PROGRAMME OBJECTIVES:

The Petrochemical Technology Department’s educational objectives state the general goals of the program. Department’s graduates are expected to:

1) Meet the world's ever-increasing demand for hydrocarbon fuel, thermal energy, and waste and pollution management.
2) Be motivated to continuously develop their knowledge and skills.
3) Contribute to society

PROGRAMME OUTCOMES:

On completion of this programme, the students will have the

1) Ability to apply knowledge of mathematics, science, and engineering
2) Ability to design and conduct experiments, as well as to analyze and interpret data
3) Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
4) Ability to identify, formulate, and solve engineering problems related to petrochemical industry
5) Understanding of professional and ethical responsibility
6) Recognition of the need for, and an ability to engage in life-long learning
# ANNA UNIVERSITY, CHENNAI

AFFILIATED INSTITUTIONS

R - 2013

B. TECH. PETROCHEMICAL TECHNOLOGY

I – VIII SEMESTERS CURRICULUM AND SYLLABUS

## SEMESTER - I

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# Course Offerings

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#### B. TECH. PETROCHEMICAL TECHNOLOGY

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OBJECTIVES:

- To enable learners of Engineering and Technology develop their basic communication skills in English.
- To emphasize specifically the development of speaking skills amongst learners of Engineering and Technology.
- To ensure that learners use the electronic media such as internet and supplement the learning materials used in the classroom.
- To inculcate the habit of reading and writing leading to effective and efficient communication.

UNIT I

9+3
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

9+3
Listening - Listening and responding to video lectures/talks; Speaking - Describing a simple process (filling a form, etc.) - Asking and 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) - Process descriptions (general/specific) - Definitions - Recommendations – Instructions; Grammar - Use of imperatives - Subject-verb agreement; Vocabulary - Compound words - Word Association (connotation); E-materials - Interactive exercises for Grammar and Vocabulary - Listening exercises with sample telephone conversations/lectures – Picture-based activities.

UNIT III

9+3
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 and effect / compare and 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

9+3
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

UNIT V
Listening - Listening to different accents, Listening to Speeches/Presentations, Listening to broadcast and telecast from Radio and 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 and Vocabulary - Sending emails with attachment – Audio / video excerpts of different accents - Interpreting posters.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:
Learners should be able to
- speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
- write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
- read different genres of texts adopting various reading strategies.
- listen/view and comprehend different spoken discourses/excerpts in different accents

TEXTBOOKS:

REFERENCES:

EXTENSIVE Reading (Not for Examination)

WEBSITES:

TEACHING METHODS:
- Lectures
- Activities conducted individually, in pairs and in groups like self introduction, peer introduction, group poster making, grammar and vocabulary games, etc.
Discussions
- Role play activities
- Short presentations
- Listening and viewing activities with follow up activities like discussion, filling up worksheets, writing exercises (using language lab wherever necessary/possible) etc.

EVALUATION PATTERN:

Internal assessment: 20%
3 tests of which two are pen and paper tests and the other is a combination of different modes of assessment like
- Project
- Assignment
- Reviews
- Creative writing
- Poster making, etc.

All the four skills are to be tested with equal weightage given to each.
- Speaking assessment: Individual speaking activities, Pair work activities like role play, Interview, Group discussions
- Reading assessment: Reading passages with comprehension questions graded from simple to complex, from direct to inferential
- Writing assessment: Writing paragraphs, essays etc. Writing should include grammar and vocabulary.
- Listening/Viewing assessment: Lectures, dialogues, film clippings with questions on verbal as well as audio/visual content.

End Semester Examination: 80%

MA6151 MATHEMATICS – I

OBJECTIVES:
- 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

UNIT II SEQUENCES AND SERIES 9+3

UNIT III APPLICATIONS OF DIFFERENTIAL CALCULUS 9+3
Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes - Evolute as envelope of normals.

UNIT IV DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES 9+3

UNIT V MULTIPLE INTEGRALS 9+3

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:
• This course equips students to have basic knowledge and understanding in one fields of materials, integral and differential calculus.

TEXT BOOKS:

REFERENCES:
PH6151 ENGINEERING PHYSICS – I L T P C 3 0 0 3

OBJECTIVES:
• To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT I CRYSTAL PHYSICS 9
Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures (qualitative treatment) - Crystal growth techniques –solution, melt (Bridgman and Czochralski) and vapour growth techniques (qualitative)

UNIT II PROPERTIES OF MATTER AND THERMAL PHYSICS 9

UNIT III QUANTUM PHYSICS 9

UNIT IV ACOUSTICS AND ULTRASONICS 9
Production of ultrasonics by magnetostriction and piezoelectric methods - acoustic grating -Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C –scan displays, Medical applications - Sonogram

UNIT V PHOTONICS AND FIBRE OPTICS 9
Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) – attenuation, dispersion, bending - Fibre Optical Communication system (Block diagram) - Active and passive fibre sensors- Endoscope.

TOTAL: 45 PERIODS

OUTCOMES:
• The students will have knowledge on the basics of physics related to properties of matter, optics, acoustics etc., and they will apply these fundamental principles to solve practical problems related to materials used for engineering applications.
TEXT BOOKS:
1. Arumugam M. Engineering Physics. Anuradha publishers, 2010

REFERENCES:
1. Searls and Zemansky. University Physics, 2009
5. Rajagopal K. Engineering Physics. PHI, New Delhi, 2011

CY6151 ENGINEERING CHEMISTRY - I

OBJECTIVES:
- To make the students conversant with basics of polymer chemistry.
- To make the student acquire sound knowledge of second law of thermodynamics and second law based derivations of importance in engineering applications in all disciplines.
- To acquaint the student with concepts of important photophysical and photochemical processes and spectroscopy.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- To acquaint the students with the basics of nano materials, their properties and applications.

UNIT I POLYMER CHEMISTRY
Introduction: Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerization. Types and mechanism of polymerization: Addition (Free Radical, cationic and anionic); condensation and copolymerization. Properties of polymers: Tg, Tacticity, Molecular weight – weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension. Preparation, properties and uses of Nylon 6,6, and Epoxy resin.

UNIT II CHEMICAL THERMODYNAMICS
Terminology of thermodynamics - Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function: Helmholtz and Gibbs free energy functions (problems); Criteria of spontaneity; Gibbs-Helmholtz equation (problems); Clausius-Clapeyron equation; Maxwell relations – Van’t Hoff isotherm and isochore(problems).

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY
Conversion, Inter-system crossing, Fluorescence, Phosphorescence, Chemiluminescence and Photo-sensitization. Spectroscopy: Electromagnetic spectrum - Absorption of radiation – Electronic, Vibrational and rotational transitions. UV-visible and IR spectroscopy – principles, instrumentation (Block diagram only).

UNIT IV  PHASE RULE AND ALLOYS


UNIT V  NANOCHEMISTRY

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Nanoparticles: nano cluster, nano rod, nanotube(CNT) and nanowire. Synthesis: precipitation, thermolysis, hydrothermal, solvothermal, electrode position, chemical vapour deposition, laser ablation; Properties and applications

TOTAL :45 PERIODS

OUTCOMES:
• The knowledge gained on polymer chemistry, thermodynamics. spectroscopy, phase rule and nano materials will provide a strong platform to understand the concepts on these subjects for further learning.

TEXT BOOKS:

REFERENCES:

GE6151  COMPUTER PROGRAMMING

OBJECTIVES:
The students should be made to:
• Learn the organization of a digital computer.
• Be exposed to the number systems.
• Learn to think logically and write pseudo code or draw flow charts for problems.
• Be exposed to the syntax of C.
• Be familiar with programming in C.
• Learn to use arrays, strings, functions, pointers, structures and unions in C.
UNIT I  INTRODUCTION  

UNIT II  C PROGRAMMING BASICS  
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  
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  
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  
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

OUTCOMES:
At the end of the course, the student should be able to:

- Design C Programs for problems.
- Write and execute C programs for simple applications.

TEXTBOOKS:

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

CONCEPTS AND CONVENTIONS (Not for Examination)
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  5+9

UNIT II  PROJECTION OF POINTS, LINES AND PLANE SURFACES  5+9
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 traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III  PROJECTION OF SOLIDS  5+9
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  5+9
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  6+9
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.

COMPUTER AIDED DRAFTING (Demonstration Only)  3
Introduction to drafting packages and demonstration of their use.

TOTAL: 75 PERIODS
OUTCOMES:
On Completion of the course the student will be able to
- perform free hand sketching of basic geometrical constructions and multiple views of objects.
- do orthographic projection of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- prepare isometric and perspective sections of simple solids.
- demonstrate computer aided drafting.

TEXT BOOK:

REFERENCES:

Publication of Bureau of Indian Standards:

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.
OBJECTIVES:
The student should be made to:
- Be familiar with the use of Office software.
- Be exposed to presentation and visualization tools.
- Be exposed to problem solving techniques and flow charts.
- Be familiar with programming in C.
- Learn to use Arrays, strings, functions, structures and unions.

LIST OF EXPERIMENTS:
1. Search, generate, manipulate data using MS office/ Open Office
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 – Includes Parameter Passing
9. Program using Recursive Function and conversion from given program to flow chart.
10. Program using structures and unions.

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Apply good programming design methods for program development.
- Design and implement C programs for simple applications.
- Develop recursive programs.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:
Standalone desktops with C compiler 30 Nos.

(or)
Server with C compiler supporting 30 terminals or more.

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

GROUP A (CIVIL & MECHANICAL)
I CIVIL ENGINEERING PRACTICE

Buildings:
(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:
(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works.
(d) Hands-on-exercise:

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:
(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:

Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE

Welding:
(a) Preparation of arc welding of butt joints, lap joints and tee joints.
(b) Gas welding practice

Basic Machining:
(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:
(a) Forming & Bending:
(b) Model making – Trays, funnels, etc.
(c) Different type of joints.

Machine assembly practice:
(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:
(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting – Exercises – Preparation of square fitting and vee – fitting models.
GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
5. Measurement of energy using single phase energy meter.

IV ELECTRONICS ENGINEERING PRACTICE

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EOR and NOT.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 45 PERIODS

OUTCOMES:

- 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.

REFERENCES:


LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. 15 Sets.
2. Carpentry vice (fitted to work bench) 15 Nos.
4. Models of industrial trusses, door joints, furniture joints 5 each
5. Power Tools: (a) Rotary Hammer 2 Nos
   (b) Demolition Hammer 2 Nos
   (c) Circular Saw 2 Nos
   (d) Planer 2 Nos
   (e) Hand Drilling Machine 2 Nos
   (f) Jigsaw 2 Nos

   MECHANICAL

1. Arc welding transformer with cables and holders 5 Nos.
2. Welding booth with exhaust facility 5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc. 5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit. 2 Nos.
5. Centre lathe 2 Nos.
6. Hearth furnace, anvil and smithy tools 2 Sets.
7. Moulding table, foundry tools 2 Sets.
8. Power Tool: Angle Grinder 2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner One each.

   ELECTRICAL

1. Assorted electrical components for house wiring 15 Sets
2. Electrical measuring instruments 10 Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp 1 each
4. Megger (250V/500V) 1 No.
5. Power Tools: (a) Range Finder 2 Nos
   (b) Digital Live-wire detector 2 Nos

   ELECTRONICS

1. Soldering guns 10 Nos.
2. Assorted electronic components for making circuits 50 Nos.
3. Small PCBs 10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply

GE6163 PHYSICS AND CHEMISTRY LABORATORY – I

PHYSICS LABORATORY – I

OBJECTIVES:
- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics and properties of matter.

LIST OF EXPERIMENTS
(Any FIVE Experiments)
1. (a) Determination of Wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
2. Determination of velocity of sound and compressibility of liquid – Ultrasonic
   interferometer.
3. Determination of wavelength of mercury spectrum – spectrometer grating
5. Determination of Young’s modulus by Non uniform bending method
6. Determination of specific resistance of a given coil of wire – Carey Foster’s Bridge

OUTCOMES:
• The hands on exercises undergone by the students will help them to apply
  physics principles of optics and thermal physics to evaluate engineering properties
  of materials.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Diode laser, lycopodium powder, glass plate, optical fiber.
2. Ultrasonic interferometer
3. Spectrometer, mercury lamp, grating
4. Lee’s Disc experimental set up
5. Traveling microscope, meter scale, knife edge, weights
6. Carey foster’s bridge set up
   (vernier Caliper, Screw gauge, reading lens are required for most of the
   experiments)

CHEMISTRY LABORATORY- I

OBJECTIVES:
• To make the student to acquire practical skills in the determination of water
  quality parameters through volumetric and instrumental analysis.
• To acquaint the students with the determination of molecular weight of a polymer
  by vacometry.

LIST OF EXPERIMENTS
(Any FIVE Experiments)

1. Determination of DO content of water sample by Winkler’s method.
2. Determination of chloride content of water sample by argentometric method.
3. Determination of strength of given hydrochloric acid using pH meter.
4. Determination of strength of acids in a mixture using conductivity meter.
5. Estimation of iron content of the water sample using spectrophotometer.
   (1,10- phenanthroline / thiocyanate method).
7. Conductometric titration of strong acid vs strong base.

TOTAL: 30 PERIODS

OUTCOMES:
• The students will be outfitted with hands-on knowledge in the quantitative
  chemical analysis of water quality related parameters.

REFERENCES:


**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

1. Iodine flask - 30 Nos
2. pH meter - 5 Nos
3. Conductivity meter - 5 Nos
4. Spectrophotometer - 5 Nos
5. Ostwald Viscometer - 10 Nos

**Common Apparatus:** Pipette, Burette, conical flask, porcelain tile, dropper (each 30 Nos.)

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**HS6251**

**TECHNICAL ENGLISH II**

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**OBJECTIVES:**

- To make learners acquire listening and speaking skills in both formal and informal contexts.
- To help them develop their reading skills by familiarizing them with different types of reading strategies.
- To equip them with writing skills needed for academic as well as workplace contexts.
- To make them acquire language skills at their own pace by using e-materials and language lab components.

**UNIT I**

9+3

Listening - Listening to informal conversations and participating; Speaking - Opening a conversation (greetings, comments on topics like 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 and 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 / her success, thanking one’s friends / relatives);
Grammar - modal verbs, Purpose expressions; Vocabulary - Phrasal verbs and their meanings, Using phrasal verbs in sentences; E-materials - Interactive exercises on Grammar and vocabulary, Extensive reading activity (reading stories / novels), Posting reviews in blogs - Language Lab - Dialogues (Fill up exercises), Recording students’ 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 time limit - Skimming; Writing - Minutes of meeting – format and practice in the preparation of minutes - Writing summary after reading articles from journals - Format for 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 and vocabulary - Speed Reading practice exercises; Language Lab - Intonation practice using EFLU and RIE materials – Attending a meeting and writing minutes.

UNIT IV 9+3
Listening - Listening to a telephone conversation, Viewing model interviews (face-to-face, telephonic and video conferencing); Speaking - Role play practice in telephone skills - listening and responding, -asking questions, -note taking – passing on messages, Role play and mock interview for grasping 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 and 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 - Checklist - 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; Language Lab - Different models of group discussion.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:
Learners should be able to
- speak convincingly, express their opinions clearly, initiate a discussion, negotiate, argue using appropriate communicative strategies.
- write effectively and persuasively and produce different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing.
read different genres of texts, infer implied meanings and critically analyse and evaluate them for ideas as well as for method of presentation.

listen/view and comprehend different spoken excerpts critically and infer unspoken and implied meanings.

TEXTBOOKS:

REFERENCES:

EXTENSIVE Reading (Not for Examination)

Websites
2. http://owl.english.purdue.edu

TEACHING METHODS:
- Lectures
- Activities conducted individually, in pairs and in groups like individual writing and presentations, group discussions, interviews, reporting, etc
- Long presentations using visual aids
- Listening and viewing activities with follow up activities like discussions, filling up worksheets, writing exercises (using language lab wherever necessary/possible) etc
- Projects like group reports, mock interviews etc using a combination of two or more of the language skills

EVALUATION PATTERN:

Internal assessment: 20%
3 tests of which two are pen and paper tests and the other is a combination of different modes of assessment like
- Project
- Assignment
- Report
- Creative writing, etc.

All the four skills are to be tested with equal weightage given to each.

- Speaking assessment: Individual presentations, Group discussions
- Reading assessment: Reading passages with comprehension questions graded following Bloom’s taxonomy
Writing assessment: Writing essays, CVs, reports etc. Writing should include grammar and vocabulary.

Listening/Viewing assessment: Lectures, dialogues, film clippings with questions on verbal as well as audio/visual content graded following Bloom’s taxonomy.

End Semester Examination: 80%

MA6251 MATHEMATICS – II

OBJECTIVES:
- 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 VECTOR CALCULUS 9+3
Gradient, divergence and curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green’s theorem in a plane, Gauss divergence theorem and Stokes’ theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.

UNIT II ORDINARY DIFFERENTIAL EQUATIONS 9+3
Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy’s and Legendre’s linear equations – Simultaneous first order linear equations with constant coefficients.

UNIT III LAPLACE TRANSFORM 9+3

UNIT IV ANALYTIC FUNCTIONS 9+3
Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: w = z+k, kz, 1/z, z^2, e^z and bilinear transformation.

UNIT V COMPLEX INTEGRATION 9+3
Complex integration – Statement and applications of Cauchy’s integral theorem and Cauchy’s integral formula – Taylor’s and Laurent’s series expansions – Singular points – Residues – Cauchy’s residue theorem – Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).

**TOTAL (L:45+T:15): 60 PERIODS**

**OUTCOMES:**

- The subject helps the students to develop the fundamentals and basic concepts in vector calculus, ODE, Laplace transform and complex functions. Students will be able to solve problems related to engineering applications by using these techniques.

**TEXT BOOKS:**


**REFERENCES:**


**PH6251 ENGINEERING PHYSICS – II**

**OBJECTIVES:**

- To enrich the understanding of various types of materials and their applications in engineering and technology.

**UNIT I CONDUCTING MATERIALS**


**UNIT II SEMICONDUCTING MATERIALS**

UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS

Superconductivity: properties – Type I and Type II superconductors – BCS theory of superconductivity(Qualitative) - High Tc superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

UNIT IV DIELECTRIC MATERIALS


UNIT V ADVANCED ENGINEERING MATERIALS


TOTAL: 45 PERIODS

OUTCOMES:
- The students will have the knowledge on physics of materials and that knowledge will be used by them in different engineering and technology applications.

TEXT BOOKS:

REFERENCES:

CY6251 ENGINEERING CHEMISTRY - II

OBJECTIVES:
- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- Principles of electrochemical reactions, redox reactions in corrosion of materials and methods for corrosion prevention and protection of materials.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.
- Preparation, properties and applications of engineering materials.
Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.

UNIT I WATER TECHNOLOGY
Introduction to boiler feed water-requirements-formation of deposits in steam boilers and heat exchangers- disadvantages (wastage of fuels, decrease in efficiency, boiler explosion) prevention of scale formation -softening of hard water -external treatment zeolite and demineralization - internal treatment- boiler compounds (phosphate, calgon, carbonate, colloidal) - caustic embrittlement -boiler corrosion-priming and foaming-desalination of brackish water –reverse osmosis.

UNIT II ELECTROCHEMISTRY AND CORROSION

UNIT III ENERGY SOURCES
Introduction- nuclear energy- nuclear fission- controlled nuclear fission- nuclear fusion-differences between nuclear fission and fusion- nuclear chain reactions- nuclear reactor power generator- classification of nuclear reactor- light water reactor- breeder reactor-solar energy conversion- solar cells- wind energy. Batteries and fuel cells:Types of batteries- alkaline battery- lead storage battery- nickel-cadmium battery- lithium battery-fuel cell H₂ -O₂ fuel cell- applications.

UNIT IV ENGINEERING MATERIALS
Abrasives: definition, classification or types, grinding wheel, abrasive paper and cloth. Refractories: definition, characteristics, classification, properties – refractoriness and RUL, dimensional stability, thermal spalling, thermal expansion, porosity; Manufacture of alumina, magnesite and silicon carbide, Portland cement- manufacture and properties - setting and hardening of cement, special cement- waterproof and white cement– properties and uses. Glass - manufacture, types, properties and uses.

UNIT V FUELS AND COMBUSTION

TOTAL: 45 PERIODS

OUTCOMES:
• The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

TEXT BOOKS:
1. Vairam S, Kalyani P and SubaRamesh.,“Engineering Chemistry”, Wiley India PvtLtd., New Delhi, 2011

REFERENCES:

GE6252 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING L T P C 4 0 0 4

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.

UNIT I ELECTRICAL CIRCUITS & MEASUREMENTS

<table>
<thead>
<tr>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.</td>
</tr>
</tbody>
</table>

UNIT II ELECTRICAL MECHANICS

<table>
<thead>
<tr>
<th>Topic</th>
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</table>

UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS

<table>
<thead>
<tr>
<th>Topic</th>
</tr>
</thead>
</table>

UNIT IV DIGITAL ELECTRONICS

<table>
<thead>
<tr>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip Flops – Registers and Counters – A/D and D/A Conversion (single concepts)</td>
</tr>
</tbody>
</table>

UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING

<table>
<thead>
<tr>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication Systems: Radio, TV, Fax, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).</td>
</tr>
</tbody>
</table>
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.

TEXT BOOKS:

REFERENCES:

GE6253 ENGINEERING MECHANICS

OBJECTIVES:
• To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.

UNIT I BASICS AND STATIC OF PARTICLES 12

UNIT II EQUILIBRIUM OF RIGID BODIES 12
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 12
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 for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

UNIT IV DYNAMICS OF PARTICLES 12

UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 12
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

OUTCOMES:
- ability to explain the differential principles applies to solve engineering problems dealing with force, displacement, velocity and acceleration.
- ability to analyse the forces in any structures.
- ability to solve rigid body subjected to dynamic forces.

TEXT BOOKS:

REFERENCES:

GE6261 COMPUTER AIDED DRAFTING AND MODELING LABORATORY L T P C
0 1 2 2

OBJECTIVES:
- To develop skill to use software to create 2D and 3D models.

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

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

TOTAL: 45 PERIODS

OUTCOMES:
• ability to use the software packers for drafting and modeling
• ability to create 2D and 3D models of Engineering Components

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Description of Equipment</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Pentium IV computer or better hardware, with suitable graphics facility</td>
<td>30 No.</td>
</tr>
<tr>
<td>2.</td>
<td>Licensed software for Drafting and Modeling.</td>
<td>30 Licenses</td>
</tr>
<tr>
<td>3.</td>
<td>Laser Printer or Plotter to print / plot drawings</td>
<td>2 No.</td>
</tr>
</tbody>
</table>

GE6262  PHYSICS AND CHEMISTRY LABORATORY – II  L  T  P  C
0  0  2  1

PHYSICS LABORATORY – II

OBJECTIVES:
• To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics and properties of matter.

LIST OF EXPERIMENTS
(Any FIVE Experiments)
1. Determination of Young’s modulus by uniform bending method
2. Determination of band gap of a semiconductor
3. Determination of Coefficient of viscosity of a liquid – Poiseuille’s method
4. Determination of Dispersive power of a prism - Spectrometer
5. Determination of thickness of a thin wire – Air wedge method
6. Determination of Rigidity modulus – Torsion pendulum

OUTCOMES:
• The students will have the ability to test materials by using their knowledge of applied physics principles in optics and properties of matter.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:
1. Traveling microscope, meter scale, Knife edge, weights
2. Band gap experimental set up
3. Burette, Capillary tube, rubber tube, stop clock, beaker and weighing balance
4. spectrometer, prism, sodium vapour lamp.
5. Air-wedge experimental set up.
6. Torsion pendulum set up.
   (vernier Caliper, Screw gauge, reading lens are required for most of the experiments)

CHEMISTRY LABORATORY - II

OBJECTIVES:
- 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.

LIST OF EXPERIMENTS
(Any FIVE Experiments)
1. Determination of alkalinity in water sample
2. Determination of total, temporary & permanent hardness of water by EDTA method
3. Estimation of copper content of the given solution by EDTA method
4. Estimation of iron content of the given solution using potentiometer
5. Estimation of sodium present in water using flame photometer
6. Corrosion experiment – weight loss method
7. Conductometric precipitation titration using BaCl$_2$ and Na$_2$SO$_4$

TOTAL: 30 PERIODS

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.

REFERENCES:
- Laboratory classes on alternate weeks for Physics and Chemistry.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potentiometer</td>
<td>5 Nos</td>
</tr>
<tr>
<td>Flame photometer</td>
<td>5 Nos</td>
</tr>
<tr>
<td>Weighing Balance</td>
<td>5 Nos</td>
</tr>
</tbody>
</table>
4. Conductivity meter - 5 Nos

Common Apparatus: Pipette, Burette, conical flask, porcelain tile, dropper (30 Nos each)

GE6263 COMPUTER PROGRAMMING LABORATORY L T P C
0 1 2 2

OBJECTIVES:
The Students should be made to
- Be exposed to Unix shell commands
- Be familiar with an editor on Unix
- Learn to program in Shell script
- Learn to write C programme for Unix platform

LIST OF EXPERIMENTS
1. UNIX COMMANDS 15
   Study of Unix OS - Basic Shell Commands - Unix Editor

2. SHELL PROGRAMMING 15
   Simple Shell program - Conditional Statements - Testing and Loops

3. C PROGRAMMING ON UNIX 15
   Dynamic Storage Allocation-Pointers-Functions-File Handling

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the students should be able to:
- Use Shell commands
- Design of Implement Unix shell scripts
- Write and execute C programs on Unix

HARDWARE / SOFTWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS

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

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

MA6351 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C
3 1 0 4

OBJECTIVES:
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
• To acquaint the student with Fourier transform techniques used in wide variety of situations.
• To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I  PARTIAL DIFFERENTIAL EQUATIONS  9 + 3
Formation of partial differential equations – Singular integrals -- Solutions of standard types of first order partial differential equations - Lagrange’s linear equation -- Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II  FOURIER SERIES  9 + 3

UNIT III  APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS  9 + 3
Classification of PDE – Method of separation of variables - Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).

UNIT IV  FOURIER TRANSFORMS  9 + 3

UNIT V  Z - TRANSFORMS AND DIFFERENCE EQUATIONS  9 + 3

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

• The understanding of the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.

TEXT BOOKS:

REFERENCES:
OBJECTIVE:
To enable the students to acquire knowledge in the field of electrochemistry, solubility behaviour, chemical reaction kinetics, photochemical reactions and colloidal chemistry towards different applications.

UNIT I  ELECTROCHEMISTRY

UNIT II  CHEMICAL KINETICS

UNIT III  PHOTOCHEMISTRY

UNIT IV  COLLOIDS

UNIT V  THE DISTRIBUTION LAW

TOTAL : 45 PERIODS

OUTCOME:
Upon completion of this course, the students would understand the chemical equilibria, phase equilibria, electrochemical equilibria and biochemical reactions equilibria towards different applications.

TEXT BOOKS:

REFERENCES:

GE6351    ENVIRONMENTAL SCIENCE AND ENGINEERING        L T P C  3 0 0 3

OBJECTIVES:
To the study of nature and the facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth’s interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I    ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY  12
Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers-Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – 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  10
Definition – causes, effects and control measures of: (a) Air pollution (Atmospheric chemistry- Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry;- Mitigation procedures- Control of particulate and gaseous emission, Control of SO₂, NOₓ, CO and HC) (b) Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance; Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. (c) Soil pollution - soil waste management: causes, effects and
control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards– role of an individual in prevention of pollution – pollution case studies – Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES
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 overutilization of surface and ground 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. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; 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. Introduction to Environmental Biochemistry: Proteins –Biochemical degradation of pollutants, Bioconversion of pollutants.
Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT
Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT

TOTAL : 45 PERIODS

OUTCOMES:
Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

TEXT BOOKS:
OBJECTIVE:
To enable the students to gain knowledge on various aspects of production engineering and understand the practical methods of production in a chemical factory.

UNIT I SULFUR, SULFURIC ACID AND CEMENT
Sulfur, Raw materials Sources, Mining and production of Sulfur – Sulfuric acid, Methods of production of Sulfuric acid – Contact process – Chamber process. Cement – properties of Cement – Methods of production – Overall factors for Cement industry.

UNIT II FERTILIZER INDUSTRY, FUEL AND INDUSTRIAL GASES

UNIT III PULP, PAPER, SUGAR AND STARCH INDUSTRIES

UNIT IV PETROLEUM AND PETRO CHEMICAL INDUSTRIES

UNIT V RUBBERS, POLYMERS AND SYNTHETIC FIBRE
OUTCOME:
Student can classify the chemical process industry into industrial categories of base, intermediate end-products and specialty chemicals manufacturers

TEXT BOOKS:

REFERENCES:

EE6351 ELECTRICAL DRIVES AND CONTROL L T P C 3 0 0 3

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

UNIT I INTRODUCTION
Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors

UNIT II DRIVE MOTOR CHARACTERISTICS
Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound - single phase and three phase induction motors.

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

UNIT IV CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES
Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers – applications

UNIT V CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C.DRIVES
Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications.

TOTAL : 45 PERIODS

OUTCOME:
Students able to describe the structure of Electric Drive systems and their role in various applications such as flexible production systems, energy conservation, renewable energy, transportation etc., making Electric Drives an enabling technology.
TEXT BOOKS:

REFERENCES:

CS6365 DATA STRUCTURES

OBJECTIVE:
To make the students understand the fundamentals of writing algorithms and data structures. To know storage management systems.

UNIT I FUNDAMENTALS OF ALGORITHMS

UNIT II FUNDAMENTALS OF DATA STRUCTURES

UNIT III TREES

UNIT IV GRAPHS AND THEIR APPLICATIONS

UNIT V STORAGE MANAGEMENT

OUTCOME:
Students have the ability to analyze algorithms and to determine algorithm correctness and time efficiency class.

TEXT BOOKS:

REFERENCES:
EI6411  ELECTRICAL MACHINES LABORATORY  L T P C
0 0 3 2

OBJECTIVES:
To impart hands on experience in verification of circuit laws and theorems, measurement of circuit parameters, study of circuit characteristics and simulation of time response. To expose the students to the basic operation of electrical machines and help them to develop experimental skills.

LIST OF EXPERIMENTS

1. Open circuit characteristics of D.C. shunt generator.
2. Load characteristics of D.C. shunt generator.
3. Load test on D.C. shunt motor.
4. Load test on D.C. series motor.
5. Swinburne’s test
7. Load test on single phase transformer
8. Open circuit and short circuit tests on single phase transformer (Determination of equivalent circuit parameters).
9. Load test on single phase induction motor.
10. No load and blocked rotor tests on three phase induction motor (Determination of equivalent circuit parameters)
11. Load test on Three phase induction motor.
12. Study of Starters

TOTAL: 45 PERIODS

OUTCOMES:
- Ability to understand and analyze Instrumentation systems and their applications to various industries

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. DC Shunt Motor with Loading Arrangement – 3 nos
2. Single Phase Transformer – 4 nos
3. DC Series Motor with Loading Arrangement – 1 No.
4. Three Phase Induction Motor with Loading Arrangement – 2 nos
5. Single Phase Induction Motor with Loading Arrangement – 1 No.
6. DC Shunt Motor Coupled With DC Compound Generator – 2 nos
7. DC Shunt Motor Coupled With DC Shunt Generator – 1 No.
8. Tachometer -Digital/Analog – 8 nos
9. Single Phase Auto Transformer – 2 nos
10. Three Phase Auto Transformer – 1 No.
11. Single Phase Resistive Loading Bank – 2 nos
12. Three Phase Resistive Loading Bank – 2 nos
13. SPST switch – 2 nos

CS6363 DATA STRUCTURES LABORATORY L T P C
0 0 3 2

OBJECTIVES:
The students should be made to:
- Be familiar with c & c++ programming
- Be exposed to implementing abstract data types
- Learn to use files

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

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Apply good programming design methods for program development
- Apply the different data structures for implementing solutions to practical problem.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
1. Standalone desktops with C or C++ compiler - 30 Nos.
   (or)
2. Serve with C or C++ Supporting 30 terminals or more

MA6468 PROBABILITY AND STATISTICS L T P C
3 1 0 4

OBJECTIVES:
- This course aims at providing the required skill to apply the statistical tools in engineering problems.

UNIT I RANDOM VARIABLES 9 + 3
Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions.

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 TESTING OF HYPOTHESIS 9 + 3
Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample test based on Normal distribution for single mean and difference of means - Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT IV DESIGN OF EXPERIMENTS 9 + 3
One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design - 2^k factorial design.

UNIT V STATISTICAL QUALITY CONTROL 9 + 3
Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:
- The students will have a fundamental knowledge of the concepts of probability. Have knowledge of standard distributions which can describe real-life phenomenon. Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

TEXT BOOKS:

REFERENCES:
OBJECTIVE:
To enable the students to learn the type of components in which organic reactions take place and also to know the preparation of the essential organic compounds.

UNIT I CARBOHYDRATES
Introduction – various definitions and classifications of carbohydrates – Preparation, Physical & Chemical properties, 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
Preparation, Physical & Chemical properties and Uses of Pyrrole, Furan, Furfural, TetrahydroFuran, Thiophene, Indole, Pyridine, Quinoline and Isoquinoline.

UNIT III DYE CHEMISTRY
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
Preparation and Synthetic utilities of Grignard reagent, Ethyl acetoacetate and Maleic ester.

UNIT V PHARMACEUTICAL CHEMISTRY

TOTAL : 45 PERIODS

OUTCOME:
At the end of the course students will be in a position to have knowledge on various reaction mechanism, preparation of organic compounds and their properties. This will be a precursor for the study on Chemical Reaction Engineering.

TEXT BOOKS:

REFERENCES:
OBJECTIVE:
To provide students with a strong foundation in materials science with emphasis on the fundamental scientific and engineering principles which underlie the knowledge and implementation of material structure, processing, properties, and performance of all classes of materials used in engineering systems.

UNIT I STRUCTURE OF MATERIALS
Introduction-classification of materials, selection of materials, properties of materials, x-ray crystallography, Bragg's law, x-ray diffraction, electron diffraction, neutron diffraction, structure of NaCl and diamond, Crystal defects - point, line, surface and volume defects, alloy formation, solid solution types, solidification of castings, structural examination using microscopy.

UNIT II METALLURGICAL PROPERTIES OF MATERIALS

UNIT III TYPES OF MATERIALS

UNIT IV PHYSICAL CHARACTERISTICS OF MATERIALS

UNIT V NON-METALLIC MATERIALS

OUTCOME:
Students will be able to understand various material and its properties and manufacturing methods.

TEXT BOOKS:

REFERENCES:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>L T P C</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC6404</td>
<td>PROCESS CALCULATIONS</td>
<td>3 0 0 3</td>
</tr>
</tbody>
</table>

OBJECTIVE:
This course is to present to the students, an introduction to chemical engineering calculations, establish mathematical methodologies for the computation of material balances, energy balances and to present an overview of industrial chemical processes. It is prerequisite for several other courses in the curriculum, including courses in process dynamics, heat transfer and phase equilibrium.

UNIT I BASIC CHEMICAL CALCULATIONS
Units and Dimensions
Basic and derived units – Use of model units in calculations – Methods of expression – Compositions of mixture and solutions.
Gas Calculations

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

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

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

UNIT V ENERGY BALANCE
Thermo Physics

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

OUTCOME:
The student will know the 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.

**TEXT BOOKS:**

**REFERENCES:**

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**PC6403**  
**FLUID FLOW OPERATION**  
**L T P C**  
**3 0 0 3**

**OBJECTIVE:**
To impart the students, the knowledge on fluid properties, fluid statics, dynamic characteristics for through pipes and porous medium, flow measurement and fluid machineries

**UNIT I**  
**PROPERTIES OF FLUIDS AND CONCEPT OF PRESSURE**  

**UNIT II**  
**MOMEMTUM BALANCE AND ITS APPLICATIONS**  

**UNIT III**  
**FLOW OF INCOMPRESSIBLE FLUIDS THROUGH DUCTS**  

**UNIT IV**  
**FLOW OF FLUIDS THROUGH SOLIDS**  

**UNIT V**  
**TRANSPORTATION AND METERING**  
displacement pumps – Rotary and Reciprocating pumps – Centrifugal pumps – Performance and characteristics – Air lift and diaphragm pumps.

TOTAL : 45 PERIODS

OUTCOME:
The students would develop skills in analyzing fluid flows through the proper use of modeling and the application of the basic fluid-flow principles.

TEXT BOOKS:

REFERENCES:

CH6404 MECHANICAL OPERATIONS L T P C
3 0 0 3

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

UNIT I
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
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
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, jiggling

UNIT IV
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
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, conveyor selection, different types of conveyors and their performance characteristics.

TOTAL: 45 PERIODS

OUTCOME:
The students would understand about solids, their characterization, handling and various processes involving solids. The students will have knowledge on basic theory, calculations and machinery involved in various solid handling operations.

TEXT BOOKS:

REFERENCE:

PC6411 PHYSICAL AND ORGANIC CHEMISTRY LABORATORY

OBJECTIVE:
To improve the practical knowledge on the properties and characteristics of solvents and mixtures of Physical and Organic.

LIST OF EXPERIMENTS

PHYSICAL
1. Determination of molecular weight of a polymer by viscosity method.
2. Determination of partition co-efficient of iodine between two immiscible solvents
3. Determination of partition co-efficient of benzoic acid between two immiscible solvents
4. Determination of Ka of the weak acid
5. Conductometric experiments- Verification of Oswald’s Dilution Law
6. Titration of Strong Acid Vs Strong Base
7. Titration of mixture of Strong Acid Weak Acid Vs Strong Base
8. Titration of Weak Acid Vs Weak Base
9. Determination of Rate Constant (K)
10. Determination of Activation Energy (ΔE)
11. Estimation of Ferrous ion concentration by Potentiometric Titration
12. Determination of standard electrode potential (Zn, Cu, Ag)
13. Adsorption studies
14. To study the adsorption of Acetic acid on charcoal and construct the isotherm.
15. Determination of pH metric titration of Strong Acid Vs Strong Base
16. Enzyme catalytic reaction by varying pH.
17. Application of Phase Rule to Phenol-Water system
18. To study the inversion of cane sugar by polarimeter.

a. Polarimeter-Inversion of cane sugar
b. Refractometer

ORGANIC
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.
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 salicylic acid from methyl salicylate. 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 : 45 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
PHYSICAL AND ORGANIC
1. Micro Calorimeter
2. Beckman Thermometers. Glasswares,
3. Thermometers 0 to 110 – 0°. Bottle Shakers .pH meters
5. Viscometers-Ostwald Cannan Ubbelholde. Voltage Stabiliser
6. Stalalmometer
7. Surface Tension Meter .Tape Heaters
8. Mantle Heaters
9. DC Power Supply. Thermostat. Cyrostats

OBJECTIVE:
To learn experimentally to calibrate flow meters, find pressure loss for fluid flows and determine pump characteristics and separation characteristics of different mechanical operation separators.

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 settling
13. Drop weight crusher
14. Vacuum leaf filter
15. Ball mill
16. Jaw crusher
17. Screen effectiveness

TOTAL: 45 PERIODS

OUTCOME:
Students will have practical knowledge and hands-on experience on various separation techniques like filtration, sedimentation, screening, elutriation, centrifugation principles which is having wide applications in various industries.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
- Viscometer
- Venturi meter
- Orifice meter
- Rotameter
- Weir
- Open drum with orifice
- Pipes and fittings
- Helical and spiral coils
- Centrifugal pump
- Packed column
- Fluidized bed
- Ball mill
- Jaw crusher
- Leaf filter

MA6459    NUMERICAL METHODS    L T P C
3 1 0 4

OBJECTIVES:
- This course aims at providing the necessary basic concepts of a few numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.

UNIT I    SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS    10+3

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

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

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 9+3

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 (L:45+T:15): 60 PERIODS

OUTCOMES:

- The students will have a clear perception of the power of numerical techniques, ideas and would be able to demonstrate the applications of these techniques to problems drawn from industry, management and other engineering fields.

TEXT BOOKS:

REFERENCES:

PC6501 HEAT TRANSFER L T P C
3 1 0 4

OBJECTIVE:
To make the students to learn heat transfer by conduction, convection and radiation and heat transfer equipments like evaporator and heat exchanger
UNIT I  CONDUCTION  

UNIT II  CONVECTION  

UNIT III  RADIATION  

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

UNIT V  EVAPORATORS  

TOTAL (L : 45 + T : 15) : 60 PERIODS

OUTCOME:  
Students gain knowledge in various heat transfer methodology in process engineering and to design heat transfer equipments such as furnace, boilers, heat exchangers.  

TEXT BOOKS:  

REFERENCES:  
OBJECTIVE:
Students will learn to determine mass transfer rates under laminar and turbulent conditions.

UNIT I  DIFFUSION

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

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

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

UNIT V  HUMIDIFICATION AND CRYSTALLIZATION

TOTAL (L : 45 + T : 15) : 60 PERIODS

OUTCOME:
Students would be able to apply the mass transfer concepts in the designing of humidification columns, dryers and crystallizers.

TEXTBOOKS:

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

UNIT I  ZEROTH AND FIRST LAWS, PROPERTIES OF PURE SUBSTANCES

UNIT II  APPLICATION OF I LAW TO STEADY - STATE PROCESSES, II LAW

UNIT III  POWER CYCLES, THERMODYNAMIC POTENTIALS, EQUILIBRIA AND STABILITY

UNIT IV  PROPERTIES OF PURE COMPONENTS AND MIXTURES

UNIT V  PHASE EQUILIBRIA AND CHEMICAL REACTION EQUILIBRIA
Phase Equilibria of Mixtures. Osmotic pressure and Osmotic coefficients. Boiling point elevation and freezing point depression. Chemical Reaction Equilibria. Reaction extent and Independent reactions. Equilibrium criteria and equilibrium constant. Standard enthalpies and Gibbs free energy, temperature and pressure effects on reactions, heterogeneous reaction, multiple chemical reactions

OUTCOME:
The course will help the students to know about engineering thermodynamics and understand the practical implications of thermodynamic law in engineering design.
TEXT BOOKS:

REFERENCES:

PC6505 NATURAL GAS ENGINEERING

OBJECTIVE:
To enable the students to understand the basic concept and applications of Natural Gas Engineering.

UNIT I PROPERTIES AND COMPOSITION OF NATURAL GAS

UNIT II ESTIMATION AND PRODUCTION OF NATURAL GAS

UNIT III GAS FROM CONDENSATE OIL FIELDS
Processing of condensate well fluids – Cycling of gas condensate reservoirs – Sweep patterns – Katy cycling plant.

UNIT IV ACID GAS TREATING OF NATURAL GAS
Acid gas removal: Metal oxide process – Slurry process – Amine process – Carbonate washing process – Methanol based process and other process – Sulphur recovery process.

UNIT V DEHYDRATION OF NATURAL GAS AND NGL RECOVERY

TOTAL : 45 PERIODS

OUTCOME:
At the end of this course, the students learn the Natural gas processing, Gas Compression, Gas Gathering and Transport Installation, Operation and trouble shooting of natural gas pipelines.

TEXT BOOKS:
REFERENCES:

PC6503 PETROLEUM EXPLORATION AND EXPLOITATION TECHNIQUES

OBJECTIVE:
To make the students understand the stages of oil and gas exploration and production

UNIT I ORIGIN AND OCCURRENCE OF PETROLEUM AND SEDIMENTARY ENVIRONMENT

UNIT II EXPLORATION METHODS, WELL PROGNOSIS AND ECONOMIC ANALYSIS

UNIT III GEOLOGICAL STRUCTURE AND GEOLOGGING

UNIT IV DRILLING FLUIDS AND WORK COMPLETION

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

TOTAL (L : 45 + T :15) : 60 PERIODS

OUTCOME:
The student will know different geological and geophysical methods for exploration and exploitation of oil and gas

TEXT BOOKS:

REFERENCES:

CH6411 TECHNICAL ANALYSIS LABORATORY

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

LIST OF EXPERIMENTS

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
OUTCOME:
At the end of this practical course, the student would have a thorough understanding on the estimation and analysis of chemical compounds.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
1. Silica Crucible
2. Heating Mantle
3. Muffle Furnace
4. Hot air oven
5. Desiccator
6. Vacuum pump
7. Condenser
8. Reflux Condenser
9. Pensky martens closed cup apparatus
10. Cleveland open cup apparatus
11. Cloud point apparatus
12. Aniline point apparatus
13. Saybolt Viscometer
14. Redwood viscometer
15. Bomb Calorimeter
16. Junkers gas Calorimeter
17. Conductivity meter
18. pH meter

GE6674 COMMUNICATION AND SOFT SKILLS: LABORATORY BASE

OBJECTIVES:
To enable learners to,

- Develop their communicative competence in English with specific reference to speaking and listening
- Enhance their ability to communicate effectively in interviews.
- Strengthen their prospects of success in competitive examinations.

UNIT I LISTENING AND SPEAKING SKILLS
Conversational skills (formal and informal)- group discussion- making effective presentations using computers, listening/watching interviews conversations, documentaries. Listening to lectures, discussions from TV/ Radio/ Podcast.

UNIT II READING AND WRITING SKILLS
Reading different genres of tests ranging from newspapers to creative writing. Writing job applications- cover letter- resume- emails- letters- memos- reports. Writing abstracts- summaries- interpreting visual texts.

UNIT III ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS AND PLACEMENTS
International English Language Testing System (IELTS) - Test of English as a Foreign Language (TOEFL) - Civil Service(Language related)- Verbal Ability.
UNIT IV INTERVIEW SKILLS
Different types of Interview format- answering questions- offering information- mock interviews-body language(paralinguistic features)- articulation of sounds- intonation.

UNIT V SOFT SKILLS
Motivation- emotional intelligence-Multiple intelligences- emotional intelligence-managing changes-time management-stress management-leadership straits-team work-career planning - intercultural communication- creative and critical thinking

TOTAL: 60 PERIODS

Teaching Methods:
1. To be totally learner-centric with minimum teacher intervention as the course revolves around practice.
2. Suitable audio/video samples from Podcast/YouTube to be used for illustrative purposes.
3. Portfolio approach for writing to be followed. Learners are to be encouraged to blog, tweet, text and email employing appropriate language.
4. GD/Interview/Role Play/Debate could be conducted off the laboratory (in a regular classroom) but learners are to be exposed to telephonic interview and video conferencing.
5. Learners are to be assigned to read/write/listen/view materials outside the classroom as well for graining proficiency and better participation in the class.

Lab Infrastructure:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description of Equipment (minimum configuration)</th>
<th>Qty Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Server</strong>&lt;br&gt;• PIV System&lt;br&gt;• 1 GB RAM / 40 GB HDD&lt;br&gt;• OS: Win 2000 server&lt;br&gt;• Audio card with headphones&lt;br&gt;• JRE 1.3</td>
<td>1 No.</td>
</tr>
<tr>
<td>2</td>
<td><strong>Client Systems</strong>&lt;br&gt;• PIII or above&lt;br&gt;• 256 or 512 MB RAM / 40 GB HDD&lt;br&gt;• OS: Win 2000&lt;br&gt;• Audio card with headphones&lt;br&gt;• JRE 1.3</td>
<td>60 Nos.</td>
</tr>
<tr>
<td>3</td>
<td>Handicam</td>
<td>1 No.</td>
</tr>
<tr>
<td>4</td>
<td>Television 46”</td>
<td>1 No.</td>
</tr>
<tr>
<td>5</td>
<td>Collar mike</td>
<td>1 No.</td>
</tr>
<tr>
<td>6</td>
<td>Cordless mike</td>
<td>1 No.</td>
</tr>
<tr>
<td>7</td>
<td>Audio Mixer</td>
<td>1 No.</td>
</tr>
<tr>
<td>8</td>
<td>DVD recorder/player</td>
<td>1 No.</td>
</tr>
<tr>
<td>9</td>
<td>LCD Projector with MP3/CD/DVD provision for Audio/video facility</td>
<td>1 No.</td>
</tr>
</tbody>
</table>
Evaluation:

Internal: 20 marks

Record maintenance: Students should write a report on a regular basis on the activities conducted, focusing on the details such as the description of the activity, ideas emerged, learning outcomes and so on. At the end of the semester records can be evaluated out of 20 marks.

External: 80 marks

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online Test</td>
<td>35</td>
</tr>
<tr>
<td>Interview</td>
<td>15</td>
</tr>
<tr>
<td>Presentation</td>
<td>15</td>
</tr>
<tr>
<td>Group Discussion</td>
<td>15</td>
</tr>
</tbody>
</table>

Note on Internal and External Evaluation:

1. Interview – mock interview can be conducted on one-on-one basis.
2. Speaking – example for role play:
   a. Marketing engineer convincing a customer to buy his product.
   b. Telephonic conversation- fixing an official appointment / placing an order / enquiring and so on.
3. Presentation – should be extempore on simple topics.
4. Discussion – topics of different kinds; general topics, and case studies.

OUTCOMES:

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

- Take international examination such as IELTS and TOEFL
- Make presentations and Participate in Group Discussions.
- Successfully answer questions in interviews.

REFERENCES:

2. Graded Examinations in Spoken English and Spoken English for Work downloadable materials from Trinity College, London.
4. Interactive Multimedia Programs on Managing Time and Stress.

Web Sources:
http://www.slideshare.net/rohitjsh/presentation-on-group-discussion
http://www.washington.edu/doit/TeamN/present_tips.html
http://www.oxforddictionaries.com/words/writing-job-applications
http://www.kent.ac.uk/careers/cv/coveringletters.htm
http://www.mindtools.com/pages/article/newCDV_34.htm
OBJECTIVE:
To introduce of open and closed loop systems and its responses, control loop components and stability of control systems along with instrumentation.

UNIT I  INSTRUMENTATION  9
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  9
Laplace transformation and its application in process control. 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 controllers Z-N tuning rules, C-C tuning rules.

UNIT V  ADVANCED CONTROL SYSTEMS  8
Introduction to advanced control systems, cascade control, feed forward control, Smith predictor, control of distillation towers and heat exchangers, introduction to computer control of chemical processes.

TOTAL : 45 PERIODS

OUTCOME:
Students will Understand and discuss the importance of process control in process operation and the role of process control engineers They know the design of modern hardware and instrumentation needed to implement process control.

TEXT BOOKS:

REFERENCES:
AIM
To impart knowledge on different staged mass transfer operations.

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

UNIT I  
ABSORPTION  
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  
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 McCabe - 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  
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  
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  
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.

TOTAL : 45 PERIODS

OUTCOME:
Students develop a sound knowledge on the types of Mass Transfer through a driving force in the same fashion as temperature differences as driving force for heat transfer. The students shall have an elementary knowledge on fluid flow, heat transfer and stoichiometry.

TEXT BOOKS:

REFERENCES:

PC6603 CHEMICAL REACTION ENGINEERING – I

OBJECTIVE:
To enable the students to gain knowledge on different types of chemical reactors, the design of chemical reactors under isothermal and non-isothermal conditions

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

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

UNIT IV
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
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 : 45 PERIODS

OUTCOME:
At the end of this course, the students would gain knowledge on the selection of reactor for the required reaction.

TEXT BOOKS:
REFERENCE:

PC6604 PROCESS EQUIPMENT DESIGN AND DRAWING - I L T P C 3 0 0 3

OBJECTIVE:
To develop skill to design and install process equipments used widely in a chemical industry.

UNIT I DESIGN OF PIPE FITTINGS AND JOINTS 9
Design and schematic of simple bolts and screws – Riveted joints – Design and drawing of shafts and couplings.

UNIT II DESIGN OF REACTION VESSEL AND STORAGE TANK 9
Design and schematic of storage tank, (vertical and horizontal) supports, agitated vessel.

UNIT III DESIGN OF HIGH PRESSURE SYSTEMS 9
Design of high pressure vessels and reactors.

UNIT IV DESIGN OF PHASE SEPARATION EQUIPMENT 9
Design of physical separation equipments such as cyclones, centrifuges, thickeners, filtration equipment

UNIT V DRAWING OF HEAT EXCHANGERS AND COLUMNS 9
Drawing of physical process equipments such as double pipe heat exchangers – Shell and tube heat exchangers – Plate and frame heat exchangers – Distillation columns and reactors.

TOTAL : 45 PERIODS

OUTCOME:
Students would develop skill to design and install process equipments used widely in a chemical industry.

TEXT BOOKS:

REFERENCES:
PC6605 PETROCHEMICAL UNIT PROCESSES L T P C
3 0 0 3

OBJECTIVE:
To design and conduct experiments and analyze and interpret data related to petrochemical Unit processes

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

UNIT II SYNTHESIS GAS PRODUCTION
Steam reforming of Natural gas – Naphtha and Heavy distillate to produce Hydrogen and Synthesis gas – Production of Methanol – Oxo process.

UNIT III UNIT PROCESSES I
Fundamental and Technological principled involved in Alkylation – Oxidation – Nitration and Hydrolysis.

UNIT IV UNIT PROCESSES II
Fundamental and Technological principled involved in Sulphonation, Sulfation and Isomerisation.

UNIT V UNIT PROCESSES III
Fundamental and Technological principles involved in Halogenation and Esterification

TOTAL : 45 PERIODS

OUTCOME:
Students would be able to understand the principles of various unit processes in the petrochemical industry.

TEXT BOOKS:

REFERENCES:
OBJECTIVE:
To make the students to learn the testing of petroleum products, crude processing and treatment techniques

UNIT I   GENERAL

UNIT II   TESTING OF PETROLEUM PRODUCTS

UNIT III   CRUDE PROCESSING

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

UNIT V   BITUMEN PROCESSING and FINAL TREATMENT TECHNIQUES
Asphalt manufacture, Air blowing technology, Bitumen Types and their properties, Acid gas removal and sulphur removal techniques.

TOTAL : 45 PERIODS

OUTCOME:
Students will be able to understand the principles of crude processing and various treatment techniques.

TEXT BOOKS:

REFERENCES:
OBJECTIVE:
To determine experimentally the methods of controlling the processes including measurements using process simulation techniques.

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 thermal system
6. Closed loop study on a level system
7. Closed loop study on a flow system
8. Closed loop study on a thermal system
9. Tuning of a level system
10. Tuning of a pressure system
11. Tuning of a thermal system
12. Flow co-efficient of control valves
13. Characteristics of different types of control valves
14. Closed loop study on a pressure system
15. Tuning of pressure system
16. Closed loop response of cascade control system

*Minimum 10 experiments shall be offered.

TOTAL : 45 PERIODS

OUTCOME:
Students gain knowledge on the development and use of right type of control dynamics for process control under different operative conditions.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. U tube manometer with controller
2. Interacting Tank
3. Non Interacting Tank
4. Open loop control system
5. Closed loop control system
6. ON/OFF controller
7. Control valve characteristics
8. Pressure Tuner
9. Temperature Tuner
10. Proportional Controller
11. Flow Transmitter
12. Level Transmitter
13. Cascade control system

(Any Ten experiments)
OBJECTIVE:
To train the students to have sound working knowledge on different types of heat transfer & Mass Transfer equipments.

LIST OF EXPERIMENTS
1. Transient state heat conduction
2. Solvent extraction
3. Batch drying
4. Temperature profile of a rod
5. Natural convection
6. Thermal conductivity of composite wall
7. Emissivity measurement
8. Measurement of diffusion coefficient
9. Simple distillation
10. Leaching
11. Adsorption
12. Double pipe heat exchanger

TOTAL : 45 PERIODS

OUTCOME:
Student would be able to calculate heat transfer by conduction, different types of convection using classical models for these phenomena. They will have knowledge on the determination of important data for the design and operation of the process equipment’s like distillation, extraction, diffusivity, drying principles which are having wide applications in various industries

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
1. Data Logger
2. Heat Exchanger
3. Condenser
4. Thermal conductivity measurement apparatus
5. Soxlet Extractor
6. Rotating Disc Contactor
7. Controllers of Temperature
8. Convection Apparatus
9. Emissivity measurement apparatus
10. Distillation Apparatus
11. Double pipe heat exchanger
12. Diffusion Apparatus

REFERENCE:
1. Laboratory Manual prepared by Faculty

PC6701 PROCESS EQUIPMENT DESIGN AND DRAWING - II L T P C
3 0 2 4

(All Tables/Chemical Engineers’ Handbook/Data Books/Graph Sheets are permitted)
AIM
To impart practical knowledge on the shape and drawing of the process equipments

OBJECTIVE:
To become a design engineers on process equipments design and drawing consideration of the following:

UNIT I THERMODYNAMIC PROPERTIES EVALUATION FOR DESIGN 9
Physical properties evaluation, Thermodynamic properties of gases and binary mixtures–
Methods of calculations –Vapor-liquid equilibrium data for ideal and non-ideal mixtures.
Bubble points and dew points, flash distillation calculation.

UNIT II HEAT EXCHANGER DESIGN 9
Design of double pipe heat exchangers, Heat exchanger types and its selection – shell
and tube heat exchangers and Condensers – Effectiveness – NTU method of heat
exchanger analysis.

UNIT III EVAPORATOR DESIGN 9
Steam – Uses of steam – Outstanding qualities of steam – BPE – Duhring’s rule –
Principle of multiple effect evaporation – Temperature driving force – Evaporators types
and its selection – Design of single and multiple effect evaporators.

UNIT IV COLUMN DESIGN 9
Design of distillation columns and Absorption columns.

UNIT V PUMPS, FANS AND COMPRESSORS 9
Pumps, fans and compressors – Types and its applications – Characteristics – Piping
and pressure drop calculations – Performance analysis of pumps, fans and compressors.

OUTCOME:
Students would gain knowledge to develop key concepts and techniques to design the
process equipment in a process plant. These key concepts would be utilized to make
design and operating decisions.

TEXT BOOKS:
1990.

REFERENCES:
2. Robert H. Perry and Don W. Green, “Perry’s Chemical Engineer’s Hand Book”, 7th
AIM
To introduce the students about heterogeneous reactors and catalytic reactions in reactors.

OBJECTIVE:
The objective is to study the gas-solid catalytic and non-catalytic reactors and gas-liquid reactors.

UNIT I NON – IDEAL REACTORS 9
Residence time distribution function and its measurement – Characteristics of tracer – Mean residence time – Conversion in non-ideal flow reactors.

UNIT II HETEROGENEOUS PROCESS AND SOLID CATALYSIS 9
Rate equation for heterogeneous reactions – Nature of catalysis – Adsorption isothermal and rates of adsorption – Desorption and surface reaction analysis of rate equation – Rate controlling steps.

UNIT III GAS – SOLID CATALYTIC REACTORS 9

UNIT IV GAS – SOLID NON – CATALYTIC REACTORS 9

UNIT V GAS – LIQUID REACTIONS 9

TOTAL : 45 PERIODS

OUTCOME:
Students would have the ability to determine experimentally the kinetics and rate constants of reactions in different types of reactors. These studies have wide applications in various process industries.

TEXT BOOKS:

REFERENCES:
OBJECTIVE:
To impart knowledge on different types of petrochemicals

UNIT I  FIRST GENERATION PETROCHEMICALS 1
Alternate routes with flow diagram for production of methane, ethane, propane, ethylene, propylene, butylenes, acetylene, naphthalene. Chemicals from methane, ethane, propane, ethylene, propylene, butylenes, acetylene.

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

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

UNIT IV  THIRD GENERATION PETROCHEMICALS I
Polymerization – Modes and techniques – Production of polyethylene – LDPE, HDPE, polypropylene, poly butadiene rubber, SBR, polystyrene, SAN, ABS.

UNIT V  THIRD GENERATION PETROCHEMICALS II
Polyacrylonitrile, polyvinyl chloride, polycarbonates, nylon 6, nylon 66, polyesters, formaldehyde resins, explosives, dyes.

TOTAL : 45 PERIODS

OUTCOME:
Upon completion of this course, the students will know the sources and production methods of petrochemicals and the methods of manufacture of different petrochemicals from additives to electronic chemicals.

TEXT BOOKS:

REFERENCES:
Students will learn the refining operations like cracking, reforming, alkylation, isomerization and coking.

**UNIT I   CRACKING**  

**UNIT II   CATALYTIC REFORMING**  

**UNIT III   ALKYLATION AND ISOMERIZATION**  

**UNIT IV   COKING**  
Methods of Petroleum Coke Production – Koppers, Thermal Cracking, Delayed Coking, Fluid Coking and Contact Coking. Hydro Cracking principles, reactions in Hydro Cracking, Catalyst, Hydro Cracking Reaction Conditions, Iso Max Processes and Hydro Desulphurization Processes.

**UNIT V   ASPHALT TECHNOLOGY**  

**OUTCOME:**
Student would attain detailed knowledge on petroleum refining operations as this course being the second part of the three parts series.

**TEXT BOOKS:**

**REFERENCES:**
OBJECTIVES:
To enable the students to understand
- Different types of fluids, their flow characteristics and different mathematical models applied to actual situations
- Mechanism of fluids in motion under different conditions.

UNIT I TRANSPORT PHENOMENA BY MOLECULAR MOTION
Importance of transport phenomena; analogous nature of transfer process; basic concepts, conservation laws; continuous concept, field, reference frames, substantial derivative and boundary conditions; methods of analysis; differential, integral and experimental methods.
Phenomenological laws of transport properties Newtonian and non Newtonian fluids; rheological models; theories of transport properties of gases and liquids; effect of pressure and temperature.

UNIT II ONE DIMENSIONAL TRANSPORT IN LAMINAR FLOW (SHELL BALANCE)
General method of shell balance approach to transfer problems; Choosing the shape of the shell; most common boundary conditions; momentum flux and velocity distribution for flow of Newtonian and non-Newtonian fluids in pipes for flow of Newtonian fluids in planes, slits and annulus heat flux and temperature distribution for heat sources such as electrical, nuclear viscous and chemical; forced and free convection; mass flux and concentration profile for diffusion in stagnant gas, systems involving reaction and forced convection.

UNIT III EQUATIONS OF CHANGE AND THEIR APPLICATIONS
Conservation laws and equations of change; Development of equations of continuity motion and energy in single multicomponents systems in rectangular co-ordinates and the forms in curvilinear co-ordinates; simplified forms of equations for special cases, solutions of momentum mass and heat transfer problems discussed under shell balance by applications of equation of change, scale factors; applications in scale-up

UNIT IV TRANSPORT IN TURBULENT AND BOUNDARY LAYER FLOW
Turbulents phenomena; phenomenological relations for transfer fluxes; time smoothed equations of change and their applications for turbulent flow in pipes; boundary layer theory; laminar and turbulent hydrodynamics thermal and concentration boundary layer and their thicknesses; analysis of flow overflat surface.

UNIT V ANALOGIES BETWEEN TRANSPORT PROCESSES
Importance of analogy; development and applications of analogies between momentum and mass transfer; Reynolds, Prandtl, Von Karman and Colbum analogies.

OUTCOME:
Students would gain the knowledge of fundamental connections between the conservation laws in heat, mass, and momentum in terms of vector and tensor fluxes. The students would be able to understand the mechanism of fluids in motion under different conditions

TOTAL: 45 PERIODS

TEXT BOOKS:
REFERENCES:

PC6711 PETROLEUM PRODUCT TESTING LABORATORY

OBJECTIVE:
To learn basic principles involved in determination of flash point, cloud point, aniline point, viscosity etc.

LIST OF EXPERIMENTS

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

TOTAL: 45 PERIODS

OUTCOME:
Students would have knowledge about the lubricants and use of right type of lubricant in different machines.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. Abel's Flash point apparatus
2. Penky morten Flash point apparatus
3. Red wood viscometer
4. Sayboh viscometer
5. Cloud and pour point apparatus.
OBJECTIVE:
To impart knowledge on design of reactors.

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

TOTAL: 45 PERIODS

OUTCOME:
Students would get a sound working knowledge on different types of reactors.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
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.

PC6801  SAFETY AND RISK MANAGEMENT IN INDUSTRIES  L T P C
3 0 0 3

OBJECTIVE:
Students will learn about implementation of safety procedures, risk analysis and assessment and hazard identification

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

UNIT II  HAZARD IDENTIFICATION AND CONTROL
UNIT III RISK MANAGEMENT

UNIT IV SAFETY PROCEDURES

UNIT V SAFETY IN HANDLING AND STORAGE OF CHEMICALS
Safety measures in handling and storage of chemicals – Fire chemistry and its control Personnel protection – Safety color codes of chemicals.

TOTAL : 45 PERIODS

OUTCOME:
Students get acquainted with risk assessment, process safety auditing and management systems in the petrochemical Industry

TEXT BOOKS:

REFERENCES:

PM6603 WATER TREATMENT AND MANAGEMENT

OBJECTIVE:
To focus on the wastewater transport system and the theory and design technique for the wastewater treatment process

UNIT I INTERNAL TREATMENT PROCESS

UNIT II EXTERNAL TREATMENT PROCESS

UNIT III BOILER WATER AND COOLING WATER
UNIT IV WASTE WATER TREATMENT

UNIT V WATER MANAGEMENT IN INDIA

OUTCOME:
The students would have learnt the physical/chemical/biological characteristics and evaluation technique for sewage. They would understand the theory, engineering application, and design technique for the wastewater treatment unit process.

TEXT BOOKS:

REFERENCES:

CH6002 FLUIDIZATION ENGINEERING L T P C
3 0 0 3

OBJECTIVE:
To enable the students to learn the design aspects of fluidized beds.

UNIT BASICS OF FLUIDIZATION
Packed bed – Velocity – Pressure drop relations – Correlations of Ergun, Koznekyarman – On set of fluidization – Properties of fluidized beds – Development of fluidization from fixed bed.

UNIT II FLUIDIZED BED TYPES

UNIT III DESIGN ASPECTS

UNIT IV HEAT AND MASS TRANSFER IN FLUIDIZED BEDS
Heat and mass transfer in fluidized bed systems – Industrial applications and case studies of fluidized bed systems.
UNIT V  OTHER TYPES OF FLUIDIZATION  9
Single stage and multistage fluidization – Collection of fines – Use of cyclones.

TOTAL : 45 PERIODS

OUTCOME:
Upon completion of this course, the students will have the knowledge on fluidization phenomenon, behavior of fluidized beds and industrial applications.

TEXT BOOKS:

REFERENCES:
TEXT BOOKS:

REFERENCES:

MG6091                  INDUSTRIAL MANAGEMENT                              L T P C
                                      3 0 0 3

OBJECTIVE:
• To provide an opportunity to learn basic management concepts essential for business.

UNIT I               INTRODUCTION

UNIT II              FUNCTIONS OF MANAGEMENT

UNIT III             ORGANIZATIONAL BEHAVIOUR
UNIT IV  GROUP DYNAMICS  9

UNIT V  MODERN CONCEPTS  9

TOTAL : 45 PERIODS

OUTCOME :
- Students gain knowledge on the basic management principles to become management(s) professional.

TEXTBOOKS:

REFERENCES:

PC6003  PROCESS OPTIMIZATION  L T P C
3 0 0 3

OBJECTIVE:
To expose the students with various mathematical methods for numerical analysis and use of software tools.

UNIT I  OPTIMISATION  15
Introduction; formulation of objective functions; fitting models to data; classification of functions; necessary and sufficient conditions for optimum; unimodal, multimodal functions; analytical methods lagrange multiplier methods.

UNIT II  NUMERICAL METHODS  15
Unimodel functions; newton’s quasi newton, secant methods; region elimination methods, polynomial approximation; quadratic and cubic interpolation techniques for optimum. Multimodal functions; direct methods; random, grid. Hooke’s nelder and mead methods; Powell’s technique; indirect methods; gradient and conjugate gradient methods; secant
methods.

UNIT III  LINEAR AND NON-LINEAR PROGRAMMING APPLICATIONS  15
Review on basic concepts of LP formulations; Simplex methods; Integer, quadratic, geometric and dynamic programming. Heat transfer and energy conservation; separation processes; fluid flow systems; reactor design and operation; large scale systems.

TOTAL : 45 PERIODS

OUTCOME:
Fully understand key concepts of separation processes including equilibrium stages, reflux, countercurrent contacting, limiting cases, efficiency and mass transport effects.

TEXT BOOKS:

REFERENCES:

PC6004  NOVEL SEPARATION PROCESSES  L T P C
3 0 0 3

OBJECTIVE :
To teach the principle and technical concept of advanced separation processes.

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.

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
OUTCOME:
The students would have fully understood the key concepts of separation processes including equilibrium stages, reflux, countercurrent contacting, limiting cases, efficiency and mass transport effects at the end of this course.

TEXTBOOKS:

REFERENCE:

GE6083 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

UNIT I INTRODUCTION TO DISASTERS
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)
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
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
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

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

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.

TEXTBOOKS:


REFERENCES

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
UNIT I  ENERGY RESOURCES – A GLOBAL VIEW

UNIT II  ENERGY AND ENVIRONMENT

UNIT III  MANAGEMENT OF ENERGY CONSERVATION IN CHEMICAL INDUSTRIES
Chemical industries – Classification – Conservation in unit operation such as separation – Cooling tower – Drying – Conservation applied to refineries, petrochemical, fertilizers, cement, pulp and paper, food industries – Chloroalkali industries – Conservation using optimization techniques.

UNIT IV  ENERGY ALTERNATIVES

UNIT V  ECONOMIC BALANCE IN ENERGY CONSUMPTION

TOTAL : 45 PERIODS

OUTCOME:
Students will have the ability to apply the fundamentals of energy conversion and applications.

TEXT BOOKS:

REFERENCES:

GE6757  TOTAL QUALITY MANAGEMENT
OBJECTIVE:
- To facilitate the understanding of Quality Management principles and process.

UNIT I  INTRODUCTION
Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus -
Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality.

UNIT II  TQM PRINCIPLES  9
Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

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

UNIT IV  TQM TOOLS AND TECHNIQUES II  9

UNIT V  QUALITY SYSTEMS  9

TOTAL: 45 PERIODS

OUTCOME :
• The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXTBOOK:

REFERENCES:

CH6009  FERTILIZER TECHNOLOGY  L T P C
3 0 0 3

OBJECTIVE:
To enable the students to learn the fertilizer manufacturing including new or modified fertilizer products and new techniques.

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

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

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

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

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

TOTAL: 45 PERIODS

OUTCOME:
Upon completion of this course, the students will be able to understand the chemical technology of various fertilizers and their methods of production, characteristics and specification.

TEXT BOOKS:

REFERENCES:

PC6006  MULTICOMPONENT DISTILLATION  L T P C
3 0 0 3

OBJECTIVE:
To enable the students to understand the concepts of multicomponent distillation systems.

UNIT I  THERMODYNAMIC PRINCIPLES  9

UNIT II  THERMODYNAMIC PROPERTY EVALUATION  9
Fundamental principles involved in the separation of multi component mixtures – Determination of bubble-point and Dew Point Temperatures for multi component mixtures.
– equilibrium flash distillation calculations for multi component mixtures – separation of multi component mixtures at total reflux.

UNIT III MINIMUM REFLUX RATIO FOR MCD SYSTEM

UNIT IV VARIOUS METHODS OF MCD COLUMN DESIGN
Theta method of convergence – Kb method and the constant composition method – Application of the Theta method to complex columns and to system of columns – Lewis Matheson method –Stage and reflux requirements – Short cut methods and Simplified graphical procedures.

UNIT V VARIOUS TYPES OF MCD COLUMNS
Design of sieve, bubble cap, valve trays and structured packing columns for multi component distillation – computation of plate efficiencies.

TOTAL: 45 PERIODS

OUTCOME:
Students will be able to design multicomponent distillation unit. They also have learnt about various types of MCD column.

TEXT BOOKS:

REFERENCES:

OBJECTIVE:
To make the students understand about combustion and furnace design and selection of thermal and mechanical energy equipment.

UNIT I COMBUSTION STOICHIOMETRY
Stoichiometry relations – Theoretical air required for complete combustion – Calculation of minimum amount of air required for a fuel of known composition – Calculation of dry flue gases if fuel composition is known – Calculation of the composition of fuel and excess air supplied, from exhaust gas analysis – Dew point of products – Flue gas analysis (O2, CO2, CO, NOX, SOX).

UNIT II COMBUSTION THERMODYNAMICS AND KINETICS
Combustion reaction – Reaction kinetics – Rate of reaction – Mass and energy balance of chemical reactions – First and second law analysis of combustion system – Adiabatic flame temperature- Calculation of equilibrium composition and temperature.
UNIT III  
TUBESTILL HEATERS  
9

UNIT IV  
HEAT TREATMENT FURNACE  
9

UNIT V  
BURNER DESIGN  
9

OUTCOME:
By completing this module, the students will become familiar with
- All aspects of the combustion furnace process, specifically the equipment used in the process
- Fundamental concepts related to the sub-processes.

TEXT BOOKS:

REFERENCES:
UNIT II  ADDITION POLYMERIZATION  12
Chemistry of Olefins and Dienes – double bonds – Chemistry of free radicals –
monomers – functionality – Polymerization: Initiation – types of initiation – free radical
polymerization – cationic polymerization – anionic polymerization – coordination
polymerization – industrial polymerization – bulk, emulsion, suspension and solution
polymerization techniques – Kinetics – Copolymerization concepts.

UNIT III  CONDENSATION POLYMERIZATION  9
Simple condensation reactions – Extension of condensation reactions to polymer
synthesis – functional group reactivity – polycondensation – kinetics of polycondensation-
Carother’s equation – Linear polymers by polycondensation – Interfacial polymerization –
crosslinked polymers by condensation – gel point.

UNIT IV  MOLECULAR WEIGHTS OF POLYMERS  9
Difference in molecular weights between simple molecules and polymers – number
average and weight average molecular weights – Degree of polymerization and
molecular weight – molecular weight distribution – Polydispersity – molecular weight
determination. Different methods – Gel Permeation Chromatography – Osmometry, Light
Scattering.

UNIT V  TRANSITIONS IN POLYMERS  9
First and second order transitions – Glass transition, Tg – multiple transitions in polymers
– experimental study – significance of transition temperatures – crystallinity in polymers –
effect of crystallization – in polymers – factors affecting crystallization crystal nucleation
and growth – relationship between Tg and Tm – Relationship between properties and
crystalline structure.

TOTAL: 45 PERIODS

OUTCOME:
Upon completion of this course, the student will be able to explain different types of
polymerizations and computation of molecular weight of polymers.

TEXTBOOKS:
2. Seymour.R.B., and Carraher.C.E., Jr., Polymer Chemistry, 2nd Ed., Marcel Dekker,

REFERENCES:
   5th edition, Tayloran

CH6016  PROCESS MODELLING AND SIMULATION  L T P C
3 0 0 3

OBJECTIVE:
To give an overview of various methods of process modeling, different computational
techniques for simulation. The focus shall be on the techniques themselves, rather than
specific applications so that the student can take up modeling and simulation challenges
in his profession.

UNIT I  INTRODUCTION  6
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  8
Analysis of compressible flow, heat exchanger, packed columns, plug flow reactor, solution of ODE boundary value problems.

UNIT V  UNSTEADY STATE DISTRIBUTED SYSTEM & OTHER MODELLING APPROACHES  13

TOTAL : 45 PERIODS

OUTCOME:
Upon completing the course, the student should have understood the development of process models based on conservation principles and process data and computational techniques to solve the process models.

TEXT BOOKS:

REFERENCES:

GE6084  HUMAN RIGHTS  L T P C  3 0 0 3

OBJECTIVES:
• To sensitize the Engineering students to various aspects of Human Rights.
UNIT I

UNIT II

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

UNIT IV
Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V

TOTAL : 45 PERIODS

OUTCOME :
• Engineering students will acquire the basic knowledge of human rights.

REFERENCES: