P C

3 0 0 3

OBJECTIVES

- To study the type of components in which organic reactions take place and also to know the preparation of the essential organic compounds.

OUTCOME:

Understand the classification of carbohydrates and preparation of heterocyclic compounds.
Understanding the dye chemistry and synthesis of dyes.
Apply the concept to prepare organic compounds and synthesis the ant malarial and Antibacterial drugs.

UNIT I CARBOHYDRATES 9

Introduction – various definitions and classifications of carbohydrates – Preparation, Physical & Chemical propertie, Structure and Uses of Monosaccharides (Glucose & Fructose) Interconversions – Aldo pentose to aldo hexose–Aldo hexose to aldo pentose- aldose to isomeric Ketose – Ketose to isomeric Aldose – Aldose to epimer

UNIT II HETEROCYCLIC COMPOUNDS 9

Preparation, Physical & Chemical properties and Uses of Pyrrole, Furan, Furfural, TetrahydroFuran, Thiophene, Indole, Pyridine, Quinoline and Isoquinoline.

UNIT III DYE CHEMISTRY 9

Witt's theory and modern theory of colors – Synthesis of Methyl red, Methyl orange, Congo red, Malachite green, para-rosaniline, phenolphthalein, fluorescence, Eosin dyes.

UNIT IV SYNTHETIC ORGANIC CHEMISTRY 9

Preparation and Synthetic utilities of Grignard reagent, Ethyl aceto acetate and Malonic ester.

UNIT V PHARMACEUTICAL CHEMISTRY 9

Synthesis of Antimalarial drugs – isopentaquine and chloroquine Synthesis of Antibacterial drugs – Sulphaniliamide and Sulphapyridine.

TOTAL : 45 PERIODS

TEXT BOOKS

1. R.T. Morrison and R.N. Boyd "Organic Chemistry" VI Edition Prentice Hall Inc (1996) USA.
2. K.S. Tiwari, N.K. Vishnoi and S.N. Malhotra "A text book of Organic Chemistry" Second Edition, Vikas Publishing House Pvt. Ltd. (1998) New Delhi.

REFERENCE BOOKS

1. Chemistry in Engineering and Technology, Vol.2, TMH Publishing Co Ltd., New Delhi, 1994.
2. I L Finar "Organic Chemistry" ELBS (1994).

CY8351 INSTRUMENTAL METHODS OF ANALYSIS L T P C
3 0 0 3

OBJECTIVES

- To make the students acquire a sound knowledge on the principle of spectroscopy, NMR, chromatography and its application

OUTCOME:

Understand the working principle and application of spectroscopy
Understand the NMR principle and its application
Understand the chromatography principle and its application
Understand the fundamentals of electro analysis and surface microscopy

UNIT I INTRODUCTION OF SPECTROMETRY 9

Properties of electromagnetic radiation- wave properties – components of optical instruments – Sources of radiation – wavelength selectors – sample containers – radiation transducers – Signal process and read outs – signal to noise ratio - sources of noise – Enhancement of signal to noise - types of optical instruments – Principle of Fourier Transform optical Measurements.

UNIT II MOLECULAR SPECTROSCOPY 9

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer's law – Instrumentation - Applications -Theory of fluorescence and Phosphorescence – Instrumenation – Applications – Theory of Infrared absorption spectrometry – IR instrumentation – Applications – Theory of Raman spectroscopy – Instrumentation – applications.

UNIT III MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY 9

Theory of NMR – environmental effects on NMR spectra – chemical shift- NMR-spectrometers – applicatons of 1H and 13C NMR- Molecular mass spectra – ion sources – Mass spectrometer. Applications of molecular mass - Electron paramagnetic resonance- g values – instrumentation.

UNIT IV SEPARATION METHODS 9

General description of chromatography – Band broadening and optimization of column performance- Liquid chromatography – Partition chromatography - Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography- Affinity chromatography- principles of GC and applications – HPLC- Capillary electrophoresis – Applications.

UNIT V ELECTRO ANALYSIS AND SURFACE MICROSCOPY 9

Electrochemical cells- Electrode potential cell potentials – potentiometry- reference electrode – ion selective and molecular selective electrodes – Instrument for potentiometric studies – Voltametry – Cyclic and pulse voltametry- Applications of voltametry . Study of surfaces –

Scanning probe microscopes – AFM and STM.

TOTAL : 45 PERIODS

TEXT BOOK

1. Instrumental Methods of Analysis. D.A. Skoog, F. James Holler, Stanky, R.Crouch . Cengage Learning – 2007.

CH8351 SOLID MECHANICS FOR TECHNOLOGISTS L T P C
3 0 0 3

AIM

To given them knowledge on structural, Mechanical properties of Beams, columns.

OBJECTIVES

- The students will be able to design the support column, beams, pipelines, storage tanks and reaction columns and tanks after undergoing this course. This is precursor for the study on process equipment design and drawing.

OUTCOMES:

- Solve the problems related to the structural components under various loading conditions

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids – forces on solids and supports – equilibrium and stability – strength and stiffness – tension, compression and shear stresses – Hooke's law and simple problems – compound bars – thermal stresses – elastic constants and poission's ratio.

UNIT II TRANSVERSE LOADING ON BEAMS 9

Beams – support conditions – types of Beams – transverse loading on beams – shear force and bending moment in beams – analysis of cantilevers, simply – supported beams and over hanging beams – relationships between loading, S.F. and B.M. In beams and their applications – S.F.& B.M. diagrams.

UNIT III DEFLECTIONS OF BEAMS 9

Double integration method – Macaulay's method – Area – moment theorems for computation of slopes and deflections in beams.

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UNIT IV STRESSES IN BEAMS **9**

Theory of simple bending – assumptions and derivation of bending equation (M/I = F/Y = E/R) – analysis of stresses in beams – loads carrying capacity of beams – proportioning beam sections – leaf springs – flitched beams – shear stress distribution in beams – determination of shear stress in flanged beams.

UNIT V TORSION AND COLUMNS **9**

Torsion of circular shafts – derivation of torsion equation (T/J = fs/R = Cθ/L) – stress and deformation in circular and hollow shafts – stresses and deformation in circular and hollow shafts – stepped shafts – shafts fixed at both ends – stresses in helical springs – deflection of springs – spring constant. Axially loaded short columns – columns of unsymmetrical sections – Euler's theory of long columns – critical loads for prismatic columns with different end conditions – effect of eccentricity.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Junarkar, S.B., Mechanics of Structure Vol. 1, 21st Edition, Character Publishing House, Anand, Indian, (1995)
2. William A.Nash, Theory and Problems of Strength of Materials, Schaum's Outline Series. McGraw Hill International Editions, Third Edition, 1994.
3. Bansal, R.K, Strength of Materials, Laxmi Publications(P) Ltd., Fourth Edition 2010

REFERENCE

1. Elangovan, A., Thinma Visai Iyal (Mechanics of Solids in Tamil), Anna University, Madras, 1995.

CH8301 FLUID MECHANICS FOR CHEMICAL ENGINEERS **LTPC**

3 0 0 3

OBJECTIVES

- To acquire a sound knowledge on fluid properties, fluid statics, dynamic characteristics for through pipes and porous medium, flow measurement and fluid machineries

OUTCOME

Understand the fundamental properties of fluids and its characteristics under static conditions. Develop empirical correlation using dimensionless analysis.

Analyze flow of fluid through pipe and over the of solid
Understand and select flow meter(s), characteristics of pumps used in Chemical Process Industries

UNIT I **6**

Methods of analysis and description - fluid as a continuum – Velocity and stress field - Newtonian and non-Newtonian fluids – Classification of fluid motion

UNIT II **9**

Fluid statics – basic equation - equilibrium of fluid element – pressure variation in a static fluid - application to manometry – Differential analysis of fluid motion – continuity, equation of motions, Bernoulli equation and Navier- Stokes equation.

UNIT III **9**

The principle of dimensional homogeneity – dimensional analysis, Rayleigh method and the Pi-theorem - non-dimensional action of the basic equations - similitude - relationship between dimensional analysis and similitude - use of dimensional analysis for scale up studies

UNIT IV **12**

Reynolds number regimes, internal flow - flow through pipes – pressure drop under laminar and turbulent flow conditions – major and minor losses; Line sizing; External flows - boundary layer concepts, boundary layer thickness under laminar and turbulent flow conditions- Flow over a sphere – friction and pressure drag - flow through fixed and fluidized beds.

UNIT V **9**

Flow measurement - Constant and variable head meters; Velocity measurement techniques;Types, characteristics and sizing of valves; Classification, performance characteristics and sizing of pumps, compressors and fans

TOTAL : 45 PERIODS

TEXT BOOKS

1. Noel de Nevers, “Fluid Mechanics for Chemical Engineers “, Second Edition, McGraw-Hill, (1991).
2. Munson, B. R., Young, D.F., Okiishi, T.H. “Fundamentals of Fluid Mechanics”, 5th Edition“, John Wiley, 2006

REFERENCES

1. White, F.M., “Fluid Mechanics “, IV Edition, McGraw-Hill Inc., 1999.

2. James O Wilkes and Stacy G Bike, “Fluid Mechanics for Chemical Engineers’ Prentice Hall PTR (International series in Chemical Engineering) (1999)
3. McCabe W.L, Smith, J C and Harriot. P “Unit operations in Chemical Engineering”, McGraw Hill, VII Edition, 2005

CH8302 PROCESS CALCULATIONS L T P C
3 0 0 3

OBJECTIVES

- To acquire a concept of degree of freedom and its application to solution of mass and energy balance equations for single and network of units and introduce to process simulators

OUTCOME

Understand the fundamentals of units and stoichiometric equations.
Write material balance for different chemical process.
Understand the fundamentals of ideal gas behavior and phase equilbria.
Write energy balance for different chemical process.

UNIT I **6**

Units, dimensions and conversion; Process variables and properties; Stoichiometric Equations, Degrees of freedom.

UNIT II **11**

Introduction to material balances. Material balance problems for single units; Stoichiometry and Chemical reaction equations; material balance for processes involving reaction bypass, purging, recycle operations.

UNIT III **11**

Ideal gases, Real gases, Single component two phase systems, Multiple component phase systems, Phase rule, Phase equilbria, Combustion processes.

UNIT IV **11**

Energy balances, Conservation of Energy processes without reaction, Heat capacity, Energy balances with chemical reaction, Efficiency applications.

UNIT V **6**

Application of energy balances. Unsteady state material and energy balances. Solving material and energy balances using process simulators.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Himmelblau, D.M., "Basic Principles and Calculations in Chemical Engineering", EEE Sixth Edition, Prentice Hall Inc., 2003
2. Felder, R. M. and Rousseau, R. W., "Elementary Principles of Chemical Processes",3rd Edn., John Wiley & Sons, New York, 2000.
3. Bhatt, B.L., Vora, S.M., "Stoichiometry ", 4th Edition,Tata McGraw-Hill (2004)

REFERENCES

1. Hougen O A, Watson K M and Ragatz R A, "Chemical process principles" Part I, CBS publishers (1973).

ME8351 BASIC MECHANICAL ENGINEERING L T P C
3 0 0 3

OBJECTIVES

- Students will learn thermodynamics and thermal engineering to understand the principles behind the operation of thermal equipments like IC engines and turbines etc., Students should be able to appreciate the theory behind operation of machinery and be able to design simple mechanisms

OUTCOME

Apply the law of thermodynamics to the real systems
Understand and analyse different thermodynamic cycles, calculate their thermal efficiencies and the testing of I.C engines.
Understand the Steam distribution and utilisation systems and comprehend principles of steam turbines

Understand the principle of kinematic mechanics, flywheel and belt & rope drives

UNIT I LAWS OF THERMODYNAMICS 10

Basic concepts and hints; Zeroth law; First Law of Thermodynamics - Statement and application; Steady flow energy equation-problems- Second law of Thermodynamics – Kelvin

- Plank statement and Clausius statement- problems; Limitations; Heat Engine, Refrigerator and Heat Pump, Available energy, Third law of Thermodynamics - Statement.

UNIT II HEATING AND EXPANSION OF GASES 6

Expressions for work done, Internal energy and heat transfer for Constant Pressure, Constant Volume, Isothermal, Adiabatic and Polytropic processes-Derivations and problems; Free expansion and Throttling process.

UNIT III AIR STANDARD CYCLES 6

Carnot cycle; Stirlings cycle; Joule cycle; Otto cycle; Diesel cycle; Dual combustion Cycle-Derivations and problems.

UNIT IV I.C. ENGINES, STEAM AND ITS PROPERTIES AND STEAM TURBINES 12

Engine nomenclature and classification; SI Engine; CI Engine; Four Stroke cycle, Two stroke cycle; Performance of I.C.Engine; Brake thermal efficiency; Indicated Thermal Efficiency, Specific fuel consumption.

Steam - Properties of steam; Dryness fraction; latent heat; Total heat of wet steam; Dry steam; Superheated steam. Use of steam tables; volume of wet steam, volume of superheated steam; External work of evaporation; Internal energy; Entropy of vapour, Expansion of vapour, Rankine cycle.

Steam turbines – Impulse and Reaction types - Principles of operation.

UNIT V SIMPLE MECHANISM, FLY WHEEL, DRIVES AND BALANCING 11

Definition of Kinematic Links, Pairs and Kinematic Chains;

Flywheel-Turning moment Diagram; Fluctuation of Energy.

Belt and rope drives; Velocity ratio; slip; Creep; Ratio of tensions; Length of belt; Power Transmitted; gear trains-types.

Balancing of rotating masses in same plane; Balancing of masses rotating in different planes.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Nag, P.K., " Engineering Thermodynamics ", II Edition, Tata McGraw Hill Publishing Co., Ltd., 1995.
2. Rajput, R .K, "Thermal Engineering", Laxmi publications (P) Ltd, 2001.
3. Khurmi R.S., and Gupta J.K, "Theory of Machines", Eurasia Publishing House (P) Ltd.,

2004.

REFERENCES

1. Smith, " Chemical Thermodynamics ", Reinhold Publishing Co., 1977.
2. Bhaskaran, K.A., and Venkatesh, A., " Engineering Thermodynamics " Tata McGraw Hill, 1973.
3. Pandya A. and Shah, " Theory of Machines ", Charatakar Publishers, 1975.
4. Khurmi R.S., and Gupta J.K, "Thermal Engineering", S.Chand & Company (P) Ltd.,2001.
5. Kothandaraman and Dhomkundwar,": A course in Thermal Engineering (SI Units)", Dhanpat Rai and Sons, Delhi (2001)

CH8311	ELECTRICAL ENGINEERING LABORATORY FOR TECHNOLOGISTS	L T P C 0 0 4 2

OBJECTIVES

- To provide the practical knowledge and control methods of electrical machines

OUTCOME

Conduct load test as DC Shunt and series motor, evaluate the open circuit and load characteristics of different DC generator and interpret the results.
Perform short circuit, open circuit and load test on single phase transformers and interpret the results.
Conduct load test on single and three phase induction motor and interpret the results.
Ability to conduct regulation of three phase generator test and interpret the results.

1. Study of Starters
2. Power Measurements in Three-Phase Circuits
3. Speed Control of DC Motor
4. Load Test on DC Shunt Motor
5. OCC & Load Test on DC Shunt Generator
6. Load Test on DC series motor.

7. OC and SC Test on Single- Phase Transformer
8. Load Test on Single-Phase Transformer
9. Load Test on Single-Phase Induction Motor
10. Load Test on Three-Phase Induction Motor
11. Load Characteristics of Alternator.

TOTAL : 60 PERIODS

CH8312	ORGANIC CHEMISTRY LAB	L T P C
		0 0 4 2

OBJECTIVES

- To learn basic principles involved in analysis and synthesis of different organic derivatives.

OUTCOME:

Conduct simple experiments to identify the nature(aliphatic/aromatic), (Saturated/Unsaturated) of organic compounds

Conduct simple experiments to indentify the functional groups

Prepare organic compounds like acetanilide, salyciliate, m-dinitrobenzene etc.,

1. Quantitative analysis of organic compounds – Identification of aliphatic/aromatic, saturated/unsaturated compounds.
2. Identification and characterization of various functional groups by their characteristic reactions:

   a) alcohol, b) aldehyde, c) ketone, d) carboxylic acid, e) phenol, f) ester, g) primary, secondary and tertiary amines h) imide i) nitro compounds.
3. Analysis of an unknown organic compound and preparation of suitable solid derivatives.
4. Analysis of carbohydrates.
5. Analysis of proteins.
6. Methodology of filtration and recrystallization.
7. Introduction to organic synthetic procedures:

   i. Acetylation – Preparation of acetanilide from aniline.

   ii. Hydrolysis – Preparation of salycilic acid from methyl salyciliate.

   iii. Substitution – Conversion of acetone to iodoform.

   iv. Nitration – Preparation of m-dinitrobenzene from nitrobenzene.

   v. Oxidation – Preparation of benzoic acid from benzaldehyde/ benzyl alcohol

TOTAL : 60 PERIODS

REFERENCE MANUAL

1. Organic Chemistry Lab Manual, Chemistry Division, Chemical Engineering Department, A. C. Tech, Anna University (2007).

MA8353 **NUMERICAL METHODS** **L T P C**
3 1 0 4

OBJECTIVES

- To provide the mathematical foundations of numerical techniques for solving linear system, Eigen value problems, interpolation, numerical differentiation and integration and the errors associated with them;
- To demonstrate the utility of numerical techniques of ordinary and partial differential equations in solving engineering problems where analytical solutions are not readily available.

OUTCOME

Solve linear algebraic & transcendental equations and interpolation problems
Understand concepts of numerical differentiations and integration to solve problems using different methods.
Understand and solve boundary value problems in partial, differential equations using Laplace, Poisson method; understand and solve wave equations.

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+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 9+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 – Least square method - Linear curve fitting.

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 - Multi-step 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.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal, B.S. and Grewal,J.S., "Numerical methods in Engineering and Science", Khanna Publishers, New Delhi, 9th Edition, 2007.
2. Sankara Rao, K. "Numerical methods for Scientists and Engineers', Prentice Hall of India Private Ltd., New Delhi, 3rd Edition,2007.

REFERENCES

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education Asia, New Delhi, 1st Edition, 2007.
2. Gerald, C.F. and Wheatley, P.O., "Applied Numerical Analysis", Pearson Education Asia, New Delhi, 6th Edition, 2006.
3. Laurene V. Fausett, "Applied Numerical Analysis using MATLAB", Pearson Education, New Delhi, 1st print, 2nd Edition, 2009

CY8401 **PHYSICAL CHEMISTRY** **L T P C**
3 0 0 3

OBJECTIVES

- To acquire knowledge in the field of electrochemistry, solubility behaviour, chemical reaction kinetics, photochemical reactions and colloidal chemistry towards different applications.

OUTCOME:

Understand the basic principles of electrochemistry and colloids to apply for their application in Chemical Engineering practice.
Understand kinetics and theory of reaction rates concepts
Understand the fundamentals of photochemistry and the concept of distribution law.

UNIT I ELECTROCHEMISTRY **9**

Electrical Resistance – Specific Resistance – Electrical conductance – Specific conductance – Equivalent conductance – Cell constant – Determination of cell constant – variation of

conductance with dilution – Kohlrausch's law –Single electrode potential –Galvanic cell – Cu – Zn cell - EMF and its measurement – Reference electrode – Standard Hydrogen Electrode – Calornel electrode – Nernst equation - Electrochemical series – Applications of EMF Measurements: Fuel cells – Hydrogen -Oxygen fuel cell .

UNIT II CHEMICAL KINETICS **9**

Rate of a reaction-Order of a reaction – Examples and rate equations for Zero order, First order, Second order and Third order reactions –Molecularity of a reaction – Unimolecular and Bimolecular reactions – Half life period– Kinetics of parallel and opposing reactions – Activation energy – Arrhenius equation –Collision theory of reaction rates – Theory of absolute reaction rates – Michalis Menton kinetics of enzyme catalyzed reactions.

UNIT III PHOTOCHEMISTRY **9**

Laws of Photochemistry, Beer–Lambert's law- Grothus & Drapper's law- Stark Einstein's law- Quantum efficiency– Reason for difference in quantum efficiency –Method of determination of quantum yield. Photochemical reactions, Actinometry – Uranyl oxalate method only – Kinetics and mechanism of Hydrogen – Bromine reaction, Hydrogen – Chlorine reaction – Photosensitization- Photo inhibitor- Chemiluminescence.

UNIT IV COLLOIDS **9**

Introduction to colloids – properties of colloids – coagulation of solutions – Origin of charge on colloidal particles – Determination of size of colloidal particles – Donnan Membrane equilibrium – Emulsions – Gels – Applications of colloids – Nanoparticles (Au, Ag, Pt) – Preparation – Characterization – Properties – Application in catalysis and drug delivery systems.

UNIT V THE DISTRIBUTION LAW **9**

Distribution co-efficient - Distribution Law — Conditions for the validity of the Distribution law – I2–CCl4–H2O System – Nature of interaction of the solute with one of the solvents – Dissociation- Association – Applications of Distribution law – Process of Extraction.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Kund and Jain, Physical Chemistry, S.Chand and Company, New Delhi (1996).
2. Puri B.H. Sharma L.R. and M.S.Prathama, "Principles of Physical Chemisry", S.Chand and Company, New Delhi (2001).
3. B.S.Bahl, Arun Bahl and G.D.Tuli, "Essentials of Physical Chemistry", S.Chand and Company, New Delhi (2005).

REFERENCES

1. Gordon M. Barrow, Physical Chemistry, Sixth Edition, Tata McGraw Hill (1998).
2. Peter Atkins & Julio de Paula, Atkins' Physical Chemistry, 7th Edition, Oxford university press.(2002).

CH8401 CHEMICAL ENGINEERING THERMODYNAMICS- I L T P C
3 0 0 3

OBJECTIVES

- Students will learn PVT behaviour of fluids, laws of thermodynamics, thermodynamic property relations and their application to fluid flow, power generation and refrigeration processes.

OUTCOME:

Understand the fundamental concepts of thermodynamics
Apply second law and analyze the feasibility of systems/devices; understand the real gas behaviour
Understand thermodynamic formulations and the working of compressors and expanders.

UNIT I **6**

Scope of thermodynamics; Definition of system, control volume, state and path function, equilibrium, reversibility, energy, work and heat. zeroth law; temperature scales

UNIT II **7**

PVT behaviour of fluids; Mathematical representation of PVT behaviour; Generalized compressibility factor correlation; Generalized equations of state

UNIT III **12**

Joule's experiment, internal energy, first law, energy balance for closed systems, mass and energy balance for open systems Statements of the second law of thermodynamics, heat engine and refrigerator, Carnot cycle and Carnot theorems, thermodynamic temperature scale, entropy and its calculation, second law of thermodynamics for a control volume, Third law of thermodynamics, entropy from a microscopic point of view.

UNIT IV **12**

Thermodynamic potentials – internal energy, enthalpy, Helmholtz free energy, Gibbs free energy; thermodynamic property relations – Maxwell relations – partial derivatives and Jacobian method; residual properties; thermodynamic property tables and diagrams

UNIT V **8**

Duct flow of compressible fluids, Compression and expansion processes, steam power plant, internal combustion engines, jet and rocket engines.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Smith, J.M., Van Ness, H.C and Abbot M.M “Introduction to Chemical Engineering Thermodynamics “, McGraw Hill Publishers, VI edition, 2003
2. Narayanan, K.V. A Textbook of Chemical Engineering Thermodynamics Prentice Hall India, 2004

REFERENCES

1. Kyle, B.G., “Chemical and Process Thermodynamics III Edition”, Prentice Hall of India Pvt. Ltd., 1999.
2. Elliott J.R., Lira, C.T., “Introductory chemical engineering thermodynamics”, Prentice Hall, 1998
3. Rao, Y.V.C., “Chemical Engineering Thermodynamics” Universities Press, 2005

CH8402 **HEAT TRANSFER** **L T P C**

3 0 0 3

OBJECTIVES

- To learn heat transfer by conduction, convection and radiation and heat transfer equipments like evaporator and heat exchanger

OUTCOME:

Understand the fundamentals of heat transfer mechanism

Evaluate film coefficients.

Understand the applications of heat transfer equipments and determine the efficiency and effectiveness of evaporators and heat exchangers.

UNIT I **9**

Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer - Fourier’s law of heat conduction - one dimensional steady state heat conduction equation for flat plate, hollow cylinder, - Heat conduction through a series of resistances - Thermal conductivity measurement; effect of temperature on thermal conductivity; Heat transfer in extended surfaces.

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UNIT II **9**

Concepts of heat transfer by convection - Natural and forced convection, analogies between transfer of momentum and heat - Reynold's analogy, Prandtl and Coulburn analogy. Dimensional analysis in heat transfer, heat transfer coefficient for flow through a pipe, flow past flat plate, flow through packed beds.

UNIT III **9**

Heat transfer to fluids with phase change - heat transfer from condensing vapours, drop wise and film wise condensation, Nusselt equation for vertical and horizontal tubes, condensation of superheated vapours, Heat transfer to boiling liquids - mechanism of boiling, nucleate boiling and film boiling.

UNIT IV **9**

Theory of evaporation - single effect and multiple effect evaporation - Design calculation for single and multiple effect evaporation. Radiation heat transfer - Black body radiation, Emissivity, Stefan - Boltzman law, Plank's law, radiation between surfaces.

UNIT V **9**

Log mean temperature difference - Single pass and multipass heat exchangers; plate heat exchangers; use of correction factor charts; heat exchangers effectiveness; number of transfer unit - Chart for different configurations - Fouling factors

TOTAL : 45 PERIODS

TEXT BOOKS

1. Holman, J. P., 'Heat Transfer ', 8th Edn., McGraw Hill, 1997.
2. Ozisik, M. N., Heat Transfer: A Basic Approach, McGraw-Hill, 1984
3. Kern, D.Q., "Process Heat Transfer ", McGraw-Hill, 1999.

REFERENCES

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 6th Edn., McGraw-Hill, 2001.
2. Coulson, J.M. and Richardson, J.F., "Chemical Engineering " Vol. I, 4th Edn., Asian Books Pvt. Ltd., India, 1998.

CH8403 **MATERIAL SCIENCE AND TECHNOLOGY** **LTPC**
3 0 0 3

OBJECTIVES

- Students will be able to understand various material and its properties and manufacturing methods

OUTCOME:

Understand basic and the mechanical behavior of the metals
Understand phase diagrams and phase transformations of metals.
Understand the manufacturing process of ferrous, non-ferrous metals and composites.
Understand the basic concepts of nano materials

UNIT I INTRODUCTION **10**

Structure – Property relationship - Selection criteria and processes: General criteria of selection of materials in process industries. Properties: Mechanical, Thermal, Physical, Chemical, Electrical, Magnetic and Technological properties. Processing of Metals and Alloys- Casting, Hot and cold rolling, Forging, Extrusion, Deep drawing.

UNIT II MECHANICAL BEHAVIOUR **8**

Elastic, Anelastic and Viscoelastic Behaviour – Introduction to Slip, Slip planes, Plastic Deformation by Slip: Critical resolved shear stress, Mechanism of Creep, Creep Resistant Materials – Fracture: Ductile and Brittle, Fatigue fracture, Griffith's theory, S-N curves, Fracture toughness.

UNIT III PHASE DIAGRAMS AND PHASE TRANSFORMATIONS **8**

Gibb's Phase rule : Uniary and Binary phase diagrams , Al_2CO_3 - Cr_2O_3 , Pb-Sn, Ag-Pt and Iron- Iron Carbide Phase Diagram – Lever rule – Invariant reactions- TTT diagrams – Micro structural changes – Nucleation and growth – Martensitic transformations – Solidification and Crystallization – Glass transition – Recrystallization and Grain growth

UNIT IV FERROUS, NON-FERROUS METALS AND COMPOSITES **10**

Pig iron, Cast iron, Mild Steel-Manufacturing process, properties &, Applications Stainless steels, Special Alloy steels-properties and uses; Heat treatment of plain-carbon steels.

Manufacturing methods of Lead, Tin and Magnesium. Properties and applications in process industries.

FRP-Fiber Reinforced Plastics (FRP), manufacturing methods; Asphalt and Asphalt mixtures; Wood.

UNIT V NANOMATERIALS **9**

Introduction to Nanotechnology- Zero Dimensional Nano Structures – Nano particles – One Dimensional Nano Structures- Nano wires and Nano rods – Two Dimensional Nano Structures, Films – Special Nano Materials - Nano Structures fabricated by Physical Techniques – Characterisation and Properties of Nano Materials – Applications of Nano Structures.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Khanna O P, “Material Science and metallurgy” Dhanpat Rai Publications (1995)
2. Raghavan V, “Materials and Engineering” Prentice Hall of India, Newdelhi (2006)
3. Brenner D, “Hand book of Nanoscience and technology” (2002)
4. Material Science & Engineering, Callister

REFERENCES

1. Henry R Clauster, “Industrial and Engineering Materials” McGraw Hill Book Co. (1975)
2. Kingery W D and Bowen H K and Unimann D R, “Introduction to Ceramics” John Wiley and Sons, Second edition (1991)
3. Fahrner W R, “Nanotechnology and Nanoeletronics” Springer International edition(2005)
4. Budinsky K G and Budinsky K M “ Engineering Materials- Properties and Selection” Prentice Hall of India (2002)
5. Arumugam M, “ Material Science” Anuradha Technical Book Publishers (1997)

CH8404 **MECHANICAL OPERATIONS** **L T P C**
3 0 0 3

OBJECTIVES

- The students will learn characterization of solids, size reduction, techniques of solid - fluid separation and mixing

OUTCOME:

Apply the principles of size analysis and size reduction techniques of solids by selecting proper equipments such as crushers, grinders, etc.,

Understand the working principles of thickeners, gravity settling tanks, cyclone separators, Filters and other mechanical separation devices

Select mixing and agitation equipments, storage and transportation equipments used for handling solids in Chemical process industries.

Attested

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UNIT I **9**

General characteristics of solids, different techniques of size analysis, shape factor, surface area determination, estimation of particle size. Screening methods and equipment, screen efficiency, ideal and actual screens.

UNIT II **9**

Laws of size reduction, energy relationships in size reduction, methods of size reduction, classification of equipments, crushers, grinders, disintegrators for coarse, intermediate and fine grinding, power requirement, work index; size enlargement - principle of granulation, briquetting, pelletisation, and flocculation.

UNIT III **9**

Gravity settling, sedimentation, thickening, elutriation, double cone classifier, rake classifier, bowl classifier. Centrifugal separation - continuous centrifuges, super centrifuges, design of basket centrifuges; industrial dust removing equipment, cyclones and hydro cyclones, electrostatic and magnetic separators, heavy media separations, floatation, jigging

UNIT IV **9**

Theory of filtration, Batch and continuous filters, Flow through filter cake and filter media, compressible and incompressible filter cakes, filtration equipments - selection, operation and design of filters and optimum cycle of operation, filter aids.

UNIT V **9**

Mixing and agitation - Mixing of liquids (with or without solids), mixing of powders, selection of suitable mixers, power requirement for mixing. Storage and Conveying of solids - Bunkers, silos, bins and hoppers, transportation of solids in bulk, conveyer selection, different types of conveyers and their performance characteristics.

TOTAL : 45 PERIODS

TEXT BOOKS

1. McCabe, W.L., Smith, J.C., and Harriot, P., “Unit Operations in Chemical Engineering”, 7th Edn., McGraw-Hill, 2005.
2. Badger W.L. and Banchero J.T., “Introduction to Chemical Engineering”, Tata McGraw Hill, 1997.
3. Foust, A. S., Wenzel, L.A., Clump, C.W., Naus, L., and Anderson, L.B., “Principles of Unit Operations”, 2nd Edn., John Wiley & Sons, 1994.

REFERENCES

1. Coulson, J.M. and Richardson, J.F., “Chemical Engineering” Vol. I, 4th Edn., Asian Books Pvt. Ltd., India, 1998.

CH8411	FLUID MECHANICS LABORATORY	LTPC
		0 0 4 2

OBJECTIVES

- To learn experimentally to calibrate flow meters, find pressure loss for fluid flows and determine pump characteristics.

OUTCOME:

Use variable area flow meters and variable head flow meters

Analyze the flow of fluids through closed conduits, open channels and flow past immersed bodies

Select pumps for the transportation of fluids based on process conditions/requirements and fluid properties

LIST OF EXPERIMENTS

1. Viscosity measurement of non Newtonian fluids
2. Calibration of constant and variable head meters
3. Calibration of weirs and notches
4. Open drum orifice and draining time
5. Flow through straight pipe
6. Flow through annular pipe
7. Flow through helical coil and spiral coil
8. Losses in pipe fittings and valves
9. Characteristic curves of pumps
10. Pressure drop studies in packed column
11. Hydrodynamics of fluidized bed
12. Drag coefficient of solid particle

EQUIPMENT REQUIRED

1. Viscometer
2. Venturi meter
3. Orifice meter
4. Rotameter
5. Weir
6. Open drum with orifice
7. Pipes and fittings
8. Helical and spiral coils
9. Centrifugal pump
10. Packed column

11. Fluidized bed

TOTAL : 60 PERIODS

CH8412	**TECHNICAL ANALYSIS LAB**	**L T P C**
		0 0 4 2

OBJECTIVE

- To learn basic principles involved in estimation and characterization of industrially important materials.

OUTCOME:

Analyse and determine the various properties of soap, oils, cement, coal and fuels
Able to determine molecular weight of polymers.
Able to determine the properties of substance using calorimetric, conductivity and P^H measurement techniques.

I Soap Analysis

a. Estimation of total fatty acid
b. Estimation of percentage alkali content

II. Oil Analysis

a. Estimation of free acid
b. Determination of Saponification value
c. Determination of iodine value

III. Cement Analysis

a. Estimation of Silica content
b. Estimation of mixed oxide content
c. Estimation of calcium oxide content
d. Estimation of calcium oxide by rapid method

IV. Coal Analysis

a. Estimation of Sulphur present in coal
b. Ultimate analysis of coal
c. Proximate analysis of coal

V. Analysis of Bleaching Powder

a. Estimation of available chlorine

VI. Analysis of Glycerol

a. Estimation of purity of glycerol

VII. Analysis of fuels

a. Flash point b. Fire point c. Cloud point d. Pour point e. Aniline point.

VIII. Determination of the molecular weight of the polymer by viscometry.

IX. Calorimetric measurements

X. Conductivity measurement of an electrolyte solution

XI. pH measurements

TOTAL : 60 PERIODS

REFERENCE MANUAL

1. Technical Analysis Manual, Chemistry Division, Chemical Engineering Department, A.C.Tech, Anna University (2007).

ME8361 MECHANICAL ENGINEERING LABORATORY L T P C
0 0 3 2

OBJECTIVES

- Students will be able to understand Power-generating units such as engines and operate IC engines and conduct tests. They will be able to appreciate the theory behind the functioning of engines. Material properties, their behavior under different kinds of loading and testing can be visualized.

OUTCOME

Able to carry out performance test using Diesel and petrol Engine

LIST OF EXPERIMENTS

1. Port timing diagram
2. Valve timing diagram
3. Study of 2,4 stroke I C Engines
4. Load test on 4-stroke petrol engine
5. Performance test on 4-stroke single cylinder diesel engine
6. Performance test on 4-stroke twin cylinder diesel engine
7. Heat balance test on diesel engines
8. Tension test
9. Compression test

10. Deflection test
11. Hardness test (Rockwell and Brinell)
12. Springtest
13. Torsion test
14. Impact test

TOTAL : 45 PERIODS

* Minimum 10 experiments shall be offered

GE8351 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
3 0 0 3

OBJECTIVES

- Students acquire knowledge about the environment, ecosystems and biodiversity

OUTCOME:
Understand the environment, ecosystems and biodiversity
Understand the natural resources available in the earth and how it get polluted
Understand the influence of social issues and human population on the Environment

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 – soil 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 production 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, New Delhi, (2006).

REFERENCES

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)

CH8501 CHEMICAL ENGINEERING THERMODYNAMICS II LTPC
3 0 0 3

OBJECTIVES

- The Students will be well versed with the behavior of fluids under PVT conditions and also apply them for practical purpose. Main advantage will be to deal with power production and refrigeration processes. The study further provides a comprehensive exposition to theory and application of solution thermodynamics.

OUTCOME:

Understand and evaluate the thermodynamic properties of pure fluids and solutions
Evaluate and analyze the phase equilibrium data
Analyze chemical reaction rates and evaluate the performance of refrigeration cycles

UNIT I PROPERTIES OF SOLUTIONS 10

Partial molar properties, ideal and non-ideal solutions, standard states definition and choice, Gibbs-Duhem equation, excess properties of mixtures.

UNIT II PHASE EQUILIBRIA 14

Criteria for equilibrium between phases in multi component non-reacting systems in terms of chemical potential and fugacity, application of phase rule, vapour-liquid equilibrium, phase diagrams for homogeneous systems and for systems with a miscibility gap, effect of temperature and pressure on azeotrope composition, liquid-liquid equilibrium, ternary liquid-liquid equilibrium.

UNIT III CORRELATION AND PREDICTION OF PHASE EQUILIBRIA 12

Activity coefficient-composition models, thermodynamic consistency of phase equilibria, application of the correlation and prediction of phase equilibria in systems of engineering interest particularly to distillation and liquid extraction processes.

UNIT IV CHEMICAL REACTION EQUILIBRIA 14

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

UNIT V REFRIGERATION 10

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

L : 45, T : 15 , TOTAL: 60 PERIODS

TEXT BOOKS

1. Smith, J.M., VanNess, H.C., & Abbot M.C, “Introduction to Chemical Engineering Thermodynamics”, McGraw Hill VII Edition 2004.
2. Narayanan K.V “A Text Book of Chemical Engineering Thermodynamics” Prentice Hall of India Pvt. Ltd. 2001.

REFERENCES

1. Hougen, O.A., Watson, K.M., and Ragatz, R.A., “Chemical Process Principles Part II”, Thermodynamics, John Wiley, 1970.
2. Dodge, B.F., “Chemical Engineering Thermodynamics”, McGraw-Hill, 1960.
3. Sandler, S.I., “Chemical and Engineering Thermodynamics”, 2nd Edition, Wiley, 1989.

CH8502 CHEMICAL REACTION ENGINEERING - I LTPC

3 1 0 4

OBJECTIVES

- Students gain knowledge on different types of chemical reactors, the design of chemical reactors under isothermal and non-isothermal conditions

OUTCOME:

Apply the principles of reaction kinetics, formulate rate equations and analyse the batch reactor data.

Analyze the experimental kinetic data to select a suitable reactor for a particular application and to workout conversion and space time for different types of reactors.

Evaluate selectivity, reactivity and yield for parallel and mixed reactions.

Examine how far real reactors deviate from the ideal.

UNIT I **12**

Rate equation, elementary, non-elementary reactions, theories of reaction rate and Prediction; Design equation for constant and variable volume batch reactors, analysis of experimental kinetics data, integral and differential analysis.

UNIT II **12**

Design of continuous reactors - stirred tank and tubular flow reactor, recycle reactors, combination of reactors, size comparison of reactors.

UNIT III **12**

Design of reactors for multiple reactions - consecutive, parallel and mixed reactions - factors affecting choice, optimum yield and conversion, selectivity, reactivity and yield.

UNIT IV **12**

Non-isothermal homogeneous reactor systems, adiabatic reactors, rates of heat exchanges for different reactors, design for constant rate input and constant heat transfer coefficient, operation of batch and continuous reactors, optimum temperature progression.

UNIT V **12**

The residence time distribution as a factor of performance; residence time functions and relationship between them in reactor; basic models for non-ideal flow; conversion in non-ideal reactors

TOTAL : 60 PERIODS

TEXT BOOKS

1. Levenspiel O, “Chemical Reaction Engineering”, Wiley Eastern Ltd., II Edition, 2000.
2. Smith, J.M, “Chemical Engineering Kinetics”, McGraw Hill, III Edition, 1981.
3. Fogler.H.S., “Elements of Chemical Reaction Engineering”, Prentice Hall of India Ltd., IIIrd Edition, 2000.

REFERENCE

1. Froment. G.F. & K.B.Bischoff, “Chemical Reactor Analysis and Design”, John Wiley and Sons, 1979.

CH8503 **CHEMICAL TECHNOLOGY** **LTPC**

3 0 0 3

OBJECTIVES

- To gain knowledge on unit processes and unit operations involved in the manufacture of different chemicals in different industries like chloro-alkali, petroleum, pharmaceutical, fertilizer etc.

OUTCOME:

Understand the role of Chemical Engineers in process industries such as pulp and paper etc., and manufacture of cement, Glass and cements.

Understand manufacturing processes of oil, soap, detergent, petrochemicals, polymers, pharmaceuticals, paints, dyes and intermediates, fertilizer, sugar, food products etc.,
Understand the unit processes involved in petroleum refining etc.,

UNIT I **3**

Introduction to chemical processing; symbolic representation of different unit operations and unit processes to build a flow sheet

UNIT II **10**

Chlor-Alkali- Industries, Cement, Glass and ceramics, Pulp and paper.

UNIT III **12**

Oil, Soap and Detergent, Petroleum Refining, Petrochemicals, Polymers

UNIT IV **10**

Pharmaceuticals, Chemical Explosives, Paints and Pigments.

UNIT V **10**

Dyes and intermediates, Fertilizers, Sugar, Food Products

TOTAL : 45 PERIODS

TEXT BOOKS

1. Dryden, C. E., "Outlines of Chemicals Technology", Edited and Revised by Gopala Rao, M. and M. Sittig, Second Edition, Affiliated East-West press, 1993.
2. Austin, G. T., "Shreve's Chemical Process Industries", Fifth Edition, McGraw Hill, Singapore, 1984.

CH8504 **MASS TRANSFER I** **L T P C**
3 0 0 3

OBJECTIVES

- Students will learn to determine mass transfer rates under laminar and turbulent conditions and apply these concepts in the design of humidification columns, dryers and crystallisers.

OUTCOME:

Understand diffusional operations and theories of mass transfer

Understand the concept of interphase mass transfer and gas- liquid mass transfer operations like humidification

Apply the knowledge gained in mass transfer to perform simple calculations in drying and crystallization

UNIT I **9**

Introduction to mass transfer operations; Molecular diffusion in gases, liquids and solids; diffusivity measurement and prediction; multi-component diffusion.

UNIT II **10**

Eddy diffusion, concept of mass transfer coefficients, theories of mass transfer, different transport analogies, application of correlations for mass transfer coefficients, inter phase mass transfer, relationship between individual and overall mass transfer coefficients. NTU and NTP concepts, Stage-wise and differential contractors.

UNIT III **9**

Humidification – Equilibrium, humidity chart, adiabatic and wet bulb temperatures; humidification operations; theory and design of cooling towers, dehumidifiers and humidifiers using enthalpy transfer unit concept.

UNIT IV **9**

Drying– Equilibrium; classification of dryers; batch drying – Mechanism and time of cross through circulation drying, continuous dryers – material and energy balance; determination of length of rotary dryer using rate concept.

UNIT V **8**

Crystallization - Equilibrium, classification of crystallizers, mass and energy balance; kinetics of crystallization – nucleation and growth; design of batch crystallizers; population balance model and design of continuous crystallizers.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Treybal, R.E., “Mass Transfer Operations”, 3rd Edn, McGraw-Hill, 1981.
2. Geankoplis, C.J., “Transport Processes and Unit Operations”, 4th Edition, Prentice Hall Inc., New Jersey, 2003.

REFERENCES

1. McCabe, W.L., Smith, J.C., and Harriot, P., “Unit Operations in Chemical Engineering”, 7th Edn., McGraw-Hill, 2005.
2. Coulson, J.M. and Richardson, J.F., “Chemical Engineering” Vol. I and II, 4th Edition, Asian

Books Pvt. Ltd., India, 1998.

3. J.D. Seader and E.J. Henley, “Separation Process Principles”, 2nd Ed., John Wiley, 2006.

HS8561 **EMPLOYABILITY SKILLS** **L T P C**

(Lab / Practical Course) **0 0 2 1**

(Common to all branches of Fifth or Sixth Semester B.E / B.Tech programmes)

OBJECTIVES

- To enhance the employability skills of students with a special focus on Presentation skills, Group discussion skills and Interview skills
- To help them improve their soft skills, including report writing, necessary for the workplace situations

OUTCOME:

Apply their communicative medium as English to interact with different groups of people, participate in debates and present seminars on technical topics, listen and comprehend technical presentations and speeches

Evaluate them and improve in proper time management and reduce their standing stresses, identify their personal strengths and weaknesses and work out methods (voluntarily) to get rid of the later and apply interview in practice

1. Making presentations – introducing oneself – introducing a topic – answering questions – individual presentation practice
2. Creating effective PPTs – presenting the visuals effectively
3. Using body language with awareness – gestures, facial expressions, etc.
4. Preparing job applications - writing covering letter and résumé
5. Applying for jobs online - email etiquette
6. Participating in group discussions – understanding group dynamics - brainstorming the topic
7. Training in soft skills - persuasive skills – sociability skills - questioning and clarifying skills – mock GD
8. Writing reports – collecting, analyzing and interpreting data – drafting the report
9. Attending job interviews – answering questions confidently
10. Interview etiquette – dress code – body language – mock interview

TOTAL: 30 PERIODS

Requirements for a class of 30 students

1. A PC or a lap top with one or two speakers
2. A Collar mike and a speaker

Attested

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3. An LCD projector and a screen
4. CD's and DVD's on relevant topics
5. Individual chairs for conducting group discussions

REFERENCE BOOKS

1. Dhanavel, S.P. 2010. English and Soft Skills. Hyderabad: Orient BlackSwan Ltd.
2. Corneilssen, Joep. How to Prepare for Group Discussion and Interview. New Delhi: Tata-McGraw-Hill, 2009.
3. D'Abreo, Desmond A. Group Discussion and Team Building. Mumbai: Better Yourself Books, 2004.
4. Ramesh, Gopalswamy, and Mahadevan Ramesh. The ACE of Soft Skills. New Delhi: Pearson, 2010.
5. Gulati, Sarvesh. Corporate Soft Skills. New Delhi: Rupa and Co. 2006.
6. Van Emden, Joan, and Lucinda Becker. Presentation Skills for Students. New York: Palgrave Macmillan, 2004.

EXTENSIVE READERS

1. Covey, Stephen R. The 7 Habits of Highly Effective People. New York: Free Press, 1989.
2. Bagchi, Subroto. The Professional. New Delhi: Penguin Books India, 2009.

WEB RESOURCES

1. www.humanresources.about.com
2. www.careerride.com

CH8511 HEAT TRANSFER LABORATORY L T P C
0 0 3 2

OBJECTIVES

- Students develop a sound working knowledge on different types of heat transfer equipments

OUTCOME

Determine Heat transfer co-efficient and evaluate performance of different types of equipments including cooling towers, tray dryers, pan evaporator, packed bed, heat exchangers, condensers, helical coils and agitated vessels

LIST OF EXPERIMENTS

1. Performance studies on Cooling Tower
2. Batch drying kinetics using Tray Dryer
3. Heat transfer in Open Pan Evaporator
4. Boiling Heat Transfer
5. Heat Transfer through Packed Bed
6. Heat Transfer in a Double Pipe Heat Exchanger
7. Heat Transfer in a Bare and Finned Tube Heat Exchanger
8. Heat Transfer in a Condenser
9. Heat Transfer in Helical Coils
10. Heat Transfer in Agitated Vessels

EQUIPMENT REQUIRED

1. Cooling Tower
2. Tray Dryer
3. Open Pan Evaporator
4. Boiler
5. Packed Bed
6. Double Pipe Heat Exchanger
7. Bare and Finned Tube Heat Exchanger
8. Condenser
9. Helical Coil
10. Agitated Vessel

TOTAL : 45 PERIODS

CH8512	**MECHANICAL OPERATIONS LABORATORY**	**L T P C**
		0 0 4 2

OBJECTIVES

- Students develop a sound working knowledge on different types of crushing equipments and separation characteristics of different mechanical operation separators.

OUTCOME:

Determine work index, average particle size through experiments by crushers, ball mill and conducting sieve analysis.

Design size separation equipments such as cyclone separator, sedimentation, Filters etc.

LIST OF EXPERIMENTS

1. Sieve analysis
2. Batch filtration studies using a Leaf filter
3. Batch filtration studies using a Plate and Frame Filter press
4. Characteristics of batch Sedimentation
5. Reduction ratio in Jaw Crusher
6. Reduction ratio in Ball mill
7. Separation characteristics of Cyclone separator
8. Reduction ratio of Roll Crusher
9. Separation characteristics of Elutriator
10. Reduction ratio of Drop weight crusher
11. Size separation using Sub-Sieving

EQUIPMENT REQUIRED

1. Sieve shaker
2. Leaf filter
3. Plate and Frame Filter Press
4. Sedimentation Jar
5. Jaw Crusher
6. Ball Mill
7. Cyclone Separator
8. Roll Crusher
9. Elutriator
10. Drop Weight Crusher
11. Sieves.

TOTAL : 60 PERIODS

CH8601	CHEMICAL REACTION ENGINEERING - II	L T P C
		3 0 0 3

OBJECTIVES

- The objective is to study the non-ideal behavior of homogeneous reactors, gas-solid catalytic and non-catalytic reactors and gas-liquid reactors.

OUTCOME

Understand catalysis and preparation and characterization, Apply adsorption isotherms for analysis of development of rate equations and rate controlling steps.
Understand the mechanism of pore diffusion in catalyst to calculate effectiveness factors and to demonstrate the application of volume and surface models and to calculate conversion in non ideal flow reactor.
Design the absorption column combined with chemical reactions.

UNIT I CATALYSTS **7**

Nature of catalysts, surface area and pore-volume distribution, catalyst preparation.

UNIT II HETEROGENEOUS REACTORS **10**

Rate equations for heterogeneous reactions, adsorption isotherms, rates of adsorption and desorption, surface reaction analysis of rate equation and rate controlling steps,

UNIT III GAS-SOLID CATALYTIC REACTORS **10**

Diffusion within catalyst particle, effective thermal conductivity, mass and heat transfer within catalyst pellets, effectiveness factor, Thiele Modulus, fixed bed reactors.

UNIT IV GAS-SOLID NON-CATALYTIC REACTORS **9**

Models for explaining kinetics; volume and surface models; controlling resistances and rate controlling steps; time for complete conversion for single and mixed sizes, fluidized and static reactors.

UNIT V GAS-LIQUID REACTORS **9**

Absorption combined with chemical reactions; mass transfer coefficients and kinetic constants; application of film, penetration and surface renewal theories; Hatta number and enhancement factor for first order reaction, tower reactor design.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Levenspiel, O., “Chemical Reaction Engineering “, III Edition, John Wiley, 1999.
2. Fogler. H. S. “ Elements of Chemical Reaction Engineering “, III Edition., Prentice Hall of India, 1999.

REFERENCE

1. Smith J.M., “ Chemical Engineering Kinetics “, III Edition, McGraw-Hill, New York, 1981.
2. Froment G.F & K.B. Bischoff, “Chemical Reaction Analysis and Design”, John Wiley and Sons, 1979.

CH8602 **MASS TRANSFER II** **L T P C**
3 1 0 4

OBJECTIVES

- Students will learn to design absorber and stripper, distillation column, extraction and leaching equipments and adsorber.

OUTCOME:

Understand absorption and distillation operations and select methods of separation of mixtures based on mass transfer concepts.
Apply the ternary equilibrium diagram concepts to determine the number of stages required for separation of liquid-liquid and solid -liquid mixtures
Design a distillation tower and to perform calculations in adsorption operation

UNIT I ABSORPTION **12**

Gas Absorption and Stripping – Equilibrium; material balance; limiting gas-liquid ratio; tray tower absorber - calculation of number of theoretical stages, tray efficiency, tower diameter; packed tower absorber – rate based approach; determination of height of packing using HTU and NTU calculations.

UNIT II DISTILLATION **12**

Vapour liquid equilibria - Raoult's law, vapor-liquid equilibrium diagrams for ideal and non-ideal systems, enthalpy concentration diagrams. Principle of distillation - flash distillation, differential distillation, steam distillation, multistage continuous rectification, Number of ideal stages by Mc.Cabe - Thiele method and Ponchan - Savarit method, Total reflux, minimum reflux ratio, optimum reflux ratio. Introduction to multi-component distillation, azeotropic and extractive distillation

UNIT III LIQUID-LIQUID EXTRACTION **12**

Liquid - liquid extraction - solvent characteristics-equilibrium stage wise contact calculations for batch and continuous extractors- differential contact equipment-spray, packed and mechanically agitated contactors and their design calculations-packed bed extraction with reflux. Pulsed extractors, centrifugal extractors-Supercritical extraction

UNIT IV LEACHING **12**

Solid-liquid equilibria- leaching equipment for batch and continuous operations- calculation of number of stages - Leaching - Leaching by percolation through stationary solid beds, moving bed leaching, counter current multiple contact (shank's system), equipments for leaching operation, multi stage continuous cross current and counter current leaching, stage calculations, stage efficiency.

UNIT V ADSORPTION AND ION EXCHANGE & MEMBRANE SEPARATION PROCESS **12**

Adsorption - Types of adsorption, nature of adsorbents, adsorption equilibria, effect of pressure and temperature on adsorption isotherms, Adsorption operations - stage wise operations, steady state moving bed and unsteady state fixed bed adsorbers, break through curves. Principle of Ion exchange, techniques and applications. Solid and liquid membranes; concept of osmosis; reverse osmosis; electro dialysis; ultrafiltration.

L : 45 , T : 15 , TOTAL : 60 PERIODS

TEXT BOOKS

1. Wankat, P., "Equilibrium Stage Separations", Prentice Hall, 1993.
2. Treybal, R.E., "Mass Transfer Operations ", 3rd Edn., McGraw-Hill, 1981.
3. Geankoplis, C.J., "Transport Processes and Unit Operations", 4th Edition, Prentice Hall Inc., New Jersey, 2003.

REFERENCES

1. Seader, J.D. and E.J. Henley, "Separation Process Principles", 2nd Ed., John Wiley,2006.
2. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edn., McGraw-Hill, 2005.
3. King, C. J., "Separation Processes ", 2nd Edn.,Tata McGraw-Hill 1980.

CH8603 PLANT SAFETY AND RISK ANALYSIS **L T P C**
3 0 0 3

OBJECTIVES

- Students learn about implementation of safety procedures, risk analysis and assessment, hazard identification

OUTCOME:

Demonstrate the awareness of plant safety in selection and layout of chemical plants and the usage of safety codes.
Exhibit the skill in classifying chemical, fire, explosion hazards and to understand the occupational diseases
Analyze the bio medical and engineering response to health hazards and to implement the effective process control and instrumentation.

UNIT I **9**

Need for safety in industries; Safety Programmes – components and realization; Potential hazards – extreme operating conditions, toxic chemicals; safe handling

UNIT II **9**

Implementation of safety procedures – periodic inspection and replacement; Accidents – identification and prevention; promotion of industrial safety

UNIT III **9**

Over all risk analysis--emergency planning-on site & off site emergency planning, risk management ISO 14000, EMS models case studies. Quantitative risk assessment - rapid and comprehensive risk analysis; Risk due to Radiation, explosion due to over pressure, jet fire-fire ball.

UNIT IV **9**

Hazard identification safety audits, checklist, what if analysis, vulnerability models event tree analysis fault tree analysis, Hazan past accident analysis Fixborough-Mexico-Madras-Vizag-Bopal analysis

UNIT V **9**

Hazop-guide words, parameters, derivation-causes-consequences-recommendation-coarse Hazop study-case studies-pumping system-reactor-mass transfer system.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Chemical Process Safety: Fundamentals with Applications, Daniel A. Crowl, J.F. Louvar, Prantice Hall, NJ, 1990.
2. Fawatt, H.H. and Wood, W.S., “Safety and Accident Prevention in Chemical Operation“, Wiley Interscience, 1965.
3. Marcel, V.C., Major Chemical Hazard- Ellis Harwood Ltd., Chi Chester, UK, 1987.
4. Hyatt, N., Guidelines for process hazards analysis, hazards identification & risk analysis, Dyadem Press, 2004

REFERENCES

1. Handley, W., “Industrial Safety Hand Book “, 2nd Edn., McGraw-Hill Book Company, 1969.
2. Heinrich, H.W. Dan Peterson, P.E. and Rood, N., “ Industrial Accident Prevention“, McGraw-Hill Book Co., 1980.
3. Taylor, J.R., Risk analysis for process plant, pipelines and transport, Chapman and Hall, London, 1994

CH8651 PROCESS INSTRUMENTATION, DYNAMICS AND CONTROL LTPC
3 0 0 3

OBJECTIVES

- To introduce dynamic response of open and closed loop systems, control loop components and stability of control systems along with instrumentation.

OUTCOME:

Understand the prerequisites of control strategies and design different process control systems
Evaluate the suitable controllers for different chemical process.
Analyse and tune the control systems unto stability
Understand the mechanism of advance control systems

UNIT I INSTRUMENTATION 6

Principles of measurements and classification of process instruments, measurement of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity, pH, concentration, electrical and thermal conductivity, humidity of gases.

UNIT II OPEN LOOP SYSTEMS 11

Laplace transformation, application to solve ODEs. Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics; transportation lag.

UNIT III CLOSED LOOP SYSTEMS 10

Closed loop control systems, development of block diagram for feed-back control systems, servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transient response of closed-loop control systems and their stability.

UNIT IV FREQUENCY RESPONSE 9

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

UNIT V ADVANCED CONTROL SYSTEMS 9

Introduction to advanced control systems, cascade control, feed forward control, Smith predictor controller, control of distillation towers and heat exchangers, introduction to computer control of chemical processes.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Stephanopoulos, G., “Chemical Process Control“, Prentice Hall of India, 2003.
2. Coughnowr, D., “ Process Systems Analysis and Control “, 3rd Edn., McGraw Hill, New York, 2008.

REFERENCES

1. Marlin, T. E., “ Process Control “, 2nd Edn, McGraw Hill, New York, 2000.
2. Smith, C. A. and Corripio, A. B., “Principles and Practice of Automatic Process Control”, 2nd Edn., John Wiley, New York, 1997.

CH8611 CHEMICAL REACTION ENGINEERING LABORATORY L T P C
0 0 3 2

OBJECTIVES

- Students develop a sound working knowledge on different types of reactors.

OUTCOME:

Understand rate equation for different types of reactors.
Design experiments in kinetics to determine conversion and effect of temperature on rate constant.
Assess the performance of Plug flow Mixed flow and Packed bed by studying the residence time distribution.

LIST OF EXPERIMENTS

1. Kinetic studies in a Batch reactor
2. Kinetic studies in a Plug flow reactor
3. Kinetic studies in a CSTR
4. Kinetic studies in a Packed bed reactor
5. Kinetic studies in a PFR followed by a CSTR
6. RTD studies in a PFR
7. RTD studies in a Packed bed reactor
8. RTD studies in a CSTR
9. Studies on micellar catalysis
10. Study of temperature dependence of rate constant using CSTR.
11. Kinetic studies in Sono chemical reactor
12. Batch reactive distillation
13. Kinetics of photochemical reaction
14. Demonstration of heterogeneous catalytic reaction

15. Demonstration of gas-liquid reaction

EQUIPMENT REQUIRED

1. BATCH REACTOR
2. Plug flow reactor
3. CSTR
4. Sono-chemical reactor
5. Photochemical reactor
6. Packed bed reactor

*Minimum 10 experiments shall be offered.

TOTAL : 45 PERIODS

CH8612 COMPUTATIONAL CHEMICAL ENGINEERING LABORATORY LTPC
0 0 4 2

OBJECTIVES

- Students will solve chemical engineering problems from core courses using C and MATLAB programming and also using computational tools like Excel and Aspen.

OUTCOME:

Able to solve chemical engineering problems using C and MATLAB programming and Microsoft Excel software.

Analyse and estimate the physical properties of data bank and non data bank components; calculate bubble and dew points and generate T-xy and P-xy diagram by simulating flash drum using ASPEN PLUS Process Simulator.

Programming in C

C programs will be written to solve problems from core courses of chemical engineering.

Microsoft Excel Software

The computational, plotting and programming abilities in Excel will be used to solve different chemical engineering problems.

Programming in MATLAB

Chemical engineering problems will be solved using the powerful computational and graphical capability of MATLAB.

ASPEN Software

Individual process equipments and flowsheets will be simulated using Aspen Plus and property analysis and estimation will be done using Aspen Properties.

Evaluation

This lab course will have two or three online assessment tests and an online end semester examination in the Process Simulation Laboratory and assignments in all the above four units.

TOTAL : 60 PERIODS

REFERENCE

1. Finlayson, B. A., Introduction to Chemical Engineering Computing, John Wiley & Sons, New Jersey, 2006.

CH8701 CHEMICAL PROCESS DESIGN L T P C

3 0 0 3

OBJECTIVES

- Students apply the fundamental knowledge to design the chemical process

OUTCOME:

Understand different codes, standards, design factors and system of units used in design process

Understand the importance of process diagrams, design of reactors

Apply the skill in thermal design of heat transfer equipment and assessing thermal efficiency of the above equipment in practice.

Demonstrate the simulation skills to design process equipments

UNIT I **9**

Process Design and Development: General Design Considerations; The Hierarchy of Chemical Process Design; The Nature of Process Synthesis and Analysis;

UNIT II **9**

Choice of reactor based on reactor performance, reactor conditions and reactor configuration. Reactor networks in process flow sheets:

UNIT III **9**

Choice of separation of heterogeneous and homogeneous mixtures - Attainable region Separation systems in process flowsheets: multicomponent distillation for ideal and non-ideal systems, distillation column sequences,

UNIT IV **9**

Heat exchange networks synthesis and utilities: Energy targets, Integration in distillation columns

UNIT V **9**

Introduction to optimization approaches to optimal design, role of simulations in process design, Design under uncertainty and failure tolerance, Engineering around variations, Introduction to process integration

TOTAL : 45 PERIODS

TEXT BOOKS

1. Smith, R., Chemical Process Design, McGraw Hill, New York, 1995.
2. Douglas, J., Conceptual Design of Chemical Processes, McGraw Hill, 1989.

REFERENCES

1. Rudd, D.F. and Watson, C.C., Strategy of Process Engineering, John Wiley, 1969.
2. Sinnot, R.K., an Introduction to Chemical Engineering Design, Pergamon Press, Oxford, 1989.
3. Seider, W.D. and J.D. Seader, Product and Process Design Principles: Synthesis, Analysis and Evaluation, 2nd ed., John Wiley, 2004.

CH8702 **PROCESS ECONOMICS** **LTPC**

3 0 0 3

OBJECTIVES

- Students will acquire the knowledge about the process economics

OUTCOME:

Understand the basic themes of economics
Understand the consumer and producer behavior
Understand the different market structures
Analyse the Economics

UNIT I INTRODUCTION **5**

The themes of economics – scarcity and efficiency – three fundamental economic problems – society's capability – Production possibility fronties (PPF) – Productive efficiency Vs economic efficiency – economic growth & stability – Micro economies and Macro economies – the role of markets and government – Positive Vs negative externalities.

UNIT II CONSUMER AND PRODUCER BEHAVIOUR 10

Market – Demand and Supply – Determinants – Market equilibrium – elasticity of demand and supply – consumer behaviour – consumer equilibrium – Approaches to consumer behaviour – Production – Short-run and long-run Production Function – Returns to scale – economies Vs diseconomies of scale – Analysis of cost – Short-run and long-run cost function – Relation between Production and cost function.

UNIT III PRODUCT AND FACTOR MARKET 10

Product market – perfect and imperfect market – different market structures – Firm's equilibrium and supply – Market efficiency – Economic costs of imperfect competition – factor market – Land, Labour and capital – Demand and supply – determination of factor price – Interaction of product and factor market – General equilibrium and efficiency of competitive markets.

UNIT IV PERFORMANCE OF AN ECONOMY – MACRO ECONOMICS 10

Macro-economic aggregates – circular flow of macroeconomic activity – National income determination – Aggregate demand and supply – Macroeconomic equilibrium – Components of aggregate demand and national income – multiplier effect – Demand side management – Fiscal policy in theory.

UNIT V AGGREGATE SUPPLY AND THE ROLE OF MONEY 10

Short-run and Long-run supply curve – Unemployment and its impact – Okun's law – Inflation and the impact – reasons for inflation – Demand Vs Supply factors –Inflation Vs Unemployement tradeoff – Phillips curve –short- run and long-run –Supply side Policy and management- Money market- Demand and supply of money – money-market equilibrium and national income – the role of monetary policy.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Paul A. Samuelson and William D. Nordhaus, Economics, 18th edition, Tata McGraw Hill, 2005.
2. William Boyes and Michael Melvin, Textbook of economics, Biztantra, 2005.
3. N. Gregory Mankiw, Principles of Economics, 3rd edition, Thomson learning, New Delhi, 2007.
4. Richard Lipsey and Alee Charystal, Economics, 11th edition, Oxford University Press, New Delhi,2008.
5. Karl E. Case and Ray C. fair, Principles of Economics, 6th edition, Pearson Education Asia, New Delhi, 2002.

CH8703	PROCESS EQUIPMENT DESIGN	L T P C
		3 1 0 4

OBJECTIVES

- Students learn to do in detail process and mechanical design and engineering drawing of different chemical engineering equipments

OUTCOME:

Apply the skill in thermal design of heat transfer equipment like shell and tube, double pipe heat exchangers and evaporators, and assessing thermal efficiency of the above equipment in practice.

Demonstrate the skills in basic design and drawing of different dryers, cooling towers and cyclone separators.

Apply the concepts involved in phase separation and design of distillation, Extraction and absorption columns.

Demonstrate the skills in mechanical design of process equipment, design considerations of pressure vessels and its auxiliary devices

design the layout of process industries

UNIT I **12**

Heat Exchangers, Condensers, Evaporators

UNIT II **12**

Cooling Tower, Dryers

UNIT III **12**

Absorption column, Distillation Column, Extraction Column, Adsorption column

UNIT IV **12**

Packed bed Reactors, Pressure Vessel, Storage Vessel

UNIT V **12**

Design of Plant Layout, Pipe Lines and Pipe Layouts, Schematics and Presentation, Materials of Construction and Selection of process equipments

TOTAL : 60 PERIODS

REFERENCES

1. Baranan, C.R., “Rules of Thumb for Chemical Engineers”, Gulf Publishing Co, Texas, 1996.
2. R. K. Sinnott, “Coulson & Richardson’s Chemical Engineering”, Vol. 6, Butterworth Heinermann, Oxford, 1996.
3. Dawande, S. D., “Process Design of Equiments”, 4th Edition, Central Techno

Publications, Nagpure, 2005.
4. Green D. W., “Perry’s Chemical Engineer’s Handbook”, 7th Edition McGraw Hill, 1997.

CH8751 TRANSPORT PHENOMENA L T P C
3 1 0 4

OBJECTIVES

- To describe mass, momentum and energy transport at molecular, microscopic and macroscopic level, to determine velocity, temperature and concentration profiles.

OUTCOME:

Understand the principles of momentum, heat and mass transport by developing mathematical models to determine respective fluxes and velocity, temperature and concentration distribution for flow channels, heat sources and systems involving diffusion and reactions.
Apply the equation of change and scale factors for different coordinate systems and solve of momentum, mass and heat transport problems.
Analyze the analogy between the transports and understand the turbulence and boundary layer concept in heat and mass transport

UNIT I MOMENTUM TRANSPORT 12

Viscosity, temperature effect on viscosity of gases and liquids, Newton’s law, mechanism of momentum transport, shell balance method, pressure and velocity distributions in falling film, circular tube, annulus, slit.

UNIT II EQUATIONS OF CHANGE AND TURBULENT FLOW 12

Equation of continuity, motion, mechanical energy, use of equations of change to solve flow problems, dimensional analysis of equations of change, comparison of laminar and turbulent flows, time-smoothed equation of change, empirical expressions.

UNIT III ENERGY TRANSPORT 12

Thermal conductivity, temperature and pressure effect on thermal conductivity of gases and liquids, Fourier’s law, mechanism of energy transport, shell energy balance, temperature distribution in solids and laminar flow with electrical, nuclear, viscous, chemical heat source, heat conduction through composite walls, cylinders, spheres, fins, slits.

UNIT IV EQUATIONS OF CHANGE FOR NONISOTHERMAL SYSTEM AND TEMPERATURE DISTRIBUTION IN TURBULENT FLOWS 12

Energy equations, special forms, use of equations of change, dimensional analysis of equations of change, time-smoothed equations of change, empirical expressions, temperature distribution for turbulent flow in tubes, jets.

UNIT V MASS TRANSPORT, EQUATIONS OF CHANGE FOR MULTICOMPONENT SYSTEMS AND CONCENTRATION DISTRIBUTION IN TURBULENT FLOWS **12**

Diffusivity, temperature and pressure effect, Fick's law, mechanism of mass transport, theory of diffusion in gases and liquids, shell mass balances, concentration distribution in solids and in laminar flow : stagnant gas film, heterogeneous and homogeneous chemical reaction systems, falling film, porous catalyst. The equation of continuity, summary of equations of change and fluxes, use of equations of change, dimensional analysis, time smoothed equations of change, empirical expressions for turbulent mass flux.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Bird, R. B., Stewart, W. E. and Lighfoot, E. W., "Transport Phenomena", 2nd Edn., John Wiley, 2002
2. Brodkey, R. S., and Hershey, H. C., "Transport Phenomena", McGraw-Hill, 1988.

REFERENCES

1. Welty, J. R., Wilson, R. W., and Wicks, C. W., "Fundamentals of Momentum Heat and Mass Transfer ", 3rd Edn. John Wiley, New York, 1984.
2. Slattery, J. S., "Advanced Transport Phenomena", Cambridge University Press, London, 1999.

CH8711 MASS TRANSFER LABORATORY LTPC

0 0 4 2

OBJECTIVES

- Students develop a sound working knowledge on different types of mass transfer equipments.

OUTCOME:

Determine diffusivity, mass transfer rate and mass transfer co-efficient of given system using fundamental principles.

Generate VLE data and evaluate the performance calculate the parameters in different distillation processes

Evaluate the performance calculate the parameters in Leaching extraction and drying operations

LIST OF EXPERIMENTS

1. Separation of binary mixture using Simple distillation

Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

2. Separation of binary mixture using Steam distillation
3. Separation of binary mixture using Packed column distillation
4. Measurement of diffusivity
5. Liquid-liquid extraction
6. Drying characteristics of Vacuum Dryer
7. Drying characteristics of Tray dryer
8. Drying characteristics of Rotary dryer
9. Water purification using ion exchange columns
10. Mass transfer characteristics of Rotating disc contactor
11. Estimation of mass/heat transfer coefficient for cooling tower
12. Demonstration of Gas – Liquid absorption

EQUIPMENTS REQUIRED

1. Simple distillation setup
2. Steam distillation setup
3. Packed column
4. Liquid-liquid extractor
5. Vacuum Dryer
6. Tray dryer
7. Rotary dryer
8. Ion exchange column
9. Rotating disc contactor
10. Cooling tower
11. Absorption column

Minimum 10 experiments shall be offered.

TOTAL : 60 PERIODS

CH8712	**PROCESS CONTROL LABORATORY FOR CHEMICAL ENGINEERS**	**L T P C** **0 0 4 2**

OBJECTIVES

- Students will gain the hands on training about the control systems

OUTCOME:

Understand the prerequisites of control strategies and design different process control systems
Evaluate the suitable controllers for different chemical process.
Analyse and tune the control systems unto stability

LIST OF EXPERIMENTS

1. Response of first order system
2. Response of second order system
3. Response of Non-Interacting level System
4. Response of Interacting level System
5. Open loop study on a level system
6. Open loop study on a flow system
7. Open loop study on a thermal system
8. Closed loop study on a level system
9. Closed loop study on a flow system
10. Closed loop study on a thermal system
11. Tuning of a level system
12. Tuning of a flow system
13. Tuning of a thermal system
14. Flow co-efficient of control valves
15. Characteristics of different types of control valves

*Minimum 10 experiments shall be offered.

TOTAL : 60 PERIODS

CH8811	**PROJECT WORK**	**L T P C** **0 0 12 6**

OBJECTIVES

- The objective of the project is to make use of the knowledge gained by the student at various stages of the degree course.
- Each student is required to submit a report on the project assigned to him by the department. The report should be based on the information available in the literature or data obtained in the laboratory/industry.
- Students, in addition to the home problem will be permitted to undertake industrial/ consultancy project work, out side the department, in industries/Research labs for which proportional weightage will be given in the final assessment.

OUTCOME:

Design a manufacturing chemical process industries

Prepare clear concise project reports with the help of grape, charts and pictorialrepresentation.

Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

MA8001 **STATISTICS AND LINEAR PROGRAMMING** **LTPC**
3 1 0 4

OBJECTIVES

- The students will have a fundamental knowledge of the concepts of statistical inference
- Have the knowledge of applying Linear programming tools in management problems.

OUTCOME:

Understand different types of distributions and their uses.
Apply the various methods of testing of hypothesis, analysis of variance and randomized block design and its applications in engineering.
Design models and optimize their solution by using linear programming models

UNIT I TESTING OF HYPOTHESIS **9 + 3**

Sampling distributions - Tests for single mean , proportion and difference of means (large and small samples) – Tests for single variance and equality of variances – ψ^2-test for goodness of fit – Independence of attributes.

UNIT II DESIGN OF EXPERIMENTS **9 + 3**

Completely randomized design – Randomized block design – Latin square design - 2^2 - factorial design.

UNIT III STATISTICAL QUALITY CONTROL **9 + 3**

Control charts for measurements (and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling

UNIT IV LINEAR PROGRAMMING **9 + 3**

Formulation of LPP – Graphical methods for two variables – Simplex method - Big M method – Transportation Problem - Basic feasible solution – North West corner rule – Vogel's approximation method (Unit penalty method) – Matrix minima method (Least cost method) – Optimal solution – Non degeneracy and degeneracy problem – Assignment problem – Hungarian method – Balanced and unbalanced.

UNIT V ADVANCED LINEAR PROGRAMMING **9 + 3**

Dual simplex method – Formation and using simplex method – integer programming – Cutting plane algorithm.

L: 45, T: 15, TOTAL: 60 PERIODS

Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

TEXT BOOKS

1. Johnson, R.A. and Gupta, C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th edition, (2007).
2. Taha, H.A., "Operations Research", Pearson Education, Asia, 8th edition, (2007).

REFERENCES

1. Walpole, R.E., Myers, R.H., Myers, S.L. and Ye, K.,"Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th edition, (2007).
2. Devore, J.L., "Probability and Statistics for Engineering and the Sciences", Thomson Brooks/Cole, International Student Edition, 7th edition, (2008).
3. Winston, W.L.,"Operations Research – Applications and Algorithms",Thomson, 1st Indian Reprint, 4th edition, (2007).

CH8001 DRUGS AND PHARMACEUTICAL TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES

- Students will gain fundamental knowledge about Drugs and Pharmaceutical anf their manufacturing process

OUTCOME:

Understand the Drug Metabolism and pharmaco–kinetics principles
Apply knowledge of unit processes and analytical methods to develop new processes and product formulations.
Demonstrate statistical quality control procedure and quality assurance programmes in various stages of pharmaceutical process.

UNIT I INTRODUCTION 9

Development of drugs and pharamaceutical industry; organic therapeutic agents uses and economics

UNIT II DRUG METABOLISM AND PHARMACO KINETICS & MICROBIOLOGICAL AND ANIMAL PRODUCTS 9

Drug metabolism; physico chemical principles; pharma kinetics-action of drugs on human bodies. Antibiotics- gram positive, gram negative and broad spectrum antibiotics; hormones

UNIT III IMPORTANT UNIT PROCESSES AND THEIR APPLICATIONS 9

Chemical conversion processes; alkylation; carboxylation; condensation and cyclisation; dehydration, esterification, halogenation, oxidation, sulfonation; complex chemical conversions fermentation.

UNIT IV MANUFACTURING PRINCIPLES & PACKING AND QUALITY CONTROL 9

Compressed tablets; wet granulation; dry granulation or slugging; advancement in granulation; direct compression, tablet presses formulation; coating pills; capsules sustained action dosage forms; parential solutions, oral liquids; injections; ointments; standard of hygiene and manufacturing practice. Packing; packing techniques; quality control.

UNIT V PHARMACEUTICAL PRODUCTS & PHARMACEUTICAL ANALYSIS 9

Vitamins; cold remedies; laxatives; analgesics; nonsteroidal contraceptives; external antiseptics; antacids and others. Analytical methods and tests for various drugs and pharmaceuticals – spectroscopy, chromatography, fluorimetry, polarimetry, refractometry, pHmetry

TOTAL : 45 PERIODS

TEXT BOOK

1. Rawlines, E.A.; " Bentleys Text book of Pharmaceutics ", III Edition, Bailliere Tindall, London, 1977.

REFERENCES

1. Yalkonsky, S.H.; Swarbick. J.; " Drug and Pharamaceutical Sciences ", Vol. I, II, III, IV, V, VI and VII, Marcel Dekkar Inc., New York, 1975.
2. "Remingtons Pharmaceutical Sciences ", Mack Publishing Co., 1975.

CH8002 ELECTROCHEMICAL ENGINEERING L T P C
3 0 0 3

OBJECTIVES

- Students will gain knowledge about electrochemical process and its application

OUTCOME:

Understand the principles of electrochemistry and mechanism involved in electrochemical systems
Understand the mechanism of corrosion.
Apply the concepts involved in electro process and design of batteries, fuel cell and electrochemical reactors

UNIT I 9

Review basics of electrochemistry: Faraday's law -Nernst potential –Galvanic cells – Polarography, The electrical double layer: It's role in electrochemical processes –Electro

capillary curve –Helmoltz layer –Guoy –Steven's layer –fields at the interface.

UNIT II **9**

Mass transfer in electrochemical systems: diffusion controlled electrochemical reaction –the importance of convention and the concept of limiting current. over potential, primary-secondary current distribution –rotating disc electrode.

UNIT III **10**

Introduction to corrosion, series, corrosion theories derivation of potential-current relations of activities controlled and diffusion controlled corrosion process. Potential-pH diagram, Forms of corrosion- definition, factors and control methods of various forms of corrosion-corrosion control measures- industrial boiler water corrosion control –protective coatings –Vapor phase inhibitors –cathodic protection, sacrificial anodes –Paint removers.

UNIT IV **8**

Electro deposition –electro refining –electroforming –electro polishing –anodizing –Selective solar coatings, Primary and secondary batteries –types of batteries, Fuel cells.

UNIT V **9**

Electrodes used in different electrochemical industries: Metals-Graphite –Lead dioxide – Titanium substrate insoluble electrodes –Iron oxide –semi conducting type etc. Metal finishing-cell design. types of electrochemical reactors, batch cell, fluidized bed electrochemical reactor, filter press cell, Swiss roll cell, plug flow cell, design equation, figures of merits of different type of electrochemical reactors.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Picket, " Electrochemical Engineering ", Prentice Hall. 1977.
2. Newman, J. S., " Electrochemical systems ", Prentice Hall, 1973.

REFERENCES

1. Barak, M. and Stevenge, U. K., " Electrochemical Power Sources - Primary and Secondary Batteries" 1980
2. Mantell, C., " Electrochemical Engineering ", McGraw Hill, 1972.

CH8003 **ENERGY TECHNOLOGY** **LTPC**
3 0 0 3

OBJECTIVES

- Students will gain knowledge about different energy sources

OUTCOME:

Understand conventional Energy sources, Non- conventional Energy sources, biomass sources and develop design parameters for equipment to be used in Chemical process industries.
Understand energy conservation in process industries

UNIT I ENERGY **8**

Introduction to energy – Global energy scene – Indian energy scene - Units of energy, conversion factors, general classification of energy, energy crisis, energy alternatives.

UNIT II CONVENTIONAL ENERGY **8**

Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

UNIT III NON-CONVENTIONAL ENERGY **10**

Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV BIOMASS ENERGY **10**

Biomass origin - Resources – Biomass estimation. Thermochemical conversion – Biological conversion, Chemical conversion – Hydrolysis & hydrogenation, solvolysis, biocrude, biodiesel power generation gasifier, biogas, integrated gasification.

UNIT V ENERGY CONSERVATION **9**

Energy conservation - Act; Energy management importance, duties and responsibilities; Energy audit – Types methodology, reports, instruments. Benchmalcing and energy performance, material and energy balance, thermal energy management.

TOTAL : 45 PERIODS

TEXTBOOKS

1. Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.
2. Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984.
3. Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.
4. Energy Management, Paul W.O'Callaghan McGraw – Hill, 1993

REFERENCES

1. Nejat Vezirog, Alternate Energy Sources, IT, McGraw Hill, New York.
2. El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002.
3. Sukhatme. S.P., Solar Enery - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981.
4. Handbook of Energy Audit by 7th edition Albert Thumann, P.E., C.E.M & William J Younger C.E.M, Faiment Press 2008

CH8004 FRONTIERS OF CHEMICAL ENGINEERING L T P C
3 0 0 3

OBJECTIVES

- Students will know the latest trends to be followed in the process industries

OUTCOME:

Understand the new process and reactor configuration used in industries
Know the new sources of renewable energy and new material & its application

UNIT I PROCESS INTENSIFICATION 9

Novel reactor configurations; combination of reaction and separation; use of different energy fields, lab on a chip.

UNIT II CHEMICAL PRODUCT DESIGN 9

Scope and importance; identification of needs and specifications; sources of ideas and screening ideas; selection of product idea; process development for product manufacture; specialty chemical manufacture; economic aspects.

UNIT III RENEWABLE ENERGY 9

Hydrogen production, Hydrogen economy, Fuel Cell Technology, biofuel cells and bio-hydrogen, solar energy

UNIT IV MATERIALS ENGINEERING **9**

Polymers and composites, ceramics and glasses, colloidal dispersions and nanoparticles, thin films and electronic materials

UNIT V BIOENGINEERING **9**

Biomechanics, biotransport and biomaterials, biomolecular and cellular engineering, drug discovery and development.

TOTAL : 45 PERIODS

REFERENCES

1. Keil, F. J., Modeling of Process Intensification Wiley-VCH Verlag GmbH & Co. KGaA2007
2. Cussler, E.l. and Moggridge, G.D., "Chemical product design" Cambridge University Press, Cambridge, 2001
3. Hoffmann,P, Tomorrow's energy: hydrogen, fuel cells, and the prospects for a cleaner planet, MIT Press, Sabon, 2002
4. Mitchell, B.S., An introduction to materials engineering and science for chemical and materials engineers, John Wiley and Sons Inc., New Jersey, 2004

CH8005 MODERN SEPARATION TECHNIQUES **L T P C**
3 0 0 3

OBJECTIVES

- Students will gain knowledge about recent separation methods

OUTCOME:

Create the understanding of separation processes for selecting optimal process for new and innovative applications. Ability to exhibit the skill to develop membrane processes, adsorption process and inorganic separation process.
Apply the latest concepts like super critical fluid extraction, pervaporation, lyophilisation etc., in Chemical process industries.
Understand Innovative techniques of controlling and managing oil spills.

UNIT I BASICS OF SEPARATION PROCESS **9**

Review of Conventional Processes, Recent advances in Separation Techniques based on size, surface properties, ionic properties and other special characteristics of substances, Process concept, Theory and Equipment used in cross flow Filtration, cross flow Electro Filtration, Surface based solid – liquid separations involving a second liquid.

Attested

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UNIT II MEMBRANE SEPARATIONS 9

Types and choice of Membranes, Plate and Frame, tubular, spiral wound and hollow fiber Membrane Reactors and their relative merits, commercial, Pilot Plant and Laboratory Membrane permeators involving Dialysis, Reverse Osmosis, Nanofiltration, Ultra filtration and Micro filtration, Ceramic- Hybrid process and Biological Membranes.

UNIT III SEPARATION BY ADSORPTION 9

Types and choice of Adsorbents, Adsorption Techniques, Dehumidification Techniques, Affinity Chromatography and Immuno Chromatography, Recent Trends in Adsorption.

UNIT IV INORGANIC SEPARATIONS 9

Controlling factors, Applications, Types of Equipment employed for Electrophoresis, Dielectrophoresis, Ion Exchange Chromatography and Eletrodialysis, EDR, Bipolar Membranes.

UNIT V OTHER TECHNIQUES 9

Separation involving Lyophilisation, Pervaporation and Permeation Techniques for solids, liquids and gases, zone melting, Adductive Crystallization, other Separation Processes, Supercritical fluid Extraction, Oil spill Management, Industrial Effluent Treatment by Modern Techniques.

TOTAL : 45 PERIODS

REFERENCES

1. King, C. J., “Separation Processes”, Tata McGraw Hill, 1982.
2. Roussel, R. W., “Handbook of Separation Process Technology”, John Wiley, New York, 1987.
3. Nakagawal, O. V., “Membrane Science and Technology”’ Marcel Dekkar, 1992.

CH8006 OPTIMIZATION OF CHEMICAL PROCESSES L T P C
3 0 0 3

OBJECTIVES

- Students will gain knowledge about process modeling and optimization

OUTCOME:

Design experiments and formulate models of chemical processes/equipment.
Understand different search methods and linear programming methods for solution of chemical process problems like optimization of process variables to get maximum yield/conversion, product mix pattern product distribution etc.,
Understand the non-linear programming methods for application in R & D work.

UNIT I INTRODUCTION 5

Introduction to optimization; applications of optimization in chemical engineering; classification of optimization problems.

UNIT II SINGLE VARIABLE OPTIMIZATION 9

Necessary and sufficient conditions for optimum; region elimination methods; interpolation methods; direct root methods.

UNIT III MULTIVARIABLE OPTIMIZATION WITHOUT AND WITH CONSTRAINTS 9

Necessary and sufficient conditions for optimum; direct search methods; indirect search methods.

UNIT IV OTHER OPTIMIZATION METHODS 9

Introduction to geometric, dynamic and integer programming and genetic algorithms.

UNIT V APPLICATIONS OF OPTIMIZATION 13

Formulation of objective functions; fitting models to data; applications in fluid mechanics, heat transfer, mass transfer, reaction engineering, equipment design, resource allocation and inventory control.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Rao, S. S., Engineering Optimization - Theory and Practice, Third Edition, John Wiley & Sons, New York, 1996.
2. Edgar, T.F., Himmelblau, D.M., “Optimisation of Chemical Processes “, McGraw-Hill Book Co., New York, 2003.
3. Reklaitis, G.V., Ravindran, A., Ragsdell, K.M. “Engineering Optimisation “, John Wiley, New York, 1980.

CH8007 PETROLEUM REFINING AND PETROCHEMICALS L T P C
3 0 0 3

OBJECTIVES

- Students will gain knowledge about petroleum refining process and production of petrochemical products

OUTCOME:

Understand the classification, composition and testing methods of crude petroleum / product to develop innovative refining process and develop quality control and assurance techniques.

Apply the knowledge of treatment processes to develop the manufacture of petroleum products.

UNIT I **9**

Origin, Formation and Evaluation of Crude Oil. Testing of Petroleum Products. Refining of Petroleum – Atmospheric and Vaccum Distillation.

UNIT II **9**

Cracking, Thermal Cracking, Vis-breaking, Catalytic Cracking (FCC), Hydro Cracking, Coking and Air Blowing of Bitumen.

UNIT III **9**

Treatment Techniques: Removal of Sulphur Compounds in all Petroleum Fractions to improve performance, Solvent Treatment Processes, Dewaxing, Clay Treatment and Hydrofining.

UNIT IV **9**

Cracking of Naphtha and Feed stock gas for the production of Ethylene, Propylene, Isobutylene and Butadiene. Production of Acetylene from Methane, Catalytic Reforming of Petroleum Feed Stocks and Extraction of Aromatics.

UNIT V **9**

Production of Petrochemicals like Dimethyl Terephathalate (DMT), Ethylene Glycol, Synthetic Glycerine, Linear Alkyl Benzene (LAB), Acrylonitrile, Methyl Methacrylate (MMA), Vinyl Acetate Monomer, Phthalic Anhydride, Maleic Anhydride, Phenol and Acetone, Methanol, Formaldehyde, Acetaldehyde, Pentaerythritol and Production of Carbon Black.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Nelson, W. L., “Petroleum Refinery Engineering”, 4th Edn., McGraw Hill, New York, 1985.
2. Bhaskara Rao, B. K., “Modern Petroleum Refining Processes”, 2nd Edn., Oxford and IBH Publishing Company, New Delhi, 1990.
3. Bhaskara Rao, B. K. “A Text on Petrochemicals”, 1st Edn., Khanna Publishers, New Delhi, 1987.
4. Wiseman. P., Petrochemicals, UMIST Series in Science and Technology.
5. H. Steiner, Introduction to petrochemicals Industry’, Pergamon, 1961.

CH8008 POLYMER TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES

- Students will gain knowledge about mechanism of polymer process and its application

OUTCOME:

Understand the fundamental of mechanism of polymerization
Apply the mechanism and effectiveness of polymerization in designing reactor systems.
Understand the knowledge of polymer stability for developing new formulations and products
Acquire knowledge on different test for characterization of polymer for applications in R & D work; understand the manufacture and properties of industrial polymers.

UNIT I GENERAL ASPECTS OF POLYMERS 9

Classification, mechanisms and methods of polymerization, Properties-Molecular weight, Glass transition temperature, Crystallinity, thermal, Electrical and Mechanical properties

UNIT II APPLICATION ORIENTED POLYMERS 9

Resins – PVC, Silicon Oil and resins, fibrous Polymers – Nylon 66, Polyacrylonitrile, adhesives-Epoxides, Phenol formaldehyde, Urea formaldehyde

UNIT III ELASTOMERS 9

Natural Rubber, Styrene – butadiene, Polyisopropane – Neoprene, Silicone rubber, Thermoplastic elastomers

UNIT IV PROCESSING OF POLYMERS 9

Processing additives, plasticizers, Antiaging additives, surface and optical properties, modifiers, fire retardants, additives for rubber and elastomers, various molding techniques

UNIT V PHYSICAL AND CHEMICAL TESTING OF PLASTICS 9

Mechanical properties, tensile strength and hardness, electrical properties, volume resistivity, dielectric strength, optical properties- glass, light transmission and refractive index, chemical analysis – elemental and functional analysis

TOTAL : 45 PERIODS

REFERENCES

1. Miles, D.C & Briston, J.H., “Polymer Technology”, Chemical Publishing Co. Inc, NY, 1979
2. Maturine Morton, “Rubber Technology”, 3rd Edition, Van Nostrand Re Inhold, NY, 1987
3. Mascic, L. “Thermoplastics Materials Engineering”, Applied Science Publishers Ltd, NY, 1986.
4. Raymond E. Seymour, “Engineering, Polymer Source Book”, McGraw Hill

CH8009 PROCESS MODELLING AND SIMULATION L T P C

3 0 0 3

OBJECTIVES

- Students will develop suitable chemical process model to get process output

OUTCOME:

Understand the fundamentals of modelling and their applications to transport/energy equations, chemical and phase equilibria kinetics etc.,

Create the mathematical models for different unit operations equipments such as stirred tank heaters, Heat exchangers, Evaporators, Reactors, distillation columns etc.,.

Analyze the principles of steady state/unsteady state lumped systems and steady state/ unsteady state distributed systems and can select proper equation of state for estimating component properties and process flow sheeting.

UNIT I INTRODUCTION 3

Introduction to modeling and simulation, classification of mathematical models, conservation equations and auxiliary relations.

UNIT II STEADY STATE LUMPED SYSTEMS 9

Degree of freedom analysis, single and network of process units, systems yielding linear and non-linear algebraic equations, flow sheeting – sequential modular and equation oriented approach, tearing, partitioning and precedence ordering, solution of linear and non-linear

algebraic equations.

UNIT III UNSTEADY STATE LUMPED SYSTEMS 9

Analysis of liquid level tank, gravity flow tank, jacketed stirred tank heater, reactors, flash and distillation column, solution of ODE initial value problems, matrix differential equations, simulation of closed loop systems.

UNIT IV STEADY STATE DISTRIBUTED SYSTEM 7

Analysis of compressible flow, heat exchanger, packed columns, plug flow reactor, solution of ODE boundary value problems.

UNIT V UNSTEADY STATE DISTRIBUTED SYSTEM & OTHER MODELLINGAPPROACHES 13

Analysis laminar flow in pipe, sedimentation, boundary layer flow, conduction, heat exchanger, heat transfer in packed bed, diffusion, packed bed adsorption, plug flow reactor, hierarchy in model development, classification and solution of partial differential equations. Empirical modeling, parameter estimation, population balance and stochastic modeling.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Ramirez, W.; " Computational Methods in Process Simulation ", 2nd Edn., Butterworths Publishers, New York, 2000.
2. Luyben, W.L., " Process Modelling Simulation and Control ",2nd Edn, McGraw-Hill Book Co., 1990

REFERENCES

1. Felder, R. M. and Rousseau, R. W., " Elementary Principles of Chemical Processes ", John Wiley, 2000.
2. Franks, R. G. E., " Mathematical Modelling in Chemical Engineering ", John Wiley, 1967.

CH8010 **PROCESS PLANT UTILITIES** **L T P C**
3 0 0 3

OBJECTIVES

- Students will gain knowledge about auxiliary equipments used in chemical process plants

OUTCOME:

Comprehend the principles of water treatment, and methods of treating cooling water; understand the principles of efficient steam generation and utilisation.
Understand methods of compression of air, air drying system and different types refrigeration and humidification systems used in process industries; simple calculations of compressors
Understand the types of fuels and its disposal methods.

UNIT I IMPORTANT OF UTILITIES **9**

Hard and Soft water, Requisites of Industrial Water and its uses. Methods of water Treatment such as Chemical Softening and Demineralization, Resins used for Water Softening and Reverse Osmosis. Effects of impure Boiler Feed Water.

UNIT II STEAM AND STEAM GENERATION **9**

Properties of Steam, problems based on Steam, Types of Steam Generator such as Solid Fuel Fired Boiler, Waste Gas Fired Boiler and Fluidized Bed Boiler. Scaling and Trouble Shooting. Steam Traps and Accessories.

UNIT III REFRIGERATION **9**

Refrigeration Cycles, Methods of Refrigeration used in Industry and Different Types of Refrigerants such as Monochlorodifluro Methane, Chlorofluro Carbons and Brins. Refrigerating Effects and Liquefaction Processes.

UNIT IV COMPRESSED AIR **9**

Classification of Compressor, Reciprocating Compressor, Single Stage and Two Stage Compressor, Velocity Diagram for Centrifugal Compressor, Silp Factor, Impeller Blade Shape. Properties of Air –Water Vapors and use of Humidity Chart. Equipments used for Humidification, Dehumidification and Cooling Towers.

UNIT V FUEL AND WASTE DISPOSAL **9**

Types of Fuel used in Chemical Process Industries for Power Generation such as Natural Gas, Liquid Petroleum Fuels, Coal and Coke. Internal Combustion Engine, Petrol and Diesel Engine. Waste Disposal.

Attested

TOTAL : 45 PERIODS

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REFERENCES

1. Eckenfelder, W. W, Jr. “Industrial Water Pollution Control” McGraw-Hill: New York, 1966.
2. P. L. Ballaney, “Thermal Engineering”, Khanna Publisher New Delhi, 1986.
3. Perry R. H. Green D. W. “Perry’s chemical Engineer’s Handbook”, McGraw Hill, New York, 2007.
4. P. N. Ananthanarayan, “Basic Refrigeration & Air conditioning”, Tata McGraw Hill, New Delhi, 2007.

GE8751 ENGINEERING ETHICS AND HUMAN VALUES L T P C
3 0 0 3

OBJECTIVES

- Students will gain knowledge about ethics to be followed in industries and outside

OUTCOME:

Demonstrate their understanding of their professional and ethical responsibilities, moral issues and how the engineering designs affect the society.
Understand the concept of engineering experimentation to incorporate safety, environment and health factors in to the design of chemical process equipment.
Demonstrate the application of environmental and global ethics in the design of Chemical process systems.

UNIT I HUMAN VALUES 10

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality.

UNIT II ENGINEERING ETHICS 9

Senses of ‘Engineering Ethics’ – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg’s theory – Gilligan’s theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Ou tlook on Law – The Challenger Case Study

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – The Three Mile Island and Chernobyl Case Studies Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

UNIT V GLOBAL ISSUES 8

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Sample Code of Conduct

TOTAL : 45 PERIODS

TEXTBOOK

1. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.

REFERENCES

1. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Thompson Wadsworth, A Division of Thomson Learning Inc., United States, 2000
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, “Fundametals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001

WEB SOURCES:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

CH8011 **SUPPLY CHAIN MANAGEMENT** **LTPC**
3 0 0 3

OBJECTIVES

- Students will gain knowledge about practices followed in supply chain management

OUTCOME:

Understand the logistics management and supply chain network design
Apply latest technology used in supply chain management.

UNIT I INTRODUCTION **6**

Definition of Logistics and SCM: Evolution, Scope, Importance& Decision Phases – Drivers of SC Performance and Obstacles.

UNIT II LOGISTICS MANAGEMENT **10**

Factors – Modes of Transportation - Design options for Transportation Networks-Routing and Scheduling – Inbound and outbound logistics- Reverse Logistics – 3PL- Integrated Logistics Concepts- Integrated Logistics Model – Activities - Measuring logistics cost and performance – Warehouse Management - Case Analysis

UNIT III SUPPLY CHAIN NETWORK DESIGN **10**

Distribution in Supply Chain – Factors in Distribution network design –Design options-Network Design in Supply Chain – Framework for network Decisions - Managing cycle inventory and safety.

UNIT IV SOURCING, AND PRICING IN SUPPLY CHAIN **9**

Supplier selection and Contracts - Design collaboration - Procurement process. Revenue management in supply chain

UNIT V COORDINATION AND TECHNOLOGY IN SUPPLY CHAIN **10**

Supply chain coordination - Bullwhip effect – Effect of lack of co-ordination and obstacles – IT and SCM - supply chain IT frame work. E Business & SCM. Metrics for SC performance – Case Analysis

TOTAL : 45 PERIODS

REFERENCES

1. Supply Chain Management, Strategy, Planning, and operation – Sunil Chopra and Peter Meindl- PHI, Second edition, 2007

2. Logistics, David J.Bloomberg, Stephen Lemay and Joe B.Hanna, PHI 2002
3. Logistics and Supply Chain Management –Strategies for Reducing Cost and Improving Service. Martin Christopher, Pearson Education Asia, Second Edition
4. Modeling the supply chain, Jeremy F.Shapiro, Thomson Duxbury, 2002
5. Handbook of Supply chain management, James B.Ayers, St.Lucle Press, 2000

FT8551 BIOCHEMICAL ENGINEERING L T P C
3 0 0 3

OBJECTIVES

- Students will gain fundamental knowledge about biochemical reactions and its application to the reactor design

OUTCOME:

Apply the knowledge of micro organisms and enzymes to study different biochemical reactions and rate equations.
Understand transport mechanisms and sterilization concepts to design and analyze bioreactors.
Understand the downstream processing and industrial bioreactors

UNIT I INTRODUCTION 6

Industrial biochemical processes with typical examples, comparing chemical and biochemical processes, development and scope of biochemical engineering as a discipline. Industrially important microbial strains; their classification; structure; cellular genetics.

UNIT II KINETICS OF ENZYME ACTION 9

Kinetics of enzyme catalyzed reaction: the enzyme substrate complex and enzyme action, modulation and regulation of enzyme activity, types of inhibition. Immobilized enzyme technology: enzyme immobilization, Immobilized enzyme kinetics: effect of external mass transfer resistance.

UNIT III KINETICS OF MICROBIAL GROWTH 9

Kinetics of cellular growth in batch and continuous culture, models for cellular growth unstructured,structured and cybernetic models , medium formulation. Thermal death kinetics of cells and spores, stoichiometry of cell growth and product formation , Design and analysis of biological reactors

UNIT IV TRANSPORT PHENOMENA 9

Transport phenomena in bioprocess systems: Gas-liquid mass transfer in cellular systems,

determination of oxygen transfer rates, power requirements for sparged and agitated vessels, scaling of mass transfer equipment, heat transfer.

UNIT V DOWN STREAM PROCESSING **12**

Down stream processing: Strategies to recover and purify products; separation of insoluble products, filtration and centrifugation; cell disruption-mechanical and non-mechanical methods; separation of soluble products: liquid-liquid extractions, membrane separation (dialysis, ultra filtration and reverse osmosis),chromatographic separation-gel permeation chromatography, electrophoresis, final steps in purification –crystallization and drying.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Biochemical engineering fundamentals by J.E.Bailey and D.F.Ollis, 2nd ed, 1986, McGraw Hill.
2. Bioprocess Engineering by Michael L. Shuler and Fikret Kargi, 2nd edition, Pearson education.

REFERENCES

1. Biochemical engineering by James M.Lee – Prentice-Hall-1992.
2. Bioprocess engineering principles, Pauline M. Doran, Academic Press.
3. Biochemical Engineering, H.W. Blanch and D.S. Clark, Marcel Dekker, 1997.

GE8072 **DISASTER MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

OUTCOMES:

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarious in the Indian context,
- Disaster damage assessment and management.

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

GE8073 HUMAN RIGHTS L T P C
3 0 0 3

OBJECTIVES

- To sensitize the Engineering students to various aspects of Human Rights.

OUTCOME

- Engineering students will acquire the basic knowledge of human rights.

UNIT I **9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II **9**

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III **9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV **9**

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V **9**

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's,

Media, Educational Institutions, Social Movements.

TOTAL : 45 PERIODS

REFERENCES:

1. Kapoor S.K., “Human Rights under International law and Indian Laws”, Central Law Agency, Allahabad, 2014.
2. Chandra U., “Human Rights”, Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.