Chemical Engineering (B. Tech)

CHOICE BASED CREDIT SYSTEM (CBCS)

Syllabus 2016-2017

DEPARTMENT CHEMICAL ENGINEERING

ENGINEERING

KARPAGAM ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)
Pollachi Main Road, Eachanari (Post), Coimbatore- 641021, TamilNadu, India

Phone: 0422–2980011 –15 FaxNo: 0422–2980022-23
Email: info@karpagam.com Web: www. kahedu.edu.in
SEMESTER I

17BTCC101 ENGLISH FOR ENGINEERS 3 0 0 3

OBJECTIVES:

1. To enable students to attain fluency and accuracy to inculcate proficiency in professional communication to meet the growing demand in the field of Global communication.
2. To help students acquire their ability to speak effectively in real life situations.
3. To inculcate the habit of reading and to develop their effective reading skills.
4. To ensure that students use dictionary to improve their active and passive vocabulary.
5. To enable students to improve their lexical, grammatical and communicative competence.

INTENDED OUTCOMES:

Students undergoing this course will be able to

1. Use English language for communication: verbal & non-verbal.
2. Enrich comprehension and acquisition of speaking & writing ability.
4. Improve word power: lexical, grammatical and communication competence.

Unit- I LSRW SKILLS & GRAMMAR

Receptive Skills (Listening, Reading and Scanning) & Productive Skills (Writing, Speaking and Representing) (9)

Listening – Types of listening- Listening to class reading - Video tapes/ Audio tapes. Speaking – Introduction on self. Reading - Reading for comprehension – Reading different kind of passages like descriptive, narrative, objective, conversational and argumentative. Writing – Formal and Informal letters- Letters to the Editor.

Grammar&Vocabulary (Function Grammar & Technical Vocabulary)

Tenses - Articles. Vocabulary - Word Formation – Word expansion (Root word) - Prefix and Suffix.

Unit – II LSRW SKILLS & GRAMMAR

Receptive Skills (Listening, Reading and Scanning) & Productive Skills (Writing, Speaking and Representing) (8)


Grammar&Vocabulary (Function Grammar & Technical Vocabulary)

WH questions – Yes/No Question - Subject Verb agreement. Vocabulary– Compound Nouns/Adjectives – Irregular verbs.

Unit - III LSRW SKILLS & GRAMMAR

Receptive Skills (Listening, Reading and Scanning) & Productive Skills (Writing, Speaking and Representing) (8)


Grammar&Vocabulary (Function Grammar & Technical Vocabulary)
Unit- IV   LSRW SKILLS & GRAMMAR, CAREER ORIENTED

Receptive Skills (Listening, Reading and Scanning) & Productive Skills (Writing, Speaking and Representing) (10)

Listening – Responding to questions – Reading in class for complete understanding and for better pronunciation. Speaking – Debate- Presentations in seminars. Reading – Making inference from the reading passage – Predicting the content of reading passages. Writing - Interpreting visual materials (tables, graphs, charts, etc) & Instruction writing.

Grammar & Vocabulary (Function Grammar & Technical Vocabulary)
Parts of Speech, Sentence pattern – Voice (active and passive voice). Vocabulary – One word substitution.

Unit- V

LSRW SKILLS & GRAMMAR, FIELD WORK

Receptive Skills (Listening, Reading and Scanning) & Productive Skills (Writing, Speaking and Representing) (10)


Grammar & Vocabulary (Function Grammar & Technical Vocabulary)
Direct and Indirect speech – Conditional sentences - Auxiliary verbs. Vocabulary – Abbreviations & Acronyms.

Note: Students shall have hands on training in improving listening skill in the language laboratory @ 2 periods per each unit.

Total- 45

TEXT BOOK:

<table>
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<tr>
<th>S. NO.</th>
<th>AUTHOR(S) NAME</th>
<th>TITLE OF THE BOOK</th>
<th>PUBLISHER</th>
<th>YEAR OF PUBLICATION</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Sangeeta Sharma, Meenakshi Raman</td>
<td>Technical Communication: Principles And Practice 2nd Edition</td>
<td>OUP, New Delhi.</td>
<td>2015</td>
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<tbody>
<tr>
<td>3</td>
<td>Rutherford Andrea, J.</td>
<td>Basic Communication</td>
<td>Pearson Education,</td>
<td>2006</td>
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<td>WEBSITES:</td>
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<td><a href="http://www.learnerstv.com">www.learnerstv.com</a> – Listening/ Speaking/ Presentation</td>
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<td><a href="http://www.usingenglish.com">www.usingenglish.com</a> – Writing/ Grammar</td>
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<td><a href="http://www.englishclub.com">www.englishclub.com</a> – Vocabulary Enrichment/ Speaking</td>
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<td><a href="http://www.ispeakyouspeak.blogspot.com">www.ispeakyouspeak.blogspot.com</a> – Vocabulary Enrichment/ Speaking</td>
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<td><a href="http://www.teachertube.com">www.teachertube.com</a> – Writing Technically</td>
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OBJECTIVES:

1. To develop analytical skills for solving different engineering problems.
2. To understand the concepts of Matrices and vector differentiation.
3. To solve problems by applying Differential Calculus and Differential equations.

INTENDED OUTCOMES:

The student will be able to

1. apply advanced matrix knowledge to Engineering problems.
2. improve their ability in solving geometrical applications of differential calculus problems.
3. improve their ability in vector differentiation.

UNIT I MATRICES (12)

UNIT II DIFFERENTIAL CALCULUS (12)
Limits, Continuity (Concepts only)- Differentiation- Differentiation Techniques: standard formulae, product rule, quotient rule, chain rule, method of substitution, implicit functions and successive differentiation.

UNIT III GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS (12)
Curvature – centre, radius and circle of curvature in Cartesian co- ordinates – Evolutes - Envelope – Evolute as envelope of normals.

UNIT IV DIFFERENTIAL EQUATIONS (12)
Introduction to Ordinary differential equations: Linear ordinary differential equations of second and higher order with constant coefficients.
Introduction to Partial differential equations: Linear Partial differential equations of second and higher order with constant coefficients.

UNIT V VECTOR DIFFERENTIATION (12)
Vectors-Differentiation of vectors – scalar and vector point functions –vector operator – vector operator applied to scalar point functions: Gradient; vector operator applied to vector point functions: Divergence and curl; Physical interpretation of divergence and curl, Directional derivative, solenoidal and irrotational vectors.

Total: 60

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</table>

REFERENCES:

WEBSITES:

1. www.efunda.com
2. www.mathcentre.ac.uk
3. www.intmath.com/matrices-determinants
OBJECTIVE:
1. To enhance the fundamental knowledge in Physics and its applications relevant to various branches of Engineering and Technology

INTENDED OUTCOME:
1. The students will have the knowledge on the basics of physics related to properties of matter, fiber optics, quantum, crystal physics and that knowledge will be used by them in different engineering and technological applications

UNIT I PROPERTIES OF MATTER AND THERMODYNAMICS (9)
Three types of modulus of elasticity – basic definitions, relation connecting the modulii (Derivation), Poisson’s ratio- Torsional pendulum- bending of beams - bending moment – uniform and non uniform bending

UNIT II LASER AND FIBER OPTICS (9)
Introduction – emission and absorption process- Einstein’s coefficients derivation. Types of LASER - CO2, Semiconductor LASER- Applications of LASER in industry and medicine.
Total internal reflection – modes of propagation of light in optical fibers – numerical aperture and acceptance angle –derivations, types of optical fibers (Material, refractive index and mode) – fiber optical communication system (block diagram)

UNIT III QUANTUM PHYSICS (9)
Introduction to quantum theory – Black body radiation - dual nature of matter and radiation – de Broglie wavelength, uncertainty principle –Schrödinger’s wave equation – time dependent and time independent equations – particle in one dimensional box- physical significance of wave function, scanning electron microscope

UNIT IV CRYSTAL PHYSICS (9)
Lattice – unit cell – Bravais lattice – calculation of number of atoms per unit cell, atomic radius, coordination number, packing factor for SC, BCC, FCC and HCP structures, crystal defects – point, line and surface defects

UNIT V ULTRASONICS AND NUCLEAR PHYSICS (9)

Total- 45
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<tr>
<td>1</td>
<td>Ganesan.S and Baskar.T</td>
<td>Engineering Physics I</td>
<td>GEMS Publisher, Coimbatore-641 001</td>
<td>2015</td>
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<tr>
<td>1</td>
<td>Serway and Jewett</td>
<td>Physics for Scientists and Engineers with Modern Physics</td>
<td>Thomson Brooks/Cole, Indian reprint, New Delhi</td>
<td>2010</td>
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<tr>
<td>5</td>
<td>P. Khare, A. Swarup</td>
<td>Engineering Physics: Fundamentals and Modern Applications</td>
<td>Jones &amp; Bartlett Learning</td>
<td>2009</td>
</tr>
</tbody>
</table>

#### WEBSITES:

1. www.nptel.ac.in
2. www.physicsclassroom.com
3. www. oyc.yale.edu
4. www.physics.org
OBJECTIVES:

1. To understand about the water technology.
2. To get the information on electrochemical cells, batteries, fuels and combustion.
3. To study about the corrosion and protective coatings.
4. To gain knowledge on adsorption phenomena.

INTENDED OUTCOME:

1. This course will create an impact on the students and make them to realize the modern utility on electrochemical cells, batteries, fuels and combustion process, corrosion and adsorption methods.

UNIT I WATER TECHNOLOGY


UNIT II ELECTROCHEMISTRY AND STORAGE DEVICES


UNIT III FUELS AND COMBUSTION


UNIT IV CORROSION SCIENCE

Chemical and Electrochemical corrosion - Galvanic corrosion - Differential aeration corrosion - Corrosion control - Sacrificial anode and Impressed current cathodic methods - Corrosion inhibitors - Protective coatings – Organic coatings-Paints - Constituents and functions – Inorganic coatings-Metallic coatings - Electroplating of Cu over Fe and Electro less plating (Ni) - Surface conversion coating - Hot dipping.- Anodizing of Al

UNIT V SURFACE CHEMISTRY AND PHASE RULE

Phase Rule: Definition - Phase diagrams – one component water system, two component Ag-Pb system.

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</table>

WEBSITES:

5. http://www.chem.qmul.ac.uk/surfaces/sec
OBJECTIVES

- To study the basic unit operations and unit processes in Chemical industry
- To study the Process instrumentation and safety
- To introduce the student with basic concepts of Chemical Engineering

INTENDED OUTCOMES

- Students will be able to convert units of simple quantities from one set of units to another set of units
- Students will be able to calculate quantities and/or compositions, energy usages, etc. in various processes and process equipment such as reactors, filters, dryers, etc.
- Gain knowledge of chemical processes and the need of safety in industries.

INTRODUCTION (Not included for examination) 3

Introduction to chemical engineering; history of chemical engineering and chemical technology; Scope of Chemical Engineering, Nature of Industries.

UNIT I BASIC CHEMICAL CALCULATIONS 8

Basic Concepts: concept of mole, weight percent, mole percent, normality, molarity, molality, vapor pressure, partial pressure.

UNIT II UNIT PROCESSES 8

Introduction to unit processes with simple examples like sulphonation, polymerization, oxidation, hydrogenation, saponification, etherification, nitration, chlorination.

UNIT III UNIT OPERATIONS-I 8

Introduction, Definition, examples like Size reduction, sedimentation, filtration, Distillation, evaporation, absorption, extraction, fluid handling, mixing, solid handling, fluid-solid contacting, fluid-solid separation, fluid storage, crystallization, drying, leaching.

UNIT IV UNIT OPERATIONS-II 8

Heat Transfer- Conduction, Convection, Radiation concepts and Heat Exchangers. Principle of Ion exchange, techniques and applications. Solid and liquid membranes; concept of osmosis; reverse osmosis; electro dialysis; ultrafiltration Fluid properties, fluid flows, flow measurement devices.

UNIT V BASIC CONCEPT OF CHEMICAL PROCESSES 9

Conversion, Yield, efficiency, flow diagram, flow sheets, & block diagram, with examples

TOTAL 45
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<tr>
<td>1</td>
<td>W.L. McCabe and J.C. Smith and Peter Harriott,</td>
<td>Unit operations in chemical engineering</td>
<td>Mc Graw Hill</td>
<td>1993</td>
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<td>1</td>
<td>Himmelblau, D.H</td>
<td>Basic Principles and Calculations in Chemical Engineering</td>
<td>Prentice Hall, New York</td>
<td>1990</td>
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<td>2</td>
<td>Badger and Banchero</td>
<td>Introduction to Chemical Engineering</td>
<td>McGraw Hill,</td>
<td>1954</td>
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### WEBSITES

- [http://www.docbrown.info/page04/4_73calcs07mam.htm](http://www.docbrown.info/page04/4_73calcs07mam.htm)
- [https://docs.google.com/file/d/0B6mmcxyrKnEhdEY0ZTMzeHNVSHM/edit](https://docs.google.com/file/d/0B6mmcxyrKnEhdEY0ZTMzeHNVSHM/edit)
OBJECTIVES

1. To impart the basic knowledge about the Electric circuits.
2. To understand the working of various Electrical Machines.
3. To know about various measuring instruments.
4. To understand the basic concepts in semiconductor devices and digital electronics.

INTENDED OUTCOMES

- The students shall develop an intuitive understanding of the circuit analysis, basic concepts of electrical machines, basics of electronics and be able to apply them in practical situation.

UNIT I ELECTRIC CIRCUITS & MEASUREMENTS

- Ohm’s Law – Kirchoff’s Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits

UNIT II ELECTRICAL MACHINES


UNIT III MEASURING INSTRUMENTS

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

UNIT IV SEMICONDUCTOR DEVICES AND APPLICATIONS


UNIT V DIGITAL ELECTRONICS

- Number systems – binary codes - logic gates - Boolean algebra, laws & theorems- simplification of Boolean expression - implementation of Boolean expressions using logic gates - standard forms of Boolean expression.

TOTAL 45

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<td>2</td>
<td>Sedha R.S</td>
<td>Applied Electronics</td>
<td>S. Chand &amp; Co</td>
<td>2006</td>
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<td>S. No.</td>
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<tr>
<td>4</td>
<td>Premkumar N</td>
<td>Basic Electrical Engineering</td>
<td>Anuradha Publishers</td>
<td>2003</td>
</tr>
</tbody>
</table>
OBJECTIVE:

1. To develop basic laboratory skills and demonstrating the application of physical principles.

INTENDED OUTCOME:

1. The students will have the knowledge on Physics practical experiments and that knowledge will be used by them in different engineering and technological applications.

LIST OF EXPERIMENTS – PHYSICS

1. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
3. Determination of Young’s modulus of the material – Non uniform bending (or) Uniform bending.
5. Spectrometer Dispersive power of a prism.
7. Particle size determination using Diode Laser
10. Determination of thickness of a thin wire – Air wedge method
11. Determination of Band Gap of a semiconductor material.
12. Determination of Specific resistance of a given coil of wire – Wheatstone Bridge
17BTCH111/17BTCH211  ENGINEERING CHEMISTRY LABORATORY  0 0 4 2

OBJECTIVE:

1. To provide students with practical knowledge of quantitative analysis of materials by classical and instrumental methods for developing experimental skills in building technical competence.

INTENDED OUTCOME:

1. The students will be outfitted with hands-on knowledge in quantitative chemical analysis of water quality parameters and corrosion measurement.

LIST OF EXPERIMENTS – CHEMISTRY

1. Estimation of alkalinity of Water sample.
2. Estimation of hardness of Water by EDTA
3. Estimation of chloride in Water sample (Argentometric method)
4. Determination of corrosion rate by weight loss method.
5. Conductometric Titration (Simple acid base).
6. Conductometric Titration (Mixture of weak and strong acids).
7. Conductometric Titration using BaCl₂ vs Na₂SO₄.
8. pH Titration (acid & base).
9. Potentiometric Titration (Fe²⁺ / KMnO₄ or K₂Cr₂O₇).
10. Estimation of Ferric ion by Spectrophotometry.
11. Determination of water of crystallization of a crystalline salt (Copper sulphate).
12. Determination of molecular weight and degree of polymerization using Viscometry.
OBJECTIVE

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

INTENDED OUTCOMES

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

PART – A (MECHANICAL)

i. WELDING
   i. Preparation of arc welding of butt joints, lap joints and tee joints.

ii. BASIC MACHINING
   i. Simple Turning and Taper turning
   ii. Drilling and Tapping
   iii. Sheet Metal Work
   iv. Model making – Trays, funnels, etc.

iii. DEMONSTRATION ON
   i. Smithy operations
   ii. Foundry operations
   iii. Plumbing Works
   iv. Carpentery Works

PART – B (ELECTRICAL & ELECTRONICS)

iv. ELECTRICAL ENGINEERING
   i. Study of electrical symbols and electrical equipments.
   ii. Construct the wiring diagram for Stair case wiring.
   iii. Construct the wiring diagram for Residential house wiring using switches, fuse, indicator, lamp and energy meter.
   iv. Measurement of electrical quantities – voltage, current, power & power factor in R load.
   v. Measurement of energy using single phase energy meter.

v. ELECTRONICS ENGINEERING
   i. Study of Electronic components– Resistor (color coding), capacitors and inductors.
   ii. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
   iii. Study of logic gates AND, OR, NOT, NOR and NAND.

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<td>1</td>
<td>Jeyachandran, K., Natarajan, S. and Balasubramanian, S</td>
<td>A Premier on Engineering Practices Laboratory</td>
<td>Anuradha Publishers, Kumbakonam</td>
<td>2007</td>
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<td>Manual</td>
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OBJECTIVES

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

OUTCOMES:

On Completion of the course the student will be able to
1. perform free hand sketching of basic geometrical constructions and multiple views of objects.
2. do orthographic projection of lines and plane surfaces.
3. draw projections and solids and development of surfaces.
4. prepare isometric and perspective sections of simple solids.
5. demonstrate computer aided drafting.

UNIT I INTRODUCTION

Introduction to Engineering Drawing, Bureau of Indian Standards (BIS), Layout of drawing sheets, sizes of drawing sheets, different types of lines used in drawing practice geometric constructions, principles of dimensioning– linear, angular, aligned system, unidirectional system, parallel dimensioning, chain dimensioning, location dimension and size dimension.

UNIT II SCALES AND PLANE CURVES

SCALES: Reducing Scale, Enlarging Scale, Plain Scale, Diagonal Scale and Vernier Scale. Conics – Construction of Ellipse, Parabola and Hyperbola by eccentricity method.

UNIT III FREE HAND SKETCHING

Representation of Three Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

UNIT IV PROJECTION OF POINTS, LINES AND PLANE SURFACES

Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – Traces–Projection of polygonal surface and circular lamina inclined to both reference planes.

UNIT V PROJECTION OF SOLIDS

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

Introduction to Drafting Software/Package (Not for Exam)

Basic operation of drafting packages, use of various commands for drawing, dimensioning, editing, modifying, saving and printing/plotting the drawings. Introduction to 3D primitives.

TOTAL 45
### TEXT BOOKS

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<tr>
<td>2</td>
<td>VTU</td>
<td>A Primer on Computer Aided Engineering Drawing</td>
<td>Belgaum</td>
<td>2006</td>
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### WEB REFERENCES

OBJECTIVE:

Yoga Education Helps To Develop The Self Discipline, Self Control, Awareness, Concentration And Higher Level Of Consciousness.

AIM : To Enable The Student To Have Physical Health And Mental Health.

UNIT- I
Introduction To Yoga- Meaning Of Yoga – Concept Of Yoga- Aim And Objectives Of Yoga – History Of Yoga - Systems Of Yoga.- Stages (Or) Limbs Of Yoga

UNIT- II

UNIT- III

UNIT- IV

UNIT- V

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<tr>
<td>1.</td>
<td>Dr.K.Chandrasekaran</td>
<td>Sound Health Through Yoga</td>
<td>Prem Kalyan</td>
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<td>2.</td>
<td>B.K.S.Iyangar</td>
<td>Light On Pranayama</td>
<td>Crossroad Centuary</td>
<td>2013</td>
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<tr>
<td>3.</td>
<td>Thirumular</td>
<td>Thirumandhiram</td>
<td>Sriramakrishna Math</td>
<td>2016</td>
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</table>
OBJECTIVES:

1. To help students comprehend the role of listening skills in effective communication.
2. To familiarize students with verbal and non-verbal communication.
3. To expose students to neutral accent.
4. To develop emotional intelligence skills in them for enhancing their self-esteem.
5. To assist them in setting goals and developing positive attitude.
6. To enable students to acquire decision making skills, problem solving skills and assertive skills.

INTENDED OUTCOMES:

Students undergoing this course will be able to

1. Design and deliver a persuasive presentation that convinces the audience of the topic’s relevance and overcomes resistance, using appropriate visual support and adhering to a specified time limit.
2. Use a strategic communication model and critical thinking to identify objectives, analyze audiences, and choose the most effective structure and style for delivering strategically sound written and spoken messages.
3. Practice principles of effective business writing and document design in all written documents.
4. Build an understanding of different organizational cultures, business practices, and social norms to communicate more effectively in domestic and cross-cultural business contexts.
5. Develop their soft skills and interpersonal skills, which will make the transition from college to workplace smoother and help them excel in their job.

UNIT I


UNIT II


UNIT III

UNIT - IV
Difference between goals and dreams - SMART goal setting - 3 Ds of goal setting - Determination, Discipline and Direction - Developing the right attitude - Motivation - Intrinsic and Extrinsic motivation - Dealing with change - Dedication - Taking responsibilities - Decision making.

UNIT - V
Intrapersonal skills - Self-analysis - Thought process – Interpersonal skills - Confidence building - Resolving conflicts - Analytical skills - Team Building - Leadership skills - Planning/organizing - Ability to work independently - Professional ethics - Communicating via e-mail. Ethical perspectives and their implications for responsible communication - Proposal Presentation

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<tbody>
<tr>
<td>1</td>
<td>Meenakshi Raman ; Prakash Singh</td>
<td>1. Business Communication</td>
<td>Oxford University Press</td>
<td>2012</td>
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WEBSITES

http://tribehr.com/social-hr-software/talent-management/skills-tracking
www.ispeakyouspeak.blogspot.com
https://alison.com/subjects/6/Personal-Development-Soft-Skills
www.learning-development.hr.toolbox.com
http://www.niit.com/solution/soft-skill-training
http://mybcommlab.com to test your understanding of the concepts presented in each chapter and explore additional materials that will bring the ideas to life in videos, activities, and an online multimedia e-book.
OBJECTIVES:

1. To motivate learners to acquire listening & speaking skills in both formal and informal context.
2. To focus on question forms & to make them understand the importance of using question tags and also the functional use of transformation of sentences.
3. To improve their reading habit and to train them in critical and analytical reading.
4. To equip them to write for academic as well as work place context.
5. To enable students to face interviews.

INTENDED OUTCOMES:
Students undergoing this course will be able to

1. Acquire second language: speaking convincingly, expressing their opinions clearly, negotiating and arguing using appropriate communicative strategies.
2. Enhance them reading texts critically and analytically.
3. Develop writing effectively, persuasively and producing different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing.
4. Enrich the ability to face interviews with confidence.

UNIT I  LSRW SKILLS & GRAMMAR
Receptive Skills (Listening, Reading and Scanning) & Productive Skills (Writing, Speaking and Representing) (9)
Grammar & Vocabulary (Function Grammar & Technical Vocabulary)
Regular & Irregular verbs - Kinds of sentences - Question tags. Homonyms and Homophones.

UNIT II  LSRW SKILLS & GRAMMAR
Receptive Skills (Listening, Reading and Scanning) & Productive Skills (Writing, Speaking and Representing) (9)
Listening – Note Taking- Improving grasping ability. Speaking – Welcome address - Vote of thanks - Master of ceremony. Reading – Active and Passive reading - Reading for vocabulary- Reading for a purpose. Writing - Writing a review (Film review) - Summary of a story. Grammar & Vocabulary (Function Grammar & Technical Vocabulary)
Modal verbs – Conjunction - Expression of cause and effect. Phrasal verbs - Idioms.

UNIT III  LSRW SKILLS & GRAMMAR
Receptive Skills (Listening, Reading and Scanning) & Productive Skills (Writing, Speaking and Representing) (9)
Grammar & Vocabulary (Function Grammar & Technical Vocabulary)
Active and Passive voice - Purpose expression. Same words used as noun and verb - Often misspelt and confused words.

UNIT-IV  LSRW SKILLS & GRAMMAR, CAREER ORIENTED
Receptive Skills (Listening, Reading and Scanning) & Productive Skills (Writing, Speaking and Representing) (9)
Listening – Listening to telephone conversation - Viewing model interviews. Speaking – Group Discussion - Correlation between verbal & non - verbal communication. Reading – Reading comprehension (short & long text) - Reading job advertisements and profile of a company. Writing – Checklist preparation.
Grammar&Vocabulary (Function Grammar & Technical Vocabulary)
Grammar - Numerical expressions – Collocations. Singular and Plural (Nouns)

UNIT- V  LSRW SKILLS & GRAMMAR, FIELD WORK
Receptive Skills (Listening, Reading and Scanning) & Productive Skills (Writing, Speaking and Representing) (9)
Listening – Types of listening- Improving listening comprehension. Speaking - Oral presentation - Vocal communication techniques - Voice, quality, volume, pitch etc., Reading -Note making - Making notes from books/ any forms of writing materials. Writing - Describing process & products - Recommendation writing – Short essays writing-
Grammar&Vocabulary (Function Grammar & Technical Vocabulary)
Transformation of sentences (Simple, Compound & Complex).Collection of Technical Vocabularies with their meanings.
Note: Students shall have hands on training in improving listening skill in the language laboratory @ 2 periods per each unit.

Total-45

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<tr>
<td>1</td>
<td>Sangeeta Sharma , Meenakshi Raman</td>
<td>Technical Communication: Principles And Practice 2nd Edition</td>
<td>OUP, New Delhi.</td>
<td>2015</td>
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WEBSITES :
www.learnerstv.com – Listening/ Speaking/ Presentation
www.usingenglish.com – Writing/ Grammar
www.englishclub.com – Vocabulary Enrichment/ Speaking
www.ispeakyouspeak.blogspot.com – Vocabulary Enrichment/ Speaking
www.teachertube.com – Writing Technically
OBJECTIVES:

1. To have knowledge in integral calculus and Vector calculus
2. To expose the concept of Analytical function and Complex integration.

INTENDED OUTCOMES:

The student will be able to
1. Solve problems in Fluid Dynamics, Theory of Elasticity, Heat and Mass Transfer etc.
2. Find the areas and volumes using Multiple Integrals
3. Improve their ability in Vector calculus
4. Expose to the concept of Analytical function.
5. Apply Complex integration in their Engineering problems

UNIT I INTEGRAL CALCULUS (12)
Definite and indefinite integrals – Techniques of integration – Substitution rule, Trigonometric integrals, Integration by parts, Integration of rational functions by partial fraction, Integration of irrational functions – Improper Integrals.

UNIT II MULTIPLE INTEGRALS (12)
Double integral – Cartesian coordinates – Polar coordinates – Area as double integrals- Change the order of integration – Triple integration in Cartesian co-ordinates.

UNIT III VECTOR INTEGRATION (12)
Integration of vectors – line integral- surface integral- volume integral- Green’s theorem - Gauss divergence theorem and Stoke’s theorems (Statement Only), hemisphere and rectangular parallelopipeds problems.

UNIT IV ANALYTIC FUNCTIONS (12)
Analytic functions - Cauchy-Riemann equations in Cartesian and polar forms – Sufficient condition for an analytic function (Statement Only) - Properties of analytic functions – Constructions of an analytic function - Conformal mapping: w = z+a, az, 1/z and bilinear transformation.

UNIT V COMPLEX INTEGRATION (12)
Complex Integration - Cauchy’s integral theorem and integral formula (Statement Only) – Taylor series and Laurent series - Residues – Cauchy’s residue theorem (Statement Only) - Applications of Residue theorem to evaluate real integrals around unit circle and semi-circle (excluding poles on the real axis).

Total: 60

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WEBSITES:

1. www.efunda.com
2. www.mathcentre.ac.uk
3. www.sosmath.com/diffeq/laplace/basic/basic.html
4. www.mathworld.wolfram.com
OBJECTIVES:

1. To give a comprehensive insight into natural resources, ecosystem and biodiversity.
2. To educate the ways and means of the environment
3. To protect the environment from various types of pollution.
4. To impart some fundamental knowledge on human welfare measures.

INTENDED OUTCOME:

1. Students will prepare themselves to go ecofriendly and help preserving the nature and environment.

UNIT I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES

Definition, Scope and Importance – Need for public awareness -Forest resources: Use and over-exploitation, deforestation- Water resources- Use and over-utilization of surface and ground water, floods, drought, conflicts over water- Land resources-Land as a resource, land degradation, man induced landslides, soil erosion and desertification –Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources- Food resources-World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture- Energy resources-Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources- role of an individual in conservation of natural resources.

UNIT II ECOSYSTEM

Chemistry and Environment- Environmental segments, Composition and Structure of atmosphere- Concept of an ecosystem- Structure, components and function of an ecosystem Energy flow in the ecosystem – Food chain, Food web and Ecological pyramids, Structure and function of Terrestrial ecosystem (Forest, Desert and Grassland ecosystem) and Aquatic ecosystem (Fresh water and Marine ecosystem)

UNIT III BIODIVERSITY

Introduction to biodiversity, Definition- Genetic diversity, Species diversity and Ecosystem diversity, Biogeographical classification of India, Importance of biodiversity-Value of biodiversity - Hot Spots of biodiversity-Threats to biodiversity - Endangered and Endemic Species of India– Conservation of biodiversity- In-Situ and Ex-Situ conservation of biodiversity.

UNIT IV ENVIRONMENTAL POLLUTION

Definition – causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution and Thermal pollution. Solid waste management-causes, effects and control measures of urban and industrial wastes– Role of an individual in prevention of pollution–Disaster management-earthquake, tsunami, cyclone and landslides.

UNIT V SOCIAL ISSUES AND ENVIRONMENT

From Unsustainable to Sustainable development, Urban problems related to energy sources, Water conservation, Rain water harvesting and Watershed management, Resettlement and rehabilitation of people, its problems and concerns, Environmental ethics- Issues and possible solutions- Climate change- Green house effect and Global warming, Acid rain, Ozone layer
depletion, Wasteland reclamation- Environment Protection Act- Human Rights-
Value education, Role of Information Technology in Environment and Human health-Population
growth, Variation of population among nations-Population explosion.

Total: 45

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<tr>
<td>1.</td>
<td>Dr. Ravikrishnan, A</td>
<td>Environmental Science</td>
<td>Sri Krishna Hi tech Publishing Company Private Ltd., Chennai</td>
<td>2012</td>
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WEBSITES:

2. http://nptel.ac.in/courses.php?disciplineId=120
OBJECTIVE

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

INTENDED OUTCOME

- 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.

UNIT I  STATICS OF PARTICLES  9
Forces – system of forces – concurrent forces in plane and space– resultant – problems involving the equilibrium of a particle–free body diagram–equilibrium of particle in space.

UNIT II  STATICS OF RIGID BODIES IN TWO DIMENSIONS  9

UNIT III  CENTROID, CENTRE OF GRAVITY AND MOMENT OF INERTIA  9
Centroids of areas, composite areas, determination of moment of inertia of plane figures, polar moment of inertia – radius of gyration – mass moment of inertia of simple solids.

UNIT IV  KINEMATICS OF PARTICLES  9


UNIT V  KINETICS OF PARTICLES AND FRICTION  9


TOTAL  45

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# WEB REFERENCES

OBJECTIVE:
- To familiarize with open source office packages
- To write programs for Understanding the basic concept of C Programming, and its different modules that includes conditional and looping expressions, Arrays, Strings and Functions.

INTENDED OUTCOME:
- Study, analyze and understand logical structure of a computer program, and different construct to develop a program in ‘C’ language

THEORY:
What is computer- Computer Components- What is C- C Character set- Constants, Variables and Keywords-General form of C Program - Relational and Logical Operators - Selection Structures- If and nested if - Switch Case - Loops-Definition and types- Functions- Arrays- Introduction to Strings-Pointers.

PRACTICALS:
1. Working with word Processing, Spreadsheet and presentation software in Linux
2. Programming in Scratch:
   Practicing fundamental concepts of programming like sequence, selection decision statements, working of loops and event driven programming
3. C Programming:
   Practicing programs to get exposure to basic data types, algebraic expressions, Conditional statements, Input and Output Formatting, Decision Statements, Switch Case, Control structures, arrays, Strings and function, implementation of pointers.

Total Hours: 45

REFERENCES:
OBJECTIVES

- To Learn the chemical process kinetics and the distribution laws
- To gain practical knowledge of rate constant and activation energy

INTENDED OUTCOMES

- The student is able to determine the properties and characteristics of solvents and mixtures

UNIT I CHEMICAL KINETICS


UNIT II COLLOIDS


UNIT III THE DISTRIBUTION LAW

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

Experiments
1. Determination of partition co-efficient of iodine between two immiscible solvents
2. Determination of partition co-efficient of benzoic acid between two immiscible solvents
3. Determination of Ka of the weak acid
4. Conductometric experiments- Verification of Oswald’s Dilution Law
5. Determination of Rate Constant (K)
6. Determination of Activation Energy (ΔE)
7. Determination of standard electrode potential (Zn, Cu, Ag)
8. To study the adsorption of Acetic acid on charcoal and construct the Isotherm.
9. Application of Phase Rule to Phenol-Water system
10. To study the inversion of cane sugar by polarimeter.
   a. Polarimeter-Inversion of cane sugar
   b. Refractometer

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<tr>
<td>1</td>
<td>Kund and Jain</td>
<td>Physical Chemistry</td>
<td>S.Chand and Company, New Delhi</td>
<td>1996</td>
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Scope:
Any business has to be developed from scratch. As an entrepreneur, one should learn various avenues of promoting the given business along with ethics which is the other side of the coin. This course is meant to inculcate to develop a business plan connected with ethics.

Objective:
To explain the relevance of Ethics while taking business decisions.

Unit I

Unit II
Business Plan Process - Sources of Information – Online Resources - Offline Resources - Sources of Market Research - Benefits of market study - Coverage of market study.

Unit III

Reference books:
2. Rhonda Abrams “The business plan in a day" Prentice Hall.
3. Business plan preparation - Entrepreneurship Development Institute of India
OBJECTIVES

- To introduce the concept of probability and Sampling techniques.
- To understand the fundamentals of Experimental Designs and Quality Control.

INTENDED OUTCOME

- The students would be exposed to statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation.

UNIT - I  PROBABILITY  (11)
Probability – Definition – Law - conditional probability-Bayes theorem- Probability mass function - Probability density functions.

UNIT - II  RANDOM VARIABLES  (13)
Introduction to one dimensional random variables – Discrete – Continuous - Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Regression.

UNIT - III  TESTING OF HYPOTHESIS  (12)
Sampling distributions – Testing of hypothesis for mean, variance, proportions and differences using Normal, t, Chi-square and F distributions – Tests for independence of attributes and Goodness of fit.

UNIT – IV  DESIGN OF EXPERIMENTS  (12)

UNIT – V  RELIABILITY AND QUALITY CONTROL  (12)
Concepts of reliability – hazard functions – Reliability of series and parallel systems – control charts for measurement ( and R charts) - Control charts for attributes (p, c and np charts).

TOTAL: 60

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**WEBSITES**

2. [www.mathcentre.ac.uk](http://www.mathcentre.ac.uk)
3. [www.mathworld](http://www.mathworld). Wolfram.com
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.

INTENDED OUTCOMES

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

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 aceto acetate and Malonic ester.

UNIT V PHARMACEUTICAL CHEMISTRY


TOTAL : 45

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<tbody>
<tr>
<td>2</td>
<td>Felix A. Carroll</td>
<td>Perspectives on Structure and Mechanism in Organic Chemistry</td>
<td>John Wiley &amp; Sons</td>
<td>2011</td>
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</table>
OBJECTIVES

1. To teach 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.

2. To perform stoichiometric calculations for chemical and non-chemical systems and to understand quantitative relationships between matter and energy involved in physiochemical processes.

INTENDED OUTCOMES

On completion of the course the students will be able to

1. understand and apply different systems of units and dimensions, calculate compositions of mixtures/solutions and determine pressure, volume and temperature of gases using equations of state.

2. apply the law of conservation of mass for different batch and continuous unit operations.

3. apply the law of conservation of mass for unit processes and evaluate yield, conversion, recycle ratio/purge/bypass of chemical reactors.

4. apply energy balances for reacting systems and understand the effect of temperature and pressure on heat of reaction.

UNIT I  UNITS AND DIMENSIONS  9

Conversion of Equations, Systems of Units, Fundamental Concepts: Basic and derived units, use of different system of units in process calculations. Introduction to Chemical Engineering Calculations: Basis, Mole Fraction and Mole Percent, Mass Fraction and Mass Percent, Concentration of different forms, Conversion from one form to another, Roult’s Law, Henry’s law, Antoine’s Equation. Clausius Clapeyron Equation.

UNIT II  MATERIAL BALANCE WITHOUT CHEMICAL REACTION  9

Material Balance during Mixing, Humidity and Application of Psychrometric Chart, Solubility and Crystallization, Evaporator, Distillation Column, Absorption Column, Drier, Liquid - Liquid and Solid - Liquid Extraction Units.

UNIT III  MATERIAL BALANCE WITH CHEMICAL REACTION  9

Single Reaction, Multiple Reactions, Reactions with Recycle, Purge and By-pass, Combustion Reaction, Calculation of Excess Air, Material Balance of Unsteady State Reaction systems.

UNIT IV  ENERGY BALANCE  9

Enthalpy calculation for systems (single component and multi components) without Chemical Reaction with Mean and Temperature dependent Heat Capacity, Enthalpy calculation for systems

UNIT – V COMBUSTION

Fuels and combustion; Calculation of theoretical and excess air from combustion of solid, liquid and gaseous fuels. Composition of flue gases by Orsat analyzer.

Lecture:45, Tutorial:15, TOTAL:60

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WEBSITES

http://www.msubbu.in/sp/pc/
http://facstaff.cbu.edu/rprice/lectures/
http://che31.weebly.com/course-materials.html
OBJECTIVE

- To impart to the students the knowledge on fluid properties, fluid statics, dynamic characteristics for through pipes and porous medium, flow measurement and fluid machineries.

INTENDED OUTCOMES

On completion of the course the students will be able to

- comprehend the principles of fluid properties, fluid statics and fluid flow problems and apply the same in chemical process industries
- analyze flow behavior of solid and liquid and to demonstrate the understanding of packed and fluidized bed
- understand and select fluid moving machinery for different applications in process industries
- understand and select characteristics of pumps, flow meters and valves for different applications in process industries.

UNIT I   FLUID PROPERTIES

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

UNIT II   FLUID STATICS

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

UNIT III   PRINCIPLES OF FLUID FLOW

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

UNIT IV   FLUID FLOWS

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

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

TOTAL  45

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<td>3</td>
<td>James O Wilkes and Stacy G Bike,</td>
<td>Fluid Mechanics for Chemical Engineers</td>
<td>Prentice Hall PTR (International series in Chemical Engineering)</td>
<td>2013</td>
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<td>4</td>
<td>John F. Douglas</td>
<td>Fluid Mechanics</td>
<td>Pearson/Prentice Hall</td>
<td>2005</td>
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WEBSITES

https://books.google.co.in/books?id=FzQz6A6SnyoC&printsec=frontcover#v=onepage&q&f=false
http://eprints.staffs.ac.uk/222/1/engineering-fluid-mechanics%5B1%5D.pdf
http://nptel.ac.in/downloads/103104043/
OBJECTIVE

- In this course, the students will learn characterization of solids, size reduction techniques of solid – fluid separation and mixing.

INTENDED OUTCOMES

On completion of the course the students will be able to

☐ apply the principles of size analysis, handling, storage and transportation for handling solids in chemical process industries

☐ analyze the size reduction techniques of solids by selecting proper equipments such as crushers, grinders, etc.

☐ understand the working principles of gravity settling tank, cyclone separators, Filters and other mechanical separation devices

☐ recognize mixing and agitation equipments, power calculation and selection of mixing

UNIT I CHARACTERISTICS AND SCREENING

Characteristics and 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 SIZE REDUCTION

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 MECHANICAL SEPARATIONS

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

UNIT IV FILTRATION

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

TOTAL: 45

TEXT BOOKS

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<tr>
<td>2</td>
<td>Badger W.L. and Banchero J.T</td>
<td>Introduction to Chemical Engineering</td>
<td>Tata McGraw Hill</td>
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<tr>
<td>3</td>
<td>Dr. CM Narayan and Dr. B.C. Bhattacharya</td>
<td>Mechanical Operation for Chemical Engineers.</td>
<td>CBS Publishers &amp; Distributors Pvt. Ltd</td>
<td>2010</td>
</tr>
</tbody>
</table>
OBJECTIVE

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

INTENDED OUTCOMES

- The student is able to identify what distinguishes a strong and weak nucleophile and recall the rules of reactions.
- The student shows their mastery of nomenclature since ethyl bromide is not drawn out.
- The student analyzes a list of compounds and determines their reactivity.

LIST OF EXPERIMENTS

1. Quantitative analysis of organic compounds – Identification of aliphatic/aromatic, saturated/unsaturated compounds.
2. Identification and characterization of various functional groups by their characteristic reactions:
   a) alcohol, b) aldehyde, c) ketone, d) carboxylic acid, e) phenol, f) ester, g) primary, secondary and tertiary amines h) imide i) nitro compounds.
3. Analysis of an unknown organic compound and preparation of suitable solid derivatives
5. Analysis of proteins.
6. Methodology of filtration and recrystallization.
7. Introduction to organic synthetic procedures:
   i. Acetylation – Preparation of acetanilide from aniline.
   ii. Hydrolysis – Preparation of salycilic acid from methyl 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
OBJECTIVE

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

INTENDED OUTCOMES

On completion of the course the students will be able to

- determine the coefficient of discharge for venturi/orificemeter, open drum orifice and v-notch
- validate the Moody’s diagram for flow through straight pipe/concentric pipes and helical coil
- assess the frictional loss coefficient for different valves and pipe fittings
- appraise pressure drop through packed bed and estimate minimum fluidization velocity in fluidized bed

LIST OF EXPERIMENTS

1. Viscosity measurement of non Newtonian
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. Hydrodynamics of fluidized bed
11. Drag coefficient of solid particle

TOTAL: 45
OBJECTIVE

- To supplement the theoretical knowledge gained in Mechanics of Solids with practical testing for determining the strength of materials under externally applied loads.
- This would enable the student to have a clear understanding of the design for strength and stiffness.

INTENDED OUTCOMES

On completion of the lab course the students will be able to

- Analyze how different types of forces are to be considered and how to quantify them.
- Design. Study of different types of stresses and strains occurring in various components of the structure.
- Know the advantages and disadvantages of various geometric sections available for engineering design.

LIST OF EXPERIMENTS

1. Tensile test on metals–stress strain characteristics
2. Cupping test on metal sheets–load deformation characteristics, cupping load, cupping number.
3. Hardness test on metals–Brinell and Rockwell Hardness tests.
4. Impact test on metals–Charpy, Izod impact tests.
5. Shear test on metals–direct shear strength, single shear, double shear.
7. Torsion test on beams–torque and angle of twist characteristics, shear stress, modulus of rigidity, energy.
8. Microscopic examination of i) Hardened samples ii) Hardened and tempered samples.
9. Tempering – Improvement of Mechanical properties –Comparison for i) Unhardened specimen ii) Quenched specimen iii) Quenched and tempered specimen.
10. Study of low carbon steel and medium carbon steel.

TOTAL 45
OBJECTIVE

- To help the students understand interpersonal skills.
- To support them in building interpersonal skills.
- To better the ability to work with others.

INTENTED OUTCOMES

- ability to communicate smartly and effectively with co-workers.;relationship enhancement
- Improvement of time management and organizational skill.
- development of leadership teamwork, creativity, efficiency & productivity
- development of presentation skills
- ability to recognize stress symptom & develop stress deflecting strategies
- brain storming & problem solving strategies to increase creativity and collaborative outcomes

UNIT I
Overview to communication, self-Introduction, Presentation on their own topic, Extempore, Group Activity

UNIT II
Group Discussion, Do's and Don’ts of Group Discussion, Body language, Grooming and Resume, Resume correction

UNIT III
Introduction to HRM – Questions - Do's and Don’t's - Interview - Mock GD - Stress Management

UNIT IV
Personality Development - Presentation skills, Interpersonal skills, Critical thinking, Confidence building and Stress management.

TOTAL 15
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<tr>
<td>1</td>
<td>Barun K Mitra</td>
<td>Personality Development and Soft Skills</td>
<td>Oxford University Press-New Delhi</td>
<td>2012</td>
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<tr>
<td>2</td>
<td>Rajiv K. Mishra</td>
<td>Personality Development</td>
<td>Rupa &amp; Co</td>
<td>2012</td>
</tr>
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</table>
SEMMESTER IV
17BTCE401 CHEMICAL TECHNOLOGY 3 0 0 3 100

OBJECTIVE

- To impart the basic concepts of chemical technology.
- To develop understanding about unit process and operations in various chemical industries.
- To learn manufacturing processes of organic and Inorganic Chemicals and its applications.

INTENDED OUTCOMES

On completion of the course the students will be able to

- understand the role of chemical engineers in process industries and develop block diagrams and flow charts for manufacture of different chemicals
- comprehend the unit operations/ processes in chloro alkalies, nitrogen and sulphur industries
- gain knowledge in the manufacture of plant nutrients, agrichemicals and fertilizers
- apply principles of chemical engineering in wood chemicals, oils, fats/ soap manufacturing Units.

UNIT I PRODUCTION PROCESSES
Production of pulp, paper and rayon, Manufacture of sugar, starch and starch derivatives, Gasification of coal and chemicals from coal.

UNIT II INDUSTRIAL MICROBIAL PROCESSES AND EDIBLE OILS 9
Fermentation processes for the production of ethyl alcohol, citric acid and antibiotics, Refining of edible oils and fats, fatty acids, Soaps and detergents.

UNIT III ALKALIES AND ACIDS 9

UNIT IV CEMENT GASES, WATER AND PAINTS 9
Types and Manufacture of Portland cement, Glass: Industrial Gases: Carbon dioxide, Nitrogen, Hydrogen, Oxygen and Acetylene - Manufacture of paints - Pigments

UNIT V FERTILISERS 9
Nitrogen Fertilisers; Synthetic ammonia, nitric acid, Urea, Phosphorous Fertilisers: Phosphate rock, phosphoric acid, super phosphate and Triple Super phosphate.

TOTAL :45
### TEXT BOOKS

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<tr>
<td>1</td>
<td>Srikumar Koyikkal</td>
<td>Chemical Process Technology and Simulation</td>
<td>PHI Learning Ltd</td>
<td>2013</td>
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<tr>
<td>2</td>
<td>Shukla and G.N. Pandey</td>
<td>Text book on Chemical Technology</td>
<td>Vikas publishing company</td>
<td>2009</td>
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</tbody>
</table>
OBJECTIVE

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

INTENDED OUTCOMES

On completion of the course the student will be able to

- apply thermodynamic concepts and the laws of thermodynamics to various systems and processes
- understand the properties of solution and determine the partial molar properties from mixture properties and vice-versa
- apply the criterion for equilibrium between phases to engineering systems with two or more co-existing phases
- apply chemical reaction equilibrium for thermodynamic analysis of homogeneous reactions

UNIT – I LAWS OF THERMODYNAMICS 12

Laws of Thermodynamics Laws of Thermodynamics: Basic concepts; Zeroth law; First Law - applications to non-flow and flow processes; Second Law - heat engines, Carnot cycle and theorem, Entropy calculations; Third Law of thermodynamics.

UNIT – II PROPERTIES OF REAL GASES AND THERMODYNAMICS FORMULATIONS 12

Properties of Real Gases and Thermodynamics Formulations: PVT behaviour of fluids - compressibility factor, two- and three-parameter theorems of corresponding states; Equation of states- Virial, VanderWaals, Redlich-Kwong and Peng-Robinson equations; Basic energy relations; Maxwell relations.

UNIT – III PROPERTIES OF SOLUTIONS 12

Partial molar properties; chemical potential; fugacity and activity coefficients; Gibbs-Duhem equation; enthalpy, entropy and Gibbs free energy changes in mixing of ideal solution.

UNIT – IV PHASE EQUILIBRIA 12

Phase equilibrium and stability; criteria for equilibrium between phases in single and multi-component non-reacting systems; vapor-liquid equilibrium of binary ideal and non-ideal solutions; azeotropes; Raoults law and Henry’s law; P-x-y and T-x-y diagrams using Antoine equations.
UNIT – V  CHEMICAL REACTION EQUILIBRIA

Criteria of equilibrium; standard free energy change and reaction equilibrium constant; effect of temperature and pressure on reaction equilibrium constant; homogeneous chemical reactions - thermodynamic analysis and prediction of equilibrium compositions.

TOTAL: 60

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<td>Rao, Y.V.C</td>
<td>Chemical Engineering Thermodynamics</td>
<td>Universities Press</td>
<td>2005</td>
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<tr>
<td>4</td>
<td>Pradeep ahuja</td>
<td>Chemical Engineering Thermodynamics</td>
<td>PHI Learning Ltd</td>
<td>2009</td>
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<td>5</td>
<td>Gopinath Halder</td>
<td>Introduction to Chemical Engineering Thermodynamics</td>
<td>PHI Learning Ltd</td>
<td>2009</td>
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</table>
OBJECTIVE

- To enable the students to learn heat transfer by conduction, convection and radiation and heat transfer equipments like evaporator and heat exchanger

INTENDED OUTCOMES

On completion of the course the students will be able to
- Understand the fundamental principles of conduction
- acquire knowledge in convection and radiation heat transfer
- familiarize with the fundamentals of boiling and condensation
- apply the knowledge of heat transfer in the design of evaporators
- design and analyze the performance of heat exchangers

UNIT I  CONDUCTION

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

UNIT II  CONVECTION

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

UNIT III  BOILING AND CONDENSATION

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

UNIT IV  RADIATION AND EVAPORATION

Theory and design procedure of evaporation. Concept and nature of thermal radiations - Concept of Black and grey bodies; Stefan Boltzmann, Kirchhoff’s, Planck’s and Wien laws; Radiation between surfaces – configuration factor; radiation shield.

UNIT V  HEAT EXCHANGERS

Types of heat exchangers Log mean temperature difference - use of correction factor charts; ssurface area calculations for double pipe and shell and tube heat exchangers,heat exchangers effectiveness and number of transfer units - Chart for different configurations - Fouling factors.

TOTAL 45
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OBJECTIVE

- To impart knowledge on various aspects of production engineering and enable the students to understand the practical methods of production process in a chemical industry.

INTENDED OUTCOMES

On the completion of the course the students will be able to

- understand the various unit processes in synthesis of organic compounds
- understand the application of organic compounds in various industries
- analyze chemical reactions and reaction conditions
- identify reaction schemes and mechanisms for a number of important reactions used in organic synthesis

UNIT – I NITRATION AND AMINATION


UNIT – II HYDROGENATION AND ALKYLATION

Production and Properties of Hydrogen, Catalytic hydrogenation and Hydrogenolysis; Methanation and Fischer-Tropsch reactions. Types and Factors affecting alkylation, Industrial alkylation process.

UNIT – III OXIDATION, HYDROLYSIS AND ESTERFICATION

Types of Oxidation reaction-Liquid-phase and Vapor-phase; Hydrolysis-processes and equipment. Esterification of organic and inorganic acids-applications in chemical industries.

UNIT – IV HALOGENATION, SULFONATION AND SULFATION

Halogenation- Chlorination reaction; Sulfonation and sulfation; Desulfonation reactions.

UNIT – V DYE AND DRUG SYNTHESIS


TOTAL: 45

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OBJECTIVE

- To impart knowledge on the structure, properties, treatment, testing and applications of metals and non-metallic materials so as to identify and select suitable materials for various engineering applications.

INTENDED OUTCOMES

On completion of the course the students will be able to

- Comprehend the criterion for selection of materials for chemical process industries.
- outline the properties and applications of smart materials and nano and bio materials.
- apply the knowledge about various materials used in chemical process industries.
- select materials for high temperature and Sour service and gain knowledge of modern engineering materials.

UNIT I   NATURE OF MATERIALS

Selection process of engineering materials (General aspects), Chemical and physical properties of materials, chemical structure, Micro and macro structure, corrosion resistance, chemical reactivity. Mechanical properties, stress, strain, strength, hardness, malleability, ductility, elasticity, plasticity, toughness, thermal stability. Types of deformation: Plastic, viscous; plastic deformation of single crystal, poly crystalline metals, slip, twinning, dislocations, viscoelasticity, creeps in metals, amorphous materials.

UNIT II METALLURGY


UNIT III COMPOSITES AND ADHESIVES

UNIT IV  BIOMATERIALS
Classification of bio-materials (based on tissue response) ,Comparison of properties of some common biomaterials , Metallic implant materials (stainless steel, cobalt-based and titanium-based alloys), Polymeric implant materials (Polyamides, polypropylene, Acrylic resins and Hydro gels), Tissue replacement implants , Soft and hard tissue replacements, Skin implants, Tissue engineering, Biomaterials for organ replacement (Bone substitutes), Biosensor.

UNIT V  MODERN ENGINEERING MATERIALS
Smart materials, Shape memory alloys, Electrostatics, Irreversible Marten sites, Domain Walls, Nature of Shape Memory, Shape Memory Alloy Materials, Ferromagnetic Shape Memory Alloys, Relation to Shape Memory Alloys, Actuator and Sensor Materials, Chromic materials (Thermo, Photo and Electro), Rheological fluids, Metallic glasses.

TOTAL :45

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OBJECTIVES

- To introduce the scientific computing, covering some important aspects of solving algebraic equations, IVP, BVP.
- To implement the methods using the spread sheet in Excel.

LIST OF EXPERIMENTS

1. Finding solution of Transcendental equation
   i) Newton – Raphson Method
   ii) Bisection method
   iii) Iterative method by reducing the equation to the form \( x = f(x) \)

2. Finding the dominant eigenvalue and eigenvector by power method

3. Numerical integration
   i) Gauss 2 point and 3 point formulae
   ii) Trapezoidal method
   iii) Simpson’s 1/3 rule

4. Solution of initial value problems governed by ODE
   i) Runge - Kutta 4th order method
   ii) Modified Euler’s method
   iii) Milne’s method
   iv) Adam – Bashforth method

5. Solution of BVP governed by PDE
   i) Laplace Equation
   ii) One – dimensional heat equation
      a) Explicit method : Bender – Schmidt’s method
      b) Implicit method : Crank - Nicolson’s method
   iii) One dimensional wave equation Implicit method

TOTAL 60 PERIODS

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<td>1</td>
<td>Curtis F. Gerald and Patrick O. Wheatley</td>
<td>Applied Numerical Analysis</td>
<td>Pearson Education, South Asia</td>
<td>2009</td>
</tr>
</tbody>
</table>
OBJECTIVE

- To provide experience on preparation, analysis and testing of chemicals used for industrial raw materials and end uses.

INTENDED OUTCOMES

- At the end of this practical course, the student would have a thorough understanding on the estimation and analysis of chemical compounds.
- Familiarization with equipment like viscometers, flash and fire point apparatus etc.
- Familiarization of methods for determining TDS
- Familiarization of a few simple synthetic techniques for soap.

LIST OF EXPERIMENTS (ANY 10 EXPERIMENTS)

1. Soap Analysis
   a. Estimation of total fatty acid
   b. Estimation of percentage alkali content
2. Oil Analysis
   a. Estimation of free acid
   b. Determination of Saponification value
   c. Determination of iodine value
3. 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
4. Coal Analysis
   a. Estimation of Sulphur present in coal
   b. Ultimate analysis of coal
   c. Proximate analysis of coal
5. Analysis of Bleaching Powder
   a. Estimation of available chlorine
6. Analysis of Glycerol
   a. Estimation of purity of glycerol
7. Analysis of fuels
   a. Flash point b. Fire point c. Cloud point d. Pour point e. Aniline point.
8. Determination of the molecular weight of the polymer by viscometry.
9. Calorimetric measurements
10. Conductivity measurement of an electrolyte solution
11. pH Measurements
12. Determination of sucrose content in sugar
13. Determination of dissolved oxygen in water
14. Determination of total nitrogen and ammoniacal nitrogen
15. Determination of SS, TDS, and VSS of a wastewater sample

TOTAL: 45
OBJECTIVE

- To enable the students to develop a sound working knowledge on different types of crushing equipments and separation characteristics of different mechanical operation separators.

INTENDED OUTCOMES

On completion of the course the students will be able to
- estimate crushing characteristics, power requirements and constants of crushing laws using Jaw and Roll Crusher
- determine the critical speed and work index by using Ball mill
- determine average particle size and specific surface area by conducting Sieve analysis, Beaker Decantation and Air permeability experiments
- estimate specific cake and filter medium resistance using Filter press and Leaf filter
- design a thickener using batch sedimentation data and assess the efficiency of Cyclone separator

LIST OF EXPERIMENTS

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

TOTAL: 45
OBJECTIVE:

- To give hands on training on the development of industrially important biotechnology products

INTENDED OUTCOMES:

At the end of the course,

- The students will be able to get exposure on small scale development of biotechnology products

1. Production of ethanol from molasses and grapes
2. Production of Biofertilizers
3. Production of Single cell protein (Spirullina)
4. Mushroom cultivation
5. Production of jam from mixed fruits
OBJECTIVE

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

INTENDED OUTCOMES

On completion of the course the students will be able to
- gain knowledge on the selection of the reactor for the reaction and its design
- apply the principles of reaction kinetics and formulate rate equations and analyze the batch reactor data
- understand the ideal reactor concepts and to develop the performance equation to workout conversion and space time
- perform RTD analysis in non-ideal flow reactors and calculation of conversion

UNIT I RATE EQUATIONS

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 REACTORS

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

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 REACTOR SYSTEMS

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 NON IDEAL FLOW REACTORS

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

TOTAL: 60
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<td>A Text Book of Chemical Engineering Thermodynamics</td>
<td>Prentice Hall of India Pvt. Ltd</td>
<td>2001</td>
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OBJECTIVE

- Students will learn to determine mass transfer rates under laminar and turbulent conditions.

INTENDED OUTCOMES

On completion of the course the students will be able to
- understand diffusional operations and theories of mass transfer
- understand the concept of interphase mass transfer
- understand the concept gas-liquid mass transfer operations like humidification
- apply the knowledge gained in mass transfer to perform simple calculations in drying
- apply the knowledge gained in mass transfer to perform simple calculations in crystallization process

UNIT I DIFFUSION

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

UNIT II INTERPHASE MASS TRANSFER

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

UNIT III HUMIDIFICATION

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

UNIT IV DRYING

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

UNIT V CRYSTALLIZATION

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

TOTAL 45
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<td>Separation Process Principles</td>
<td>2nd Ed., John Wiley</td>
<td>2006</td>
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</table>
OBJECTIVE

- To impart the importance of safety in industries and the various methods of safety measures and risk analysis in the industry

INTENDED OUTCOMES

On completion of the course the students will be able to

- demonstrate the awareness of plant safety standards, codes and MSDS in handling and storage of chemicals
- exhibit the skill in classifying chemical, fire, explosion hazards and to understand the occupational diseases
- investigate safety in operations and process by undergoing HAZOP and HAZAN studies
- analyze the accident causes, costs, prevention techniques, accident proneness and case studies
- examine the legal aspects related to safety and emergency studies to know the basic rules and requirements which govern the chemical industries

UNIT – I  SAFETY PRINCIPLES  9

Need for safety, Safety programs, Training & Education, Design for ventilation; Personal protective Equipments. Safety codes: NFPA, IS and OSHA standards; colour codes for pipe lines. Materials Safety Data sheets; safety in storage and handling of chemicals.

UNIT – II  HAZARDS  9

Hazards- fire, explosion and radiation; Designs to prevent fires and explosions; relief and relief sizing. Occupational diseases - effects.

UNIT – III  SAFETY IN OPERATIONS AND PROCESSES  9


UNIT IV  INDUSTRIAL ACCIDENTS  9

Industrial accidents – types, nature/effects, causes, costs, prevention, investigation and analysis, accident proneness, case studies.

UNIT V  LEGAL ASPECTS  9

Factories act, ESI act and Workmen's compensation act, Role of Government, safety organizations, management and trade unions in promoting industrial safety. Emergency response systems for hazardous goods basic rules and requirements which govern the chemical industries.

TOTAL: 45
### TEXT BOOKS

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OBJECTIVE

- To make the students understand the working principles of different types of instruments and their applications.

INTENDED OUTCOMES

On completion of the course the students will be able to

- comprehend the principles of electromagnetic radiation and classification of instrumental methods
- grasp the principles and applications of UV, Visible, IR Spectroscopy and Photometric titrations
- appreciate the importance of AAS and NMR spectroscopy in chemical analysis
- gain knowledge about thermo gravimetric instruments and their applications
- understand the principles and applications of chromatographic methods.

UNIT I ELECTROMAGNETIC RADIATION

Various ranges, Dual properties, Various energy levels, Interaction of photons with matter, absorbance & transmittance and their relationship, Permitted energy levels for the electrons of an atom and simple molecules, classification of instrumental methods based on physical properties.

UNIT II MOLECULAR SPECTROSCOPY

Various electronic transitions in organic and inorganic compounds effected by UV, visible and infra-red radiations, various energy level diagrams of saturated, unsaturated and carbonyl compounds, excitation by UV and Visible radiations, Woodward-Fischer rules for the calculation of absorption maxima (dienes and carbonyl compounds), Effects of auxochromes and effects of conjugation on the absorption maxima; Instrumentation for UV, VISIBLE and IR spectroscopies (source, Optical parts and Detectors), Photometric titration (Experimental set-up and various types of titrations), Applications of UV, VISIBLE and IR spectroscopies.

UNIT III AAS, NMR SPECTROSCOPY


UNIT IV THERMAL METHODS

Thermogravimetry: Instrumentation, factors affecting shapes of thermo grams, and applications. Thermogram of important compounds (CaSO4.5H2O; CaC2O4.2H2O) Differential Thermal Analysis: Principle, instrumentation and applications. Differences between DSC & DTA. Application of DSC (Inorganic & Polymer samples). TGA - Principle, instrumentation and applications.
UNIT V    CHROMATOGRAPHIC METHODS

Classification of chromatographic methods; Column, Thin layer, Paper, Gas, High Performance Liquid Chromatography (principle, mode of separation and technique). Separation of organic compounds by Column and Thin Layer, Mixture of Cu, Co and Ni by Paper Chromatography. Separation of amino acids by Paper Chromatography. Estimation of organic compounds by GC and HPLC.

TOTAL: 45

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OBJECTIVE

- To enable the students to develop a sound working knowledge on different types of heat transfer equipments

COURSE OUTCOMES

On completion of the Lab course the student will be able to

- determine Stefan Boltzmann constant at different temperatures
- assess the heat transfer coefficient for natural and forced convection systems, double pipe heat exchanger / shell and tube heat exchanger and condensers
- develop temperature profile in unsteady state heat transfer system
- evaluate the convective and radiative heat transfer coefficients using radiation experiment
- appraise the fin efficiency and estimate the steam economy in an evaporator

LIST OF EXPERIMENTS

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

TOTAL:45
OBJECTIVE

- To develop skill to design and install process equipments used widely in the chemical industry

INTENDED OUTCOMES

On successful completion of the course the students will be able to
- design machine elements and Piping system/presentation of PFD and PID
- apply the skill in thermal design of heat transfer equipments like shell and tube and double pipe heat exchangers
- perform the process design of evaporators
- apply the skill in design of equipments like crystallizer and centrifuge
- understand the concepts involved in design of pressure vessel, storage vessel and tall columns

LIST OF EXPERIMENTTS:

- Basic design and drawing considerations of machine elements
- Design of Heat Exchangers
- Design of Evaporators
- Design of Crystallizers
- Design of Pressure vessel

TOTAL: 45

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OBJECTIVE

- To impart knowledge on design of reactors

INTENDED OUTCOMES

On completion of the Lab course the students will be able to

- determine the order and rate constant of the rate equations for Batch/ Mixed / Plug flow reactor
- estimate the conversion in Batch/Semi-batch/Mixed/Plug flow reactors
- determine the effect of temperature on rate of reaction to validate Arrhenius equation
- evaluate the performance of combined Mixed and Plug flow reactor system
- conduct residence time distribution studies to develop C, E & F- curve for Mixed/Plug flow reactor/Packed-bed reactor

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
OBJECTIVES

- To understand the engineering principles in a pipe stress analysis
- To study Nozzle loading and flexibility

UNIT I
Introduction to CAESAR II, General modeling in CAESAR II, Pipe stress theory, Stress analysis according to a design codes

UNIT II
Load-based piping design (e.g. earthquake and wind), Flange and nozzle analysis, Structural steel, Expansion joints

UNIT III
Hanger sizing, Fiberglass piping, Buried piping, Generation of isometric drawings

TOTAL 15

17BTCE552 IN–PLANT TRAINING - - - - 100

OBJECTIVES

- To know the basic knowledge on industry and its environment.
- To understand the psychology of the workers, their habits, attitudes and approach to problems along with the practices followed either at factory or site.

Students will undergo industrial training for four weeks during the vacation at the end of IV semester and a report with the training completion certificate from the industry will be subsequently submitted to the department within a week after completion. Viva – Voce exam will be conducted at the end of V semester and 100 marks will be awarded.
OBJECTIVE

- To enable the students to learn the gas-solid catalytic and non-catalytic reactors and gas-liquid reactors

INTENDED OUTCOMES

On completion of the course the students will be able to

- understand the ideal reactor concepts and heterogeneous reactors.
- understand the basics of catalysis and industrial catalytic reactors such as gas-solid reactors

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

UNIT II  HETEROGENEOUS REACTORS
Rate equations for heterogeneous reactions, adsorption isotherms, rates of adsorption and desorption, surface reaction analysis of rate equation and rate controlling steps.

UNIT III  GAS-SOLID CATALYTIC REACTORS
Diffusion within catalyst particle, effective thermal conductivity, mass and heat transfer within catalyst pellets, effectiveness factor, Thiele Modulus, fixed bed reactors.

UNIT IV  GAS-SOLID NON-CATALYTIC REACTORS
Models for explaining kinetics; volume and surface models; controlling resistances and rate controlling steps; time for complete conversion for single and mixed sizes, fluidized and static reactors.

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

TOTAL:  60

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OBJECTIVE

- To provide introduction to physical and thermodynamic principles of mass transfer with an emphasis on how these principles affect the design of equipment and result in specific requirements for quality and capacity

INTENDED OUTCOMES

On completion of the course the students will be able to

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

UNIT I  ABSORPTION  12

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

UNIT II  DISTILLATION  12

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

UNIT III  LIQUID-LIQUID EXTRACTION  12

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

UNIT IV  LEACHING  12

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

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.

TOTAL:60

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<td>1</td>
<td>Wankat, P.</td>
<td>Equilibrium Stage Separations</td>
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OBJECTIVE

- To impart knowledge about the elements and techniques involved in process dynamics and control

INTENDED OUTCOMES

On completion of the course the students will be able to
- understand the prerequisites of control strategies to design different process control systems
- evaluate the suitable controllers for different chemical process
- familiarize the closed loop response of control loops and characteristics of control valves
- analyze and assess the control systems unto stability
- know the tuning procedures and advanced control techniques

UNIT I INSTRUMENTATION

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

UNIT II OPEN LOOP SYSTEMS

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

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

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

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

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<td>Stephanopoulous</td>
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<td>1985</td>
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</table>
OBJECTIVES

- To enable students to understand the fundamental economic concepts applicable to engineering and
- To learn the techniques of incorporating inflation factor in economic decision making, sensitivity and risk analysis.

INTENDED OUTCOME

- Gain knowledge on cost and asset accounting, time value of money, profitability, alternative investments, and minimum attractive rate of return, sensitivity and risk analysis.

UNIT I  PRINCIPLES OF MANAGEMENT AND ORGANISATION  12
Planning, organization, staffing, coordination, directing, controlling, communicating, organization as a process and a structure; types of organizations. Method study; work measurement techniques; basic procedure; motion study; motion economy; principles of time study; elements of production control; forecasting; planning; routing; scheduling; dispatching; costs and costs control, inventory and inventory control.

UNIT II  INVESTMENT COSTS AND COST ESTIMATION  8
Time Value of money; capital costs and depreciation, estimation of capital cost, manufacturing costs and working capital, capital budgeting and project feasibility.

UNIT III  PROFITABILITY, INVESTMENT ALTERNATIVE AND REPLACEMENT  9
Estimation of project profitability, sensitivity analysis; investment alternatives; replacement policy; forecasting sales; inflation and its impact.

UNIT IV  ANNUAL REPORTS AND ANALYSIS OF PERFORMANCE  8
Principles of accounting; balance sheet; income statement; financial ratios; analysis of performance and growth.

UNIT V  ECONOMIC BALANCE  8

TOTAL : 45 PERIODS
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<td>M.L.Jhingan</td>
<td>Principles of Economics</td>
<td>Konark Publications</td>
<td>2010</td>
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</table>
OBJECTIVE

- To train the students to develop sound working knowledge on different types of mass transfer equipment

INTENTED OUTCOMES

On completion of the course the students will be able to

- determine diffusivity and mass transfer co-efficient of a given system
- generate vapour liquid equilibrium data and liquid equilibrium data for different systems
- evaluate the performance and determine the design Parameters of Simple /Packed / Steam distillation units
- appraise the performance of a simple leaching process

LIST OF EXPERIMENTS

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

TOTAL 45
OBJECTIVE

- To enable the students to learn the methods and practices followed in the design of process equipments and to draw the designed equipments to scale.

INTENDED OUTCOMES

On completion of the course the students will be able to
- apply the skill in thermal design of heat transfer equipments like condensers and reboilers
- estimate the design parameters of reactors
- perform the process design of distillation column
- apply the skill in design of absorption column

LIST OF EXPERIMENTS

- Design of Condensers
- Design of reactors
- Design of distillation Column
- Design of Absorption Column
- Design of Dryers

TOTAL: 45

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<td>Handbook of Chemical Processing Equipment</td>
<td>Butterworth</td>
<td>2000</td>
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OBJECTIVE

1. The main objective is to give an opportunity to the student to get hands on training of a complete working model, which is designed by them.

   The students may be grouped into 2 to 4 and work under a project supervisor. The device/system/component(s) to be set as a model may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

OBJECTIVES

- To equip the students with effective technical presentation
- To understand the barriers and bridges to communication
- To improve the public speaking capabilities, body language and posture

During the seminar session each student is expected to prepare and present a topic on engineering/technology, for duration of about 8 to 10 minutes. In a session of three periods per week, 15 students are expected to present the seminar. A faculty guide is to be allotted and he/she will guide and monitor the progress of the student and maintain attendance also.

Students are encouraged to use various teaching aids such as overhead projectors, power point presentation and demonstrative models.

TOTAL 15
OBJECTIVE

- To enable the students to create an awareness on Engineering Ethics, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

INTENDED OUTCOMES

On completion of the course the students will be able to
- Develop managerial skills
- Cultivate engineering ethics with oneself
- Develop stress managing attitude and entrepreneurship.

UNIT I  HISTORICAL DEVELOPMENT, PLANNING, ORGANISING  9

UNIT II  DIRECTING AND CONTROLLING  9

UNIT III  ENGINEERING ETHICS  9

UNIT IV  FACTORS OF CHANGES  9
Forces that shape culture, social control – Meaning, Agencies, Institution, Customs, Values, Folkways, Norms and Laws. Social changes – Meaning and nature – Theories.

UNIT V  ENTREPRENEURSHIP AND MOTIVATION  9
Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur – Entrepreneurship in Economic Growth – Major Motives Influencing an Entrepreneur – Achievement
Motivation Training, self rating, Business Game, Thematic Apperception Test – Stress management, Entrepreneurship Development Programs – Need, Objectives.

TOTAL 45

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<td>Entrepreneurship and innovation</td>
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<td>3</td>
<td>Charles E Harris, and Michael J Rabins</td>
<td>Engineering Ethics – Concepts and Cases</td>
<td>Wadsworth Thompson Learning, New Delhi</td>
<td>2013</td>
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WEB REFERENCES

OBJECTIVE

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.

INTENDED OUTCOMES

On completion of the course the students will be able to
- apply the shell momentum balances and velocity distribution in laminar flow and understand
- equation of continuity and motion
- establish the shell energy balances and temperature distributions in solids and apply the equations of change to solve heat transfer problems
- determine the shell mass balance and concentration distributions in systems involving diffusion and reactions
- analyze the analogy between the transports processes of heat, momentum and mass transfer

UNIT I  FUNDAMENTALS OF TRANSPORT PHENOMENA AND VELOCITY DISTRIBUTION IN LAMINAR FLOW


UNIT II  EQUATION OF CHANGE FOR ISOTHERMAL PROCESS

The Equations of Change in Terms of the Substantial Derivative-The Equation of Continuity- The Equation of Motion- Use of the Equations of Change to Solve Flow Problems- Dimensional Analysis of the Equations of Change.

UNIT III  VELOCITY DISTRIBUTION IN TURBULENT FLOW

UNIT IV  SHELL ENERGY BALANCES AND TEMPERATURE DISTRIBUTIONS IN SOLIDS AND LAMINAR FLOW


UNIT V  CONCENTRATION DISTRIBUTIONS IN SOLIDS AND LAMINAR FLOW

Shell Mass Balances; Boundary Conditions- Diffusion through a Stagnant Gas Film- Diffusion with a Heterogeneous Chemical Reaction- Diffusion with a Homogeneous Chemical Reaction- Diffusion into a Falling Liquid Film (Gas Absorption)- Diffusion into a Falling Liquid Film (Solid Dissolution)- Diffusion and Chemical Reaction inside a Porous Catalyst- Diffusion in a Three- Component Gas System- equations for change for Multi Component Systems- The Equations of Continuity for a Multicomponent Mixture.

TOTAL :45

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OBJECTIVE

- To impart computational techniques for chemical engineering calculations

INTENDED OUTCOMES

- The current rapid development of these combinatorial methods promises solutions to more complex problems, including the creation of new biosynthetic pathways.
- Computational methods are also developing quickly.
- The approaches will allow us to generate the efficient, effective catalysts needed by the pharmaceutical, food and chemicals industries and should open up new opportunities for producing energy and chemicals from renewable resources.

LIST OF EXPERIMENTS

Writing Programs and Sub Programs using C/C++ and MATLAB/SCILAB for Solving
1. Jacobi Methods, Cramer’s Rule- “Multiple Effect Evaporator and Similar Problems.”
5. “Heat conduction problems and chemical reaction” Engineering problems

COMPUTER AIDED DESIGN

Design, Rating and Simulation of Chemical Engineering Equipment Using Aspen Plus / Chemcad Software:Mixer, Flow splitter; Flash column; pipe line and pipe pressure drop; Pump; Single and multistage compressors; Heat Exchangers; Distillation Columns; Reactors etc.

COMPUTER AIDED SIMULATION


- Introduction to HYSYS Software, HYSYS User Interface, Defining the Simulation Basis, Selecting a Unit Set, Adding a Stream, Flash Calculations

- Adding Utilities, The Stream Property Value, Flash Calculations of a Ethanol-Water Mixture, Gas Plant Example
Optimization in HYSYS, Set and Adjust Logic Operations, Flash Calculation, PFD Preparation, Sizing of Columns, Oil Manager / Characterization, Pipe Sizing and Pressure Drop in HYSYS, Simulation of live Project

TOTAL 45
OBJECTIVE

- To determine experimentally the methods of controlling the processes including measurements using process simulation techniques.

INTENDED OUTCOME

- Students would have knowledge on the development and use of right type of control dynamics for process control under different operative conditions.

LIST OF EXPERIMENTS

1. Single capacity liquid level process
2. Time constant of a thermocouple
3. Calibration of resistance thermometer
4. Response of a dial thermometer
5. Two capacity liquid level process without interaction
6. Two capacity liquid level process with interaction
7. Heat transfer dynamics of stirred tank
8. Computer controlled level process analyser
9. Computer controlled flow process analyser
10. Computer controlled pressure process analyser
11. Computer controlled temperature process analyser
12. Computer controlled heat exchanger system
13. Triangle simulator trainer.

TOTAL 45
OBJECTIVE

1. To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.
OBJECTIVE

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.
PROFESSIONAL ELECTIVES
OBJECTIVE

- To enable the students to learn to design processing equipments for Food Industries

UNIT I AN OVERVIEW
General aspects of food industry; world food needs and Indian situation.

UNIT II FOOD CONSTITUENTS, QUALITY AND DERIVATIVE FACTORS
Constituents of food; quality and nutritive aspects; food additives; standards; deteriorative factors and their control

UNIT III GENERAL ENGINEERING ASPECTS AND PROCESSING METHODS
Preliminary processing methods; conversion and preservation operations.

UNIT IV FOOD PRESERVATION METHODS
Preservation by heat and cold; dehydration; concentration; drying irradiation; microwave heating; sterilization and pasteurization; fermentation and pickling; packing methods.

UNIT V PRODUCTION AND UTILISATION OF FOOD PRODUCTS
Cereal grains; pulses; vegetables; fruits; spices; fats and oils; bakery; confectionery and chocolate products; soft and alcoholic beverages; dairy products; meat; poultry and fish products.

TOTAL 45

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<tr>
<td>1</td>
<td>Heid J.L., Joslyn M.A.,</td>
<td>Fundamentals of Food Processing Operation</td>
<td>The AVI publishing Co., West port</td>
<td>1967</td>
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<td>2</td>
<td>Potter N.N</td>
<td>Food Science</td>
<td>The AVI publishing Co., Westport</td>
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<td>1</td>
<td>Heldman D.R.,</td>
<td>Food Process Engineering</td>
<td>The AVI publishing co</td>
<td>1975</td>
</tr>
</tbody>
</table>
OBJECTIVE

- To motivate the students by highlighting the importance of Energy technology and various energy management concepts

UNIT I   FUELS TECHNOLOGY
Introduction – Solid fuels – Coal origin, analysis and properties, efficient utilisation, storage and applications, Liquid fuels – Petroleum- Production and consumption, refining, properties and petroleum products, Gaseous fuels – natural gas, producer gas, water gas, gasification of coal; gases from biomass

UNIT II   COMBUSTION
Distinct features of combustion of solid, liquid and gaseous fuels - determination of gross and net calorific values - combustion of solid fuels including pulverized fuels, stoking and ash removal - fluidized bed combustion of solid fuels - combustion of liquid fuels - burners and nozzles - combustion of gaseous fuels - types of combustion: surface combustion, submerged combustion and pulsating combustion

UNIT III   HYBRID SYSTEMS
Wind-PV systems, Wind-DG systems, Wind-Hydel systems, Gasifier DG- Wind systems and Application areas, Hybrid conventional and geothermal power plants, Integrated coal gasifier and fuel cell power plant

UNIT IV   ENERGY AUDIT
Energy Audit: Types and Methodology; Energy Audit Reporting Format; Understanding Energy Costs; Benchmarking and Energy Performance; Matching Energy Usage to Requirement; Maximising System Efficiency; Fuel and Energy Substitution; Energy Audit Instruments; Duties and responsibilities of energy auditors

UNIT V   ENERGY MANAGEMENT
Definition and objectives of Energy Management; Importance; Indian need of Energy Management; Energy action planning, Energy Organization, energy costing, budgeting, Equipment professionals, staffing, Monitoring and targeting – Data and Information Analysis; Relating Energy Consumption and Production, Design of energy management programs

TOTAL 45

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<tr>
<td>1</td>
<td>Gupta</td>
<td>Elements of fuels, furnaces and refractories</td>
<td>Khanna Publishers</td>
<td>2010</td>
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<td>2</td>
<td>Rao S.&amp; Dr. Parulakar B.B</td>
<td>Energy Technology</td>
<td>Khanna Publishers</td>
<td>1994</td>
</tr>
<tr>
<td>3</td>
<td>Samir Sarkar,</td>
<td>Fuels and Combustion</td>
<td>University Press</td>
<td>2009</td>
</tr>
</tbody>
</table>
OBJECTIVE

- This course mainly discusses the role of enzymes and microbes in biotechnology sectors.

UNIT I  INTRODUCTION  9
Industrial biochemical processes with typical examples, comparing chemical and biochemical processes, development and scope of biochemical engineering as a discipline. Industrially important microbial strains; their classification; structure; cellular genetics.

UNIT II  KINETICS OF ENZYME ACTION  9
Kinetics of enzyme catalyzed reaction: the enzyme substrate complex and enzyme action, modulation and regulation of enzyme activity, types of inhibition. Immobilized enzyme technology: enzyme immobilization, Immobilized enzyme kinetics: effect of external mass transfer resistance.

UNIT III  KINETICS OF MICROBIAL GROWTH  9
Kinetics of cellular growth in batch and continuous culture, models for cellular growth unstructured, structured and cybernetic models, medium formulation. Thermal death kinetics of cells and spores, stoichiometry of cell growth and product formation, Design and analysis of biological reactors

UNIT IV  TRANSPORT PHENOMENA  9
Transport phenomena in bioprocess systems: Gas-liquid mass transfer in cellular systems, determination of oxygen transfer rates, power requirements for sparged and agitated vessels, scaling of mass transfer equipment, heat transfer.

UNIT V  DOWN STREAM PROCESSING  9
Downstream processing: Strategies to recover and purify products; separation of insoluble products, filtration and centrifugation; cell disruption-mechanical and non-mechanical methods; separation of soluble products: liquid-liquid extractions, membrane separation (dialysis, ultra filtration and reverse osmosis), chromatographic separation-gel permeation chromatography, electrophoresis, final steps in purification –crystallization and drying

TOTAL  45

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<td>1</td>
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<td>Biochemical engineering fundamentals</td>
<td>McGraw Hill</td>
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<td>2</td>
<td>Michael L. Shuler and Fikret Kargi</td>
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<td>James M. Lee</td>
<td>Biochemical engineering</td>
<td>Prentice-Hall</td>
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<td>2</td>
<td>Pauline M. Doran</td>
<td>Bioprocess engineering principles</td>
<td>Academic Press</td>
<td>1997</td>
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<tr>
<td>3</td>
<td>H.W. Blanch and D.S. Clark</td>
<td>Biochemical Engineering</td>
<td>Marcel Dekker</td>
<td>1997</td>
</tr>
</tbody>
</table>
OBJECTIVE

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

UNIT I NITROGENOUS FERTILISERS
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
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
Methods of production of potassium chloride, potassium schoenite, their characteristics and specifications.

UNIT IV COMPLEX AND NPK FERTILISERS
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
Mixed fertilizers and granulated mixtures; biofertilisers, nutrients, secondary nutrients and micro nutrients; fluid fertilizers, controlled release fertilizers, controlled release fertilizers.

TOTAL 45

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<td>Association of India, New Delhi</td>
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<td>Menno, M.G</td>
<td>Fertilizer Industry - An Introductory Survey</td>
<td>Higginbothams Pvt. Ltd</td>
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<td>The Chemistry and Technology of Fertilizers</td>
<td>ACS MONOGRAPH No. 148, Reinhold Publishing Cor. New</td>
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<tr>
<td>3</td>
<td>Slack, A.V.; Chemistry and Technology of Fertilisers</td>
<td>Interscience, New York</td>
<td>1966</td>
<td></td>
</tr>
</tbody>
</table>
OBJECTIVE:

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

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

UNIT II FLUIDIZED BED TYPES

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

TOTAL: 45 PERIODS

TEXT BOOKS

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<td>Rowe and Davidson</td>
<td>Fluidization</td>
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<td>Leva, M</td>
<td>Fluidization</td>
<td>McGraw Hill Book Co</td>
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<td>Wen-Ching Yang.,</td>
<td>Handbook of Fluidization and Fluid-Particle Systems</td>
<td>Marcel Dekker Inc</td>
<td>2003</td>
</tr>
</tbody>
</table>
OBJECTIVE

- To understand the formation and composition of petroleum
- To understand the various treatment techniques of petroleum
- Making students familiarize with upgrading process of petroleum products

UNIT – I  FORMATION AND COMPOSITION OF PETROLEUM  
Origin and formation of petroleum; composition; types and classification; Petroleum reserves.

UNIT – II PROPERTIES AND TESTING METHODS
Physical properties and testing methods – crude and petroleum products;

UNIT– III TREATMENT TECHNIQUES
Desalting of crudes, dehydration and fractionation methods; Thermal and catalytic cracking processes – vis-breaking, Dubbs two coil process, coking, FCC, Hydro cracking processes.

UNIT– IV UPGRADING PROCESSES
Solvent extraction; hydro treatment processes; Reforming and Alkylation; Isomerization; polymerization; finishing and purification processes.

UNIT – V  MATERIAL AND ENERGY BALANCES
Material and Energy balances calculation; controlling hydrocarbon losses in refinery; application of pollution control techniques.

TOTAL: 45

TEXT BOOKS:

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OBJECTIVE

- Focused on papermaking science and technology and is intended to be especially valuable to students majoring in programs leading to careers in corporate or government positions which would interface with the paper related industries.

UNIT I INTRODUCTION
Introduction Basic pulp and paper technology – Wood haves dry – Wood as a raw material

UNIT II WOODYARD OPERATION
Woodyard operation - Mechanical pulping – Chemical pulping – Secondary fibre pulp processing

UNIT III PAPER MACHINE
Paper Machine wet and addition paper machine dry and operation – Paper machine - Wet and operation

UNIT IV PAPER AND PAPERBOARD
Paper and paperboard frames and products – Surface treatments – Finishing operation– End uses

UNIT V PROPERTIES AND TESTING OF PULP AND PAPER
Properties and Testing of pulp and paper Process control – Quality assurance – Water and air pollution control

TOTAL 45

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<td>2</td>
<td>Kent J.A</td>
<td>Riggel's Hand Book of Industrial Chemistry</td>
<td>Van Nostrand Reinhold</td>
<td>1974</td>
</tr>
</tbody>
</table>
OBJECTIVE

- To enable the students to compute molecular weight averages from the molecular weight distribution, Condensation polymerization and transition in polymers.

UNIT I INTRODUCTION
History of Macromolecules – structure of natural products like cellulose, rubber, proteins – concepts of macro molecules – Staudinger’s theory of macromolecules – difference between simple organic molecules and macromolecules

UNIT II ADDITION POLYMERIZATION

UNIT III CONденSATION POLYMERIZATION

UNIT IV MOLECULAR WEIGHTS OF POLYMERS

UNIT V TRANSITIONS IN POLYMERS
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

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<td>Seymour.R.B., and Carrhaer.C.E., Jr.,</td>
<td>Polymer Chemistry</td>
<td>2nd Ed., Marcel Dekker</td>
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<td>1</td>
<td>Joel, R.F</td>
<td>Polymer Science and Technology</td>
<td>Eastern Economy Edition</td>
<td>1999</td>
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</table>
OBJECTIVE:

- To give the students an understanding of the polytechnical nature of engineering and drug discovery in the pharmaceutical industry involving Chemical Engineering.

UNIT I INTRODUCTION

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

UNIT II DRUG METABOLISM AND PHARMACO KINETICS MICROBIOLOGICAL AND ANIMAL PRODUCTS

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

UNIT III IMPORTANT UNIT PROCESSES AND THEIR APPLICATION

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

UNIT IV MANUFACTURING PRINCIPLES & PACKING AND QUALITY CONTROL

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

UNIT V PHARMACEUTICAL PRODUCTS & PHARMACEUTICAL ANALYSIS

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

TOTAL : 45 PERIODS

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<td></td>
<td>Sciences</td>
<td>New York</td>
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<td>“Remingtons Pharmaceutical Sciences”</td>
<td>Mack Publishing Co</td>
<td>1975</td>
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</table>
OBJECTIVE

- This course will give an appreciation of the fundamental principles on corrosion engineering.

UNIT I
Electrochemical and thermodynamic principles, Nernst equation and electrode potentials of metals, EMF and galvanic series, merits and demerits; origin of Pourbaix diagram and its importance to iron, aluminium and magnesium metals.

UNIT II
Exchange current density, polarization - concentration, activation and resistance, Tafel equation; passivity, electrochemical behaviour of active/passive metals, Flade potential, theories of passivity.

UNIT III
Atmospheric, pitting, dealloying, stress corrosion cracking, intergranular corrosion, corrosion fatigue, fretting corrosion and high temperature oxidation; causes and remedial measures.

UNIT IV
Purpose of testing, laboratory, semi-plant and field tests, susceptibility tests for IGC, stress corrosion cracking and pitting, sequential procedure for laboratory and on-site corrosion investigations, corrosion auditing and corrosion map of India.

UNIT V
Corrosion prevention by design improvements, anodic and cathodic protection, metallic, non-metallic and inorganic coatings, mechanical and chemical methods and various corrosion inhibitors.

TOTAL 45

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<td>Denny Jones</td>
<td>Principles and Prevention of Corrosion</td>
<td>Prentice Hall</td>
<td>1996</td>
</tr>
</tbody>
</table>
OBJECTIVE

- To understand the construction and working principle of various piping design.

UNIT I  INTRODUCTION TO PIPING ENGINEERING  9
Fluid flow, types of fluids and examples, different pipe fittings. Friction factor, pressure drop for flow Newtonian and non-Newtonian fluids, pipe sizing, economic velocity. Pipe line networks and their analysis for flow in branches, restriction orifice sizing. Pressure drop calculations for non-Newtonian fluids. Two phase flow, types of two phase flow, two phase flow as encountered in piping for steam, distillation column, pressure drop, vibrations in two phase flow.

UNIT II  MATERIALS FOR PIPING  9

UNIT III  CONTROL & SAFETY IN PIPING  9
Types of valves, control valves, safety valves, constructional features, criteria for selection. Piping components, pressure relieving devices, constructional features, selection criteria and application, safety features. Calculations for line sizing, steam traps, P.R.V. & condensive systems.

UNIT IV  PIPING SYSTEM DESIGN  9
Design principles, calculation of pipe diameter, thickness, important system characteristics and design principles related to steam flow at high and low pressures. Design principles and line sizing for vacuum pipelines, slurry pipelines, surge drums and flare stacks, vacuum devices including ejector system. Considerations governing pump selection, analysis of system and pump characteristics in connection with series, parallel flow, and minimum flow and equalizing lines, NPSH, allowable nozzle loads in various codes. Design principles and line sizing of pneumatic conveying of solids, components of conveying systems, dust and fume extraction systems principles.

UNIT V  PIPING LAYOUTS  9

TOTAL  45

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<td>McAllister E.W.</td>
<td>Pipeline Rules of Thumb Handbook</td>
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<td>2009</td>
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<td>2</td>
<td>Kellogg</td>
<td>Design of Piping System</td>
<td>M.W. Kellogg</td>
<td>2009</td>
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<td>Weaver R</td>
<td>Process Piping Design</td>
<td>Gulf Publication</td>
<td>1989</td>
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</table>
OBJECTIVE

- To understand the functions and design principles of nanotechnology

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V

TOTAL 45

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<td>B. Bhushan</td>
<td>Springer handbook of nanotechnology</td>
<td>Springer – Verlag</td>
<td>2004</td>
</tr>
<tr>
<td>2</td>
<td>Charles P. Poole; Frank K. J Owens</td>
<td>Introduction to Nanotechnology</td>
<td>A John Wiley and Sons</td>
<td>2000</td>
</tr>
</tbody>
</table>
OBJECTIVE:

- To solve problems related to the production, storage, distribution and utilization of electrochemical energy and the associated environmental issues.

UNIT I

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

UNIT III

UNIT IV

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

TOTAL: 45 PERIODS

TEXT BOOKS

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<tr>
<th>S. No.</th>
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<tr>
<td>1</td>
<td>Picket</td>
<td>Electrochemical Engineering</td>
<td>Prentice Hall</td>
<td>1977</td>
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<td>2</td>
<td>J. S</td>
<td>Electrochemical Systems</td>
<td>Prentice Hall</td>
<td>1973</td>
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<tr>
<td>1</td>
<td>Barak, M. and</td>
<td>Electrochemical Power Sources</td>
<td></td>
<td>1980</td>
</tr>
<tr>
<td>#</td>
<td>Author</td>
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</table>
OBJECTIVE:

- To make the students to demonstrate competence in setting up computational fluid dynamics models for some industrially important applications. This technical competence in building and conducting CFD simulations is a skill which enhances employability.

UNIT I CONSERVATION LAWS AND TURBULENCE MODELS 9
Governing equations of fluid flow and heat transfer – mass conservation, momentum and energy equation, differential and integral forms, conservation and non-conservation form. Characteristics of turbulent flows, time averaged Navier Strokes equations, turbulence models-one and two equation, Reynolds stress, LES and DNS.

UNIT II FINITE DIFFERENCE APPROXIMATION 9
Mathematical behaviour of PDE, finite difference operators, basic aspects of discretization by FDM, explicit and implicit methods, error and stability analysis

UNIT III FINITE VOLUME METHOD 15
Diffusion problems – explicit and implicit time integration; Convection-diffusion problems properties of discretisation schemes, central, upwind, hybrid, QUICK schemes; Solution of discretized equations.

UNIT IV FLOW FIELD COMPUTATION 6
Pressure velocity coupling, staggered grid, SIMPLE algorithm, PISO algorithm for steady and unsteady flows

UNIT V GRID GENERATION 6
Physical aspects, simple and multiple connected regions, grid generation by PDE solution, grid generation by algebraic mapping.

TOTAL: 45 PERIODS

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<tr>
<td>1</td>
<td>Anderson, J. D</td>
<td>Computational Fluid Dynamics: The Basics with Applications</td>
<td>McGraw-Hill</td>
<td>1995</td>
</tr>
<tr>
<td>2</td>
<td>Fletcher, C. A. J</td>
<td>Computational Techniques for Fluid Dynamics</td>
<td>Springer Verlag</td>
<td>1997</td>
</tr>
<tr>
<td>3</td>
<td>Versteeg, H.K. and</td>
<td>An Introduction to</td>
<td>Pearson</td>
<td>2007</td>
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<td>S. No.</td>
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<tr>
<td>1</td>
<td>Chung T.J</td>
<td>Computational Fluid Dynamics</td>
<td>Cambridge University Press</td>
<td>2003</td>
</tr>
<tr>
<td>4</td>
<td>Subas, V. Patankar</td>
<td>Numerical heat transfer fluid flow</td>
<td>Hemisphere Publishing Corporation</td>
<td>1980</td>
</tr>
</tbody>
</table>
OBJECTIVE:

- To focus on the wastewater transport system and the theory and design technique for the wastewater treatment process.

UNIT I WASTE WATER TREATMENT AN OVERVIEW

UNIT II PROCESS ANALYSIS AND SELECTION

UNIT III CHEMICAL UNIT PROCESSES
Role of unit processes in waste water treatment chemical coagulation – Chemical precipitation for improved plant performance chemical oxidation – Neutralization – Chemical Storage.

UNIT IV BIOLOGICAL TREATMENT

UNIT V ADVANCED WASTE WATER TREATMENT

TOTAL : 45 PERIODS

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OBJECTIVE

- To facilitate the understanding of Quality Management principles and process.

UNIT I INTRODUCTION

UNIT II TQM PRINCIPLES
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
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

UNIT V QUALITY SYSTEMS

TOTAL: 45 PERIODS

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OBJECTIVE

- To know the design experiments and formulate optimization models of chemical processes/equipments.

UNIT – I DEVELOPING MODELS FOR OPTIMIZATION  
Scope and hierarchy of optimization, Essential features of Optimization problems, Classification of Models, Building a model, Factorial experimental designs, Degree of freedom

UNIT – II BASIC CONCEPTS
Formation of objective function, continuity of functions, NLP problem statement, convexity and applications, Interpretation of objective function based on its Quadratic approximation

UNIT – III OPTIMIZATION OF UNCONSTRAINED FUNCTIONS
Methods for one dimensional search, Newton’s method and Quasi – Newton methods for uni dimensional search. Polynomial approximation methods

UNIT – IV UNCONSTRAINED MULTIVARIABLE OPTIMIZATION
Methods using function value only, methods using first derivative, Newton’s method, Quasi – Newton methods.

UNIT – V LINEAR PROGRAMMING
Simple method, Barrier method, sensitivity analysis, Linear mixed integer programs, Examples

TOTAL: 45

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<tbody>
<tr>
<td>2</td>
<td>Kalyanmoy Deb</td>
<td>Optimization for Engineering Design: Algorithms and Examples</td>
<td>Prentice Hall of India, New Delhi</td>
<td>2005</td>
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<td>S. NO.</td>
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<tr>
<td>1</td>
<td>Joshi M.C., and Kannan M. Moudgalya</td>
<td>Optimization, Theory and Practice</td>
<td>Narsoa Publication, New Delhi</td>
<td>2004</td>
</tr>
</tbody>
</table>
OBJECTIVES

- To understand about the pilot plants, models, similarity and scale up methods
- To understand the scale-up of reactors, columns and dryers, unit operations equipment's and its limitations

UNIT – I FUNDAMENTALS OF SCALE UP, DIMENSIONAL ANALYSIS AND SCALE-UP CRITERION
Principles of Similarity, Pilot Plants and Models, Introduction to Scale-up Methods, Dimensional Analysis, Regime Concept, Similarity Criterion and Scale up Methods used in Chemical Engineering.

UNIT – II SCALE-UP OF HEAT TRANSFER EQUIPMENT
Typical Problems in Scale-up of Mixing Equipment and Heat Transfer Equipment.

UNIT – III SCALING UP OF REACTORS
Scale-up Techniques available for Tubular Reactor, CSTR and Catalytic Reactors.

UNIT – IV SCALE-UP OF MASS TRANSFER EQUIPMENT
Distillation Column and Packed Towers: Scale-up of Distillation Columns and Packed Towers for Continuous and Batch Processes and Dryers

UNIT – V SCALE UP OF MISCELLANEOUS EQUIPMENT AND LIMITATIONS
Scaling up of Ball Mill, Pressure Jet Nozzle and Centrifugal Disk Atomizers and Screw Extruders, Furnaces and Kilns, Analogue Models, Limitations of Scale up Techniques.

TOTAL : 45

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<tbody>
<tr>
<td>2</td>
<td>Marko Zlokarnik</td>
<td>Scale-up in Chemical Engineering</td>
<td>Wiley-VCH, Germany</td>
<td>2002</td>
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<td>Marko Zlokarnik</td>
<td>Dimensional Analysis and Scale-up in Chemical Engineering</td>
<td>Springer - Verlag, Berlin, Germany</td>
<td>1986</td>
</tr>
<tr>
<td>2</td>
<td>Donald G. Jordan</td>
<td>Chemical Process Development, Part-1 and 2</td>
<td>Intersciences Publishers</td>
<td>1988</td>
</tr>
</tbody>
</table>
OBJECTIVES

1. To impart the basic concepts of industrial pollution control
2. To develop understanding about water, air, light pollution control

UNIT I INTRODUCTION
Man and Environment, Types of pollution, Pollution control aspects, Pollution monitoring and analysis of pollutant. Air pollution: Sources and effects, particulate control, control of gaseous pollutants (SOx, NOx, oxides of carbon, hydrocarbon pollutants), Air Quality Management.

UNIT II WATER POLLUTION
Types of water pollution, sources, water pollution control. Waste water treatment technologies and Recycle.

UNIT III SOLID WASTE MANAGEMENT
Sources, processing methods, waste disposal methods, energy recovery from solid waste

UNIT IV NOISE POLLUTION

UNIT V CASE STUDY
Pollution (Air, Water & Solid) control in the following process industries - Fertilizers, Petroleum Refinery and Petrochemical, Pulp and Paper, Cane Sugar, Tannery, Distilleries and Pharmaceutical Industry.

TOTAL 45

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<tbody>
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<td>1</td>
<td>S.C. Bhatia</td>
<td>Environmental Pollution and control in chemical process industries</td>
<td>Khanna Publishers</td>
<td>2001</td>
</tr>
<tr>
<td>2</td>
<td>C.S.Rao</td>
<td>Environmental Pollution Control Engineering</td>
<td>Wiley Eastern</td>
<td>1992</td>
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<tr>
<td>1</td>
<td>S.P.Mahajan</td>
<td>Pollution control in Process Industries</td>
<td>Pollution control in Process Industries</td>
<td>1990</td>
</tr>
<tr>
<td>2</td>
<td>F. P. Lees</td>
<td>Loss prevention in process industries</td>
<td>Butter worth- Heinemann</td>
<td>1996</td>
</tr>
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<td></td>
<td>Author</td>
<td>Title</td>
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<tr>
<td>3</td>
<td>Martin Crawford</td>
<td>Pollution Control Theory</td>
<td>McGraw Hill</td>
<td>1976</td>
</tr>
<tr>
<td>4</td>
<td>Marell</td>
<td>Solid Wastes</td>
<td>John Wiley</td>
<td>1975</td>
</tr>
</tbody>
</table>
OBJECTIVES

1. The student will acquire an introduction to concepts that link classical and statistical thermodynamics.
2. The course will also provide the student with the basic knowledge of statistical thermodynamics and its applications in chemistry and chemical engineering.

UNIT I STATISTICAL-MECHANICAL ENSEMBLES AND THERMODYNAMICS
Ensembles and Postulates, Canonical Ensemble and Thermodynamics, Grand Canonical Ensemble, Microcanonical Ensemble, Entropy, Other ensembles, characteristic equations, Fluctuations

UNIT II GENERAL RELATIONS FOR INDEPENDENT MOLECULES

UNIT III IDEAL MONOATOMIC AND DIATOMIC GAS
Ideal Monatomic Gas, Density of States, Thermodynamic Functions, Internal Degrees of Freedom, Homonuclear Diatomics, Molecular Partition Functions, Ideal Diatomic Gas, Vibrational, Rotational, Gas of Homonuclear Diatomics at Low Temperature, Quantum Statistics, Polyatomic Molecules

UNIT IV CHEMICAL EQUILIBRIUM IN IDEAL MIXTURES
Chemical Equilibrium, General Relations, Statistical Derivation in a Special Case, Fluctuations in a Simple Chemical Equilibrium, Examples of Chemical Equilibria.

UNIT V RATES OF CHEMICAL REACTIONS IN IDEAL MIXTURES
Potential Surfaces, Absolute Rate Theory, A Non-Chemical Application of the Eyering Theory

TOTAL 45

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<td>1</td>
<td>Terrell. L, Hill</td>
<td>An Introduction to Statistical Thermodynamics</td>
<td>Dover Publications</td>
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</table>
OBJECTIVE

1. Equipping the students with knowledge on the various process utilities and their importance in chemical process plants.

UNIT I STEAM, COMPRESSORS AND VACUUM PUMPS
Steam generation and its application in chemical process plants, steam distribution including appropriate mechanical valves and instrumentation, steam utilization, design of efficient steam heating systems, steam nozzles. Compressed air, process pumps, compressors, vacuum pumps, pressurized air distribution systems. Types of compressors and vacuum pumps.

UNIT II REFRIGERATION SYSTEMS AND INSULATION
Refrigeration system and their characteristics, load calculation and load calculation and humidification and dehumidification equipments, drying and cooling tower, air blending, exhaust, ventilation, cryogenics, their characteristics and production of liquid N2 and O2Importance of insulation for meeting for the process equipment, insulation material and their effect on various materials of equipment piping, fitting and valves, insulation for high, intermediate, low and subzero temperatures including cryogenic insulation, determination of optimum insulation thickness.

UNIT III WATER
Water Resources, process water, boiler feed water, storage and distribution of water, reuse and conservation of water.

UNIT IV PIPING
Piping: Role & scope of piping, line diagram, Process flow diagram and piping and instrumentation diagram.

UNIT V PINCH ANALYSIS

TOTAL 45

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<tr>
<td>1</td>
<td>Mahesh Rathore</td>
<td>Thermal Engineering</td>
<td>Tata McGraw Hill India</td>
<td>2010</td>
</tr>
</tbody>
</table>
OBJECTIVE

1. To provide an opportunity to learn basic management concepts essential for business

UNIT I  INTRODUCTION  9

UNIT II  FUNCTIONS OF MANAGEMENT  9

UNIT III  ORGANIZATIONAL BEHAVIOUR  9

UNIT IV  GROUP DYNAMICS  9

UNIT V  MODERN CONCEPTS  9

TOTAL  45
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<tr>
<td>1</td>
<td>Ties, AF, Stoner and R.Edward Freeman</td>
<td>Management</td>
<td>Prentice Hall of India Pvt. Ltd. New Delhi</td>
<td>1992</td>
</tr>
</tbody>
</table>
OBJECTIVE

- To enable the students to learn the principle and technical concept of advanced separation processes.

UNIT I BASICS OF SEPARATION PROCESS

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

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

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

UNIT IV INORGANIC SEPARATIONS

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

UNIT V OTHER TECHNIQUES

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

TOTAL : 45 PERIODS

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<td>1</td>
<td>King., C. J</td>
<td>Separation Processes</td>
<td>Tata McGraw Hill</td>
<td>1982</td>
</tr>
<tr>
<td>3</td>
<td>Nakagawal.O. V</td>
<td>Membrane Science and Technology</td>
<td>Marcel Dekkar</td>
<td>1992</td>
</tr>
</tbody>
</table>
OBJECTIVE

- To give an overview of various methods of process modeling, different computational techniques for simulation.

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

UNIT II  STEADY STATE LUMPED SYSTEMS
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
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
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

TOTAL: 45

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<td>Franks, R. G. E</td>
<td>Mathematical Modelling in Chemical Engineering</td>
<td>John Wiley</td>
<td>1967</td>
</tr>
<tr>
<td>3</td>
<td>Amiya K. Jana</td>
<td>Process Simulation and Control Using ASPEN</td>
<td>2nd Edn, PHI Learning Ltd</td>
<td>2012</td>
</tr>
</tbody>
</table>
COURSES OFFERED BY OTHER DEPARTMENTS
OPEN ELECTIVES OFFERED BY
DEPARTMENT OF SCIENCE AND HUMANITIES
OBJECTIVES:

- To gain knowledge in measures of central tendency.
- To provide necessary basic concepts in probability and random processes.

INTENDED OUTCOMES:

1. Learners acquire skills in handling situations involving more than one random variable and functions of random variables.
2. The students will have an exposure of various distribution functions, correlation and spectral densities.

UNIT- I MEASURES OF CENTRAL TENDENCY AND PROBABILITY

Measures of central tendency – Mean, Median, Mode - Standard Deviation Probability - Random variable - Axioms of probability - Conditional probability - Total probability – Baye’s theorem.

UNIT- II STANDARD DISTRIBUTIONS

Functions of a random variable - Binomial, Poisson, Uniform, Exponential, Gamma(one Parameter only) and Normal distributions - Moment generating functions, Characteristic function and their properties – Chebyshev's inequality.

UNIT -III TWO DIMENSIONAL RANDOM VARIABLES

Joint distributions - Marginal and conditional distributions - Probability mass function - Probability density functions – Covariance - Correlation and regression

UNIT- IV CLASSIFICATION OF RANDOM PROCESS

Definition and examples - first order, second order, strictly stationary, wide – sense stationary and Ergodic processes - Markov process - Binomial, Poisson and Normal processes - Sine wave process.

UNIT -V CORRELATION AND SPECTRAL DENSITIES


Total : 45

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<tr>
<td>1</td>
<td>Ross, S</td>
<td>A first Course in Probability</td>
<td>Pearson Education, New Delhi (Chap 2 to 8)</td>
<td>2012</td>
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</table>

WEBSITES:

2. [www.mathcentre.ac.uk](http://www.mathcentre.ac.uk)
OBJECTIVES:

- To know the fundamentals of fuzzy Algebra.
- To know the basic definitions of fuzzy theory
- To know the applications of fuzzy Technology.

INTENDED OUTCOME:

1. The Engineers will have an exposure on various topics such as fuzzy algebra, fuzzy theory and fuzzy technology.

UNIT I  FUZZY SETS  (9)

UNIT II  OPERATIONS ON FUZZY SETS  (9)
Operations on Fuzzy Sets Operations on \([0,1]\) – Fuzzy negation, triangular norms, tconorms, fuzzy implications, Aggregation Operations, Fuzzy Functional Equations

UNIT III  FUZZY RELATIONS  (9)
Fuzzy Relations Fuzzy Binary and n-ary relations – composition of fuzzy relations – Fuzzy Equivalence Relations – Fuzzy Compatibility Relations – Fuzzy Relational Equations

UNIT IV  FUZZY MEASURES  (9)

UNIT V  FUZZY INFERENCE  (9)
Approximate Reasoning Fuzzy Decision Making - Fuzzy Relational Inference – Compositional rule of Inference - Efficiency of Inference - Hierarchical

Total : 45

TEXT BOOK:

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<tr>
<td>2</td>
<td>Michal Baczynski and Balasubramaniam Jayaram</td>
<td>Fuzzy Implications</td>
<td>Springer-Verlag publishers, Heidelberg</td>
<td>2008</td>
</tr>
<tr>
<td>3</td>
<td>Kevin M Passino and Stephen Yurkovich</td>
<td>Fuzzy Control</td>
<td>Addison Wesley Longman publishers, USA</td>
<td>1998</td>
</tr>
</tbody>
</table>

**WEBSITES:**

1. www.mathcentre.ac.uk
2. www.mathworld. Wolfram.com
3. www.calvin.edu/~pribeiro/othrlinks/Fuzzy/fuzzysets.htm
OBJECTIVES:

1. To know the fundamentals of linear Algebra.
2. To study about the linear transformations
3. To introduce the concepts of inner product spaces

INTENDED OUTCOMES:

The student will be able to

1. Recognize the underlying theory of vector spaces over a field and inner product spaces over real or complex numbers
2. Visualize linear transformations as matrix form
3. Articulate the importance of Linear Algebra and its applications in branches of Mathematics

UNIT I VECTOR SPACES
General vector spaces, real vector spaces, Euclidean n-space, subspaces, linear independence, basis and dimension, row space, column space and null space,

UNIT II EIGEN VALUES AND EIGEN VECTORS
Eigen values and Eigen vectors - Diagonalization - Power method - QR decomposition

UNIT III SYSTEM OF LINEAR EQUATIONS

UNIT IV LINEAR TRANSFORMATIONS
Linear Transformations - The Null Space and Range - Isomorphisms - Matrix Representation of Linear Transformations – Similarity - Eigenvalues and Eigenvectors

UNIT V INNER PRODUCT SPACES
The Dot Product on $\mathbb{R}^n$ and Inner Product Spaces - Orthonormal Bases - Orthogonal Complements - Application : Least Squares Approximation - Diagonalization of Symmetric M - Application: Quadratic Forms

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</tr>
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<tbody>
<tr>
<td>3</td>
<td>Jim Defranza, Daniel Gagliardi</td>
<td>Introduction to Linear Algebra with Application</td>
<td>Tata McGraw-Hill, New Delhi.</td>
<td>2008</td>
</tr>
</tbody>
</table>

WEBSITES:

1. www.sosmath.com
2. www.nptel.ac.in
3. www.mathworld.wolfram.com
OBJECTIVES:

1. To provide mathematical basis for acoustics waves and the characteristic behaviour of sound in pipes, resonators and filters.
2. To introduce the properties of hearing and speech

INTENDED OUTCOME:

1. The students will have the knowledge on acoustics waves, the characteristic behaviour of sound in pipes, resonators and filters and that knowledge will be used by them in different engineering and technology applications

UNIT I INTRODUCTION

UNIT II RADIATION AND RECEPTION OF ACOUSTIC WAVES
Radiation from a pulsating sphere – Acoustic reciprocity – continuous line source radiation impedance - Fundamental properties of transducers.Absorption and attenuation of sound. Absorption from viscosity – complex sound speed and absorption – classical absorption coefficient

UNIT III PIPES RESONATORS AND FILTERS

UNIT IV ARCHITECTURAL ACOUSTICS

UNIT V TRANSDUCTION
Transducer as an electives network – canonical equation for the two simple transducers transmitters – moving coil loud speaker– horn loud speaker, receivers – condenser – microphone – moving coil electrodynamics microphone piezoelectric microphone – calibration of receivers

Total: 45
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</table>

# WEBSITES:

1. www.acousticalsociety.org
2. www.acoustics-engineering.com
3. www.nptel.ac.in
4. www.ocw.mit.edu
OBJECTIVES:

1. To understand about the solid waste
2. To study about the waste treatment
3. To gain knowledge on the disposal of waste and waste management.
4. To get the information on energy conservation.

INTENDED OUTCOME:

1. The students will know solid waste and energy conservation. They will understand the methodologies to disposal of solid waste and its management.

UNIT I SOLID WASTE (9)

UNIT II WASTE TREATMENT (9)
Size Reduction – Aerobic Composting – Incineration – batch type and continuous flow type, Medical/Pharmaceutical Waste Incineration – Environmental Impacts – Measures of Mitigate Environmental Effects due to Incineration

UNIT III WASTE DISPOSAL (9)

UNIT IV HAZARDOUS WASTE MANAGEMENT (9)

UNIT V ENERGY GENERATION FROM WASTE (9)

Total: 45
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## WEBSITES:

2. [http://www.unep.or.jp/ietc/ESTdir/Pub/MSW/](http://www.unep.or.jp/ietc/ESTdir/Pub/MSW/)
OBJECTIVES:

1. To understand about the green chemistry
2. To study the atom efficient process and synthesis elaborately.
3. To gain knowledge on the green technology and renewable energy resources.
4. To get the information on catalysis

INTENDED OUTCOME:

1. Students will know the chemistry and application of green technology for energy sources. They will understand the role of green catalyst in industries.

UNIT I  INTRODUCTION TO GREEN CHEMICAL PRINCIPLES  (9)
Definition, tools, and twelve principles of green chemistry, solvent-less reactions and reactions in water, microwaves and fluorous solvents, green resolution of racemic mixtures, materials for a sustainable economy, chemistry of longer wear, agrochemicals: problems and green alternate solutions.

UNIT II  ATOM EFFICIENT PROCESSES  (9)
Atom efficient processes, evaluating chemical reagents according to their yield and atom efficiency, examples of efficient stoichiometric and catalytic processes, atom economy and homogeneous catalysis, halide-free synthesis and alternatives to Strecker synthesis.

UNIT III  BIOTECHNOLOGY AND GREEN CHEMISTRY  (9)
Bio technology and its applications in environmental protection-Bio informatics-Bio remediation, biological purification of contaminated air.Green chemistry for clean technology-Significance of green chemistry-Basic components of green chemistry, Industrial applications of green chemistry, green fuels-e-green propellants and bio catalysts.

UNIT IV  RENEWABLE RESOURCES  (9)
Use of renewable materials, evaluating feedstock and starting materials and their origins, toxicity, sustainability and the downstream implications of the choice of feedstock, commodity chemicals from glucose and biomass conversion.

UNIT V  CATALYSIS IN GREEN CHEMISTRY  (9)
Catalysis, energy requirements and usage, optimization of the reaction by minimizing the energy requirements, examples of efficient catalytic reactions including the use of heterogeneous catalysis, zeolites, oxidation using molecular oxygen.

Total: 45

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WEBSITES:

OBJECTIVES:

1. To get the information on electrochemical material.
2. To study about the conducting polymers
3. To understand about the fuel
4. To gain knowledge on the batteries and power sources.

INTENDED OUTCOME:

1. Students will understand about the fuel. They will get knowledge on the batteries and power sources.

UNIT I  METAL FINISHING

UNIT II  CONDUCTING POLYMERS AND ELECTROCHEMICALS
lectropolymerisation- anodic and cathodic polymerization-effect of reaction parameters on the course of the reaction- Electrochemical preparation of conducting polymers- poly acetylene- Electrolytic production of perchlorates and manganese dioxide- Electro organic chemicals- constant current electrolysis.

UNIT III  BATTERIES AND POWER SOURCES-I
Principles of energy conservation- electrochemical energy conservation- thermodynamic reversibility, Gibbs equation. EMF- battery terminology, energy and power density- Properties of anodes, cathodes, electrolytes and separators- Types of electrolytes.

UNIT IV  BATTERIES AND POWER SOURCES-II
Primary batteries- Dry Leclanche cells, alkaline primary batteries, Lithium batteries, Lithium ion batteries- construction, characteristics, problems associated with system- Secondary batteries- Lead acid, nickel cadmium- Fuel cells- Introduction, types of fuel cells, advantages.

UNIT V  ELECTROCHEMICAL MATERIAL SCIENCE
Solar cells- Preparation of CdS/Cu₂S solar cells by screen printing techniques and their characteristics - Amorphous silicon solar cells - Photo electrochemical cells(PEC) for conversion of light energy to electrical energy - PEC cells based on Cd/Se and Ga/As characteristics.

Total: 45
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</table>

**WEBSITES:**

2. http://hyperphysics.phy-astr.gsu.edu/hbase/electric/battery.html
OBJECTIVES:

1. To understand about the fuel
2. To study about the abrasives and lubricants.
3. To gain knowledge on inorganic chemicals and explosive materials.
4. To get the information on agriculture chemicals.

INTENDED OUTCOME:

1. The student will acquire basic knowledge on cement. The student will understand the interaction of engineering materials and their utilization in industries.

UNIT I CEMENT AND LIME (9)

UNIT II ABRASIVES AND REFRACTORIES (9)

UNIT III INORGANIC CHEMICALS (9)

UNIT IV EXPLOSIVES (9)

UNIT V AGRICULTURE CHEMICALS (9)

Total: 45

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</table>

**WEBSITES:**

2. [http://www.hon.ch/HONselect/Selection/D01.html](http://www.hon.ch/HONselect/Selection/D01.html)
PURPOSE:
It provides techniques of writing and also trains the students to write without their influence of mother tongue. In addition to honing their skills as professional writers, students will develop technical vocabularies that will aid writing research articles and discussing articles produced by their peers.

OBJECTIVE:

| 1. Develop abilities to write technically and expressively,  
2. Recognize writing as a constructive, meaningful process,  

INTENDED OUTCOMES:
Students undergoing this course are able to

| 1. Construct simple sentences, correct common grammatical errors in written English.  
2. Build confidence in English language by imbibing lexical and syntax rules.  
3. Enrich their reading ability for effective writing. |

UNIT – 1 BASICS OF WRITING
Introduction to Technical Writing – Importance of Writing – Characteristics of Writing – Audience Recognition/ Analysis – Appropriateness of language — Conciseness and Flow – Bias free and plain writing – Impersonal and Formal Language - Techniques of Technical Writing – Overcoming writer’s block – Prioritizing for effective writing – Avoiding plagiarism.

UNIT – 2 PARAGRAPHS AND ESSAYS

UNIT – 3 LETTERS, MEMOS AND EMAIL

UNIT – 4 THE ART OF CONDENSATION AND TECHNICAL PROPOSALS
UNIT – 5 REPORTS AND RESEARCH ARTICLES


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<tbody>
<tr>
<td>1</td>
<td>V.N. Arora &amp; Lakshmi Chandra</td>
<td>Improve Your Writing: Revised First Edition</td>
<td>OUP</td>
<td>2014</td>
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<tr>
<td>1</td>
<td>Crème, P. and M. Lea.</td>
<td>Writing at University: A guide for students.</td>
<td>OUP</td>
<td>2003</td>
</tr>
<tr>
<td>2</td>
<td>Graham King</td>
<td>Collins Improve Your Writing</td>
<td>Collins; First edition</td>
<td>2009</td>
</tr>
<tr>
<td>3</td>
<td>David Morley</td>
<td>The Cambridge Intro. To Creative Writing</td>
<td>Cambridge</td>
<td>2008</td>
</tr>
</tbody>
</table>

WEBSITES:

http://www.stevepavlina.com/blog/2006/08/10-ways-to-improve-your-technical-skills/
http://www.nyu.edu/classes/keefer/brain/net2.html
https://www.udemy.com/technical-writing-and-editing/
http://techwhirl.com/what-is-technical-writing/
OPEN ELECTIVES OFFERED BY DEPARTMENT OF
COMPUTER SCIENCE AND ENGINEERING
COURSE OBJECTIVES:

- To introduce the Java programming language and explore its current strengths and weaknesses
- To study how object-oriented concepts are implemented in the Java programming language
- To write working Java code to demonstrate the use of applets for client-side programming

LEARNING OUTCOMES:

- The way that exceptions are detected and handled in the Java programming language
- Working of Java code that demonstrates multiple threads of execution

UNIT I  Introduction


UNIT II  HTML

Introduction, Editors, Elements, Attributes, Heading, Paragraph, Formatting, Link, Head, Table, List, Block, Layout, CSS, Form, Iframe, Colors, Colormode, Colorvalue, Image, Maps, map, area, attributes of image area, Extensible Markup Language (XML) - Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing, XHTML in brief, CGI Scripts - Introduction - Environment Variable, GET and POST Methods

UNIT III  PERL

Introduction, Variable, Condition, Loop, Array, Implementing datastructure, Hash, String, Regular Expression, File handling, I/O handling, JavaScript Basics, Statements, comments, variable, comparison, condition, switch, loop, break, Object - string, array, Boolean, reg-ex. Function, Errors, Validation, Cookies - Definition of cookies, Create and Store a cookie with example, Java Applets - Container Class, Components, Applet Life Cycle, Update method, Applications

UNIT IV  Client-Server Programming

Client-Server programming, In Java - Java Socket, Java RMI, Threats - Malicious code - viruses, Trojan horses, worms, eavesdropping, spoofing, modification, denial of service attacks - Network security techniques - Password and Authentication - VPN, IPSec, security in electronic transactions, Secure Socket Layer (SSL), Secure Shell (SSH), Firewall - Introduction, Packet filtering, Stateful, Application layer, Proxy.
UNITV  Internet Telephony


Total Hours: 45

TEXT BOOKS:


REFERENCES:

17BEC50E02 MULTIMEDIA AND ANIMATION

COURSE OBJECTIVES:

• To study the graphicstic techniques and algorithms.
• To study the multimedia concepts and various I/O technologies.

LEARNING OUTCOMES:

• To enable the students to develop their creativity
• To impart the fundamental concepts of Computer Animation and Multimedia.

UNIT I Introduction (9)


UNIT II Creating Animation in Flash (9)


UNIT III 3D Animation & its Concepts (9)


UNIT IV Motion Caption (9)


UNIT V Concept Development (9)


Total Hours: 45

TEXT BOOK:


REFERENCES:

1. Principles of Multimedia– Ranjan Parekh, 2007, TMH. (Unit I, Unit V)
COURSE OBJECTIVES:

- Assemble/setup and upgradepersonal computersystems
- Perform installation, configuration, and upgrading of microcomputer hardwareand software.
- Install/connect associated peripherals.

LEARNINGOUTCOME:

- Diagnose and troubleshoot microcomputer systems hardwareand software, and other
  Peripheral equipment.

UNITI   Introduction

Introduction–ComputerOrganization–Number SystemsandCodes–Memory –ALU–CU– Instruction
Multitasking and Multiprogramming–Virtual Memory – Cache Memory– Modern PC and User.

UNITII   Peripheral Devices

Special Types of Disk Drives– Mouse and Trackball– Modem–Fax–Modem – CD ROM Drive –

UNITIII  PC HardwareOverview

Introduction – HardwareBIOS DOS Interaction– The PC family– PC hardware – Inside the System Box–
MotherboardLogic – Memory Space – Peripheral Interfaces and Controllers– Keyboard Interface –
CRT Display Interface – FDC – HDC.

UNITIV   InstallationandPreventive Maintenance

Introduction– system configuration– pre installation planning– Installation practice– routine checks–
PC Assembling and Integration– BIOS Setup– Engineering versions and compatibility –
preventive maintenance– DOS– Virus – Data Recovery.

UNTV   Troubleshooting

Introduction – computer faults– Nature of faults– Types of faults– Diagnostic programs and tools–
Microprocessor and Firmware– Programmable LSI’s– Bus Faults– Faults Elimination process–
Systematic Troubleshooting– Symptom Observation and Analysis– Fault Diagnosis– Fault rectification–
Troubleshooting levels– FDD, HDD, CD ROM Problems.

Total Hours: 45
TEXT BOOK:


REFERENCES:

COURSE OBJECTIVES:

- Understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc.
- Understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.

INTENDED OUTCOMES:

- Be aware of the important topics and principles of software development.
- Have the ability to write a computer program to solve specified problems.
- Be able to use the Java SDK environment to create, debug, and run simple Java programs.

UNIT I  INTRODUCTION TO JAVA  (9)
Object-oriented programming concepts—objects—classes—methods and messages—abstraction and encapsulation—inheritance—abstract classes—polymorphism. Objects and classes in Java—defining classes—methods—access specifiers—static members—constructors—finalize method

UNIT II  PACKAGES  (9)
Arrays—Strings—Packages—Java-Doc comments—Inheritance—class hierarchy—polymorphism—dynamic binding—final keyword—abstract classes

UNIT III  I/O STREAMS  (9)
The Object class—Reflection—interfaces—object cloning—inner classes—proxies—I/O Streams—Graphics programming—Frame—Components—working with 2D shapes.

UNIT IV  EXCEPTION HANDLING  (9)
Basic of event handling—event handlers—adapter classes—actions—mouse events—AWT event hierarchy—introduction to Swing—Model-View-Controller design pattern—buttons—layout management—Swing Components—exception handling—exception hierarchy—throwing and catching exceptions.

UNIT V  MOTIVATION FOR GENERIC PROGRAMMING  (9)
Motivation for generic programming—generic classes—generic methods—generic code and virtual machine—inheritance and generics—reflection and generics—Multi-threaded programming—interrupting threads—thread states—thread properties—thread synchronization—Executors—synchronizers.
TEXTBOOK:


REFERENCES:


WEBSITES:

LIST OF OPEN ELECTIVES OFFERED BY

ELECTRICAL AND ELECTRONICS ENGINEERING DEPARTMENT
OBJECTIVES

- To understand the basic concepts of electric hybrid vehicle.
- To gain the knowledge about electric propulsion unit.
- To understand and gain the knowledge about various energy storage devices.

INTENDED OUTCOMES

- At the end of the course the student will be understand the concept of electric hybrid vehicle and its energy storage schemes.

UNIT I    INTRODUCTION

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

UNIT II    HYBRID ELECTRIC DRIVE-TRAINS

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNIT III   ELECTRIC PROPULSION UNIT

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT IV    ENERGY STORAGE

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

UNIT V    ENERGY MANAGEMENT STRATEGIES

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

TOTAL: 45 HOURS

TEXT BOOK

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<tr>
<td>1</td>
<td>Iqbal Hussein</td>
<td>Electric and Hybrid Vehicles: Design Fundamentals</td>
<td>CRC Press – 2nd edition</td>
<td>2010</td>
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OBJECTIVES

- To gain the knowledge about energy management.
- To understand the basic concepts in economic analysis in energy management.
- To understand the basic principles of energy audit.

INTENDED OUTCOMES

- At the end of the course the student will be able to understand the concept of energy efficient motors, economic crisis and energy management.

UNIT I ENERGY MANAGEMENT

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting – Energy Auditor and Energy Manager – Eligibility, Qualification and functions - Questionnaire and check list for top management.

UNIT II ECONOMIC ASPECTS AND ANALYSIS

Economics analysis – Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, life cycle costing analysis - Calculation of simple payback method, net present worth method.

UNIT III BASIC PRINCIPLES OF ENERGY AUDIT

Energy audit – definition, concept, type of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes – Energy audit of industries – energy saving potential, energy audit of process industry, thermal power station, building energy audit.

UNIT IV ENERGY EFFICIENT MOTORS


UNIT V POWER FACTOR IMPROVEMENT, LIGHTING AND ENERGY INSTRUMENTS


TOTAL: 45 HOURS

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<td>1</td>
<td>John.C.Andreas</td>
<td>Energy Efficient Electric Motors</td>
<td>Marcel Dekker Inc Ltd – 3rd edition</td>
<td>2005</td>
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</tbody>
</table>
OBJECTIVES

- To understand the basic principles of PLC systems.
- To gain the knowledge about data handling functions.
- To understand the principles of PID.

INTENDED OUTCOMES

- At the end of the course the student will be able to understand the registers and functions in PLC and they are able to do the program.

UNIT I INTRODUCTION

PLC Basics PLC system, I/O modules and interfacing CPU processor programming equipment Programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

UNIT II PLC PROGRAMMING

PLC Programming input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill-press operation. Digital logic gates programming in the Boolean algebra system, conversion examples Ladder diagrams for process control Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system.

UNIT III REGISTERS AND PLC FUNCTIONS

PLC Registers: Characteristics of Registers module addressing holding registers input registers, output registers. PLC Functions Timer functions and industrial applications counters counter function industrial applications, Architecture functions, Number comparison functions, number conversion functions.

UNIT IV DATA HANDLING FUNCTIONS

Data handling functions: SKIP, Master control Relay Jump Move FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axes and three axis Robots with PLC, Matrix functions.

UNIT V PID PRINCIPLES

Analog PLC operation: Analog modules and systems Analog signal processing multi bit data processing, analog output application examples, PID principles position indicator with PID control, PID modules, PID tuning, PID functions

TOTAL: 45 HOURS

TEXT BOOKS

<table>
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<tr>
<td>1</td>
<td>John Webb and Ronald A Reiss</td>
<td>Programmable Logic Controllers – Principle and Applications</td>
<td>Fifth edition, PHI</td>
<td>2004</td>
</tr>
</tbody>
</table>

WEBSITE

http://www.mikroe.com/old/books/plcbook/chapter1/chapter1.htm,- Introduction to programmable Logic controller
OBJECTIVES

- To gain the knowledge about environmental aspects of energy utilization.
- To understand the basic principles of wind energy conversion, solar cells, photovoltaic conversion.
- To understand the basic principles fuel cell, Geo thermal power plants.
- To gain the knowledge about hydro energy.

INTENDED OUTCOMES

- At the end of the course student understands about all types of energy sources and utilization.

UNIT I INTRODUCTION


UNIT II SOLAR ENERGY


UNIT III WIND ENERGY


UNIT IV HYDRO ENERGY

Hydropower, classification of hydro power, Turbine selection, Ocean energy resources, ocean energy routes. Principles of ocean thermal energy conversion systems, ocean thermal power plants. Principles of ocean wave energy conversion and tidal energy conversion.

UNIT V OTHER SOURCES

Bio energy and types –Fuel cell, Geo-thermal power plants; Magneto-hydro-dynamic (MHD) energy conversion.

TOTAL: 45 HOURS
### TEXT BOOKS

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<tr>
<td>1</td>
<td>Rai.G.D</td>
<td>Non-conventional sources of energy</td>
<td>Khanna publishers</td>
<td>2011</td>
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<td>1</td>
<td>Rao.S. &amp; Parulekar</td>
<td>Energy Technology</td>
<td>Khanna publishers, Eleventh Reprint</td>
<td>2013</td>
</tr>
</tbody>
</table>

### WEBSITES

1. [www.energycentral.com](http://www.energycentral.com)
2. [www.catelectricpowerinfo.com](http://www.catelectricpowerinfo.com)
OPEN ELECTIVES OFFERED BY
ELECTRONICS AND COMMUNICATION ENGINEERING TO OTHER DEPARTMENTS
OBJECTIVES:

- To introduce students to the embedded systems, its hardware and software.
- To introduce devices and buses used for embedded networking.
- To study about task management
- To learn about semaphore management and message passing
- To study about memory management

INTENDED OUTCOMES:

- Ability to understand embedded systems, its hardware and software.
- Gain knowledge about devices and buses used for embedded networking.
- Gain knowledge about task management.
- Gain knowledge about semaphore management and message passing.
- Gain knowledge about memory management.

UNIT-I INTRODUCTION TO EMBEDDED SYSTEM
Introduction- Embedded systems description, definition, design considerations & requirements-
Overview of Embedded System Architecture (CISC and RISC)- Categories of Embedded Systems-
embedded processor selection & tradeoffs- Embedded design life cycle -Product specifications-
hardware / software partitioning- iterations and implementation- hardware software integration –
product testing techniques– ARM7.

UNIT-II OPERATING SYSTEM OVERVIEW
Introduction – Advantage and Disadvantage of Using RTOS– Multitasking– Tasks– Real Time Kernels –
Scheduler- Non-Preemptive Kernels – Preemptive Kernels – Reentrancy- Reentrant Functions–
Round Robin Scheduling- Task Priorities- Static Priorities– Mutual Exclusion– Deadlock– Inter task
Communication – Message Mailboxes – Message Queues– Interrupts– Task Management– Memory
Management– Time Management– Clock Ticks.

UNIT-III TASK MANAGEMENT
Introduction–μ C/OS-II Features– Goals of μ C/OS-II– Hardware and Software Architecture– Kernel
μ C/OS-II – Clock Tick– μ C/OS-II Initialization. Task Management: Creating Tasks– Task Stacks–
Stack Checking– Task’s Priority– Suspending Task– Resuming Task. Time Management: Delaying a
Task– Resuming a Delayed Task– System Time. Event Control Blocks– Placing a Task in the ECB
Wait List– Removing a Task from an ECB wait List.

UNIT-IV SEMAPHORE MANAGEMENT AND MESSAGE PASSING
Semaphore Management: Semaphore Management Overview– Signaling a Semaphore.
Message Mailbox Management: Creating a Mailbox – Deleting Mailbox – Waiting for a Message box–
Sending Message to a Mailbox– Status of Mailbox. Message Queue Management: Creating Message
Queue– Deleting a Message Queue– Waiting for a Message Queue– Sending Message to a Queue–
Flushing a Queue.

UNIT-V MEMORY MANAGEMENT
Memory Management: Memory Control Blocks– Creating Partition– Obtaining a Memory Block–
Returning a Memory Block. Getting Started with μ C/OS-II– Installing μ C/OS-II– Porting μ C/OS-II:
Development Tools– Directories and Files– Testing a Port– IAR Workbench with μ C/OS-II–μ C/OS-II–
μ C/OS-II Porting on a 8051CPU– Implementation of Multitasking– Implementation of Scheduling
and Rescheduling – Analyze the Multichannel ADC with help of μ C/OS-II.

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<tr>
<td>1</td>
<td>JeanJ. Labrosse</td>
<td>Micro C/OS–II The Real Time Kernel</td>
<td>CMPBOOKS</td>
<td>2009</td>
</tr>
<tr>
<td>3</td>
<td>Steve Furbe,</td>
<td>ARM System-on-Chip Architecture,</td>
<td>Addison-Wesley Professional, California</td>
<td>2000</td>
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OBJECTIVES:

- To study about various speakers and microphone
- To learn the fundamental of television systems and standards
- To learn the process of audio recording and reproduction
- To study the various telephone networks

INTENDED OUTCOMES:

- Gain knowledge about various speakers and microphone
- Gain knowledge about the fundamental of television systems and standards
- Gain knowledge about the process of audio recording and reproduction
- Gain knowledge about the various telephone networks

UNIT I LOUDSPEAKERS AND MICROPHONES


UNIT II TELEVISION STANDARDS AND SYSTEMS


UNIT III OPTICAL RECORDING AND REPRODUCTION


UNIT IV TELECOMMUNICATION SYSTEMS


UNIT V HOME APPLIANCES

Basic principle and block diagram of microwave oven; washing machine hardware and software; Components of air conditioning and refrigeration systems.

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<td>1</td>
<td>S.P. Bali</td>
<td>Consumer Electronics</td>
<td>PearsonEducation</td>
<td>2007</td>
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<tr>
<td>2</td>
<td>J.S.Chitode</td>
<td>Consumer Electronics</td>
<td>Technical Publications</td>
<td>2007</td>
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<td>1</td>
<td>Philip Hoff, Philip Herbert Hoff.</td>
<td>Consumer Electronics for Engineers.</td>
<td>Cambridge University Press</td>
<td>1998</td>
</tr>
</tbody>
</table>
OBJECTIVES:

- To introduce the basic concepts of neural networks and its applications in various domain
- To educate how to use Soft Computing to solve real-world problems
- To have a solid understanding of Basic Neural Network.

INTENDED OUTCOMES:

- Understand the basic concepts of neural networks and its applications in various domain
- Ability to develop the use of Soft Computing to solve real-world problems
- Understand the Basic Neural Network.

UNIT I INTRODUCTION TO NEURAL NETWORKS
Introduction-biological neurons and their artificial models-learning, adaptation and neural network's learning rules-types of neural networks-single layer, multiple layer-feed forward, feedback networks

UNIT II LEARNING PROCESS

UNIT III PERCEPTION

UNIT IV ATTRACT OR NEURAL NETWORK AND ART

UNIT V SELF ORGANIZATION

TEXT BOOKS:

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<td>1</td>
<td>Simon Haykin</td>
<td>Neural Networks and Learning Machines</td>
<td>Pearson/Prentice Hall 3rd Edition</td>
<td>2009</td>
</tr>
<tr>
<td>2</td>
<td>Satish Kumar</td>
<td>Neural Networks: A Classroom Approach</td>
<td>TMH</td>
<td>2008</td>
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<td>3</td>
<td>Wasserman P.D</td>
<td>Neural Computing Theory &amp; Practice</td>
<td>Van Nortrand Reinhold</td>
<td>1989</td>
</tr>
<tr>
<td>4</td>
<td>Freeman J.A., S kapura D.M</td>
<td>Neural networks, algorithms, applications, and programming techniques.</td>
<td>AdditionWesley</td>
<td>2005</td>
</tr>
</tbody>
</table>
OBJECTIVES:
- To introduce the basic concepts of Fuzzy logic and its applications in various domain
- To educate how to use Fuzzy computation to solve real-world problems
- To have a solid understanding of Basic fuzzy models.

INTENDED OUTCOMES:
- Understand the basic concepts of Fuzzy logic and its applications in various domain
- Ability to develop how to use Fuzzy computation to solve real-world problems
- Understand basic fuzzy models.

UNIT-I
Basics of Fuzzy Logic: Fuzzy sets, Properties of fuzzy sets, operation in fuzzy sets, fuzzy relations, the extension principle

UNIT-II
Theory of Approximate Reasoning: Linguistic variables, Fuzzy proportions, Fuzzy if-then statements, inference rules, compositional rule of inference-fuzzy models

UNIT-III
Fuzzy Knowledge Based Controllers (Fkbc): Basic concept structure of FKBC, choice of membership functions, scaling factors, rules, fuzzy fiction and de fuzzy fiction procedures—Design of Fuzzy Logic Controller

UNIT-IV

UNIT V
Fuzzy based systems: Simple applications of FKBC-washing machines-traffic regulations-lift control-fuzzy in medical Applications-Introduction to ANFIS.

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<td>2</td>
<td>G.J. Klir and T.A. Folger</td>
<td>Fuzzy Sets Uncertainty and Information</td>
<td>PHI IEEE</td>
<td>1995</td>
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<td>1</td>
<td>Timothy J. Ross</td>
<td>Fuzzy Logic with Engineering Applications</td>
<td>McGraw Hill</td>
<td>1997</td>
</tr>
<tr>
<td>2</td>
<td>George. J Klir and Bo Yuan</td>
<td>Fuzzy Sets and Fuzzy Logic</td>
<td>Prentice Hall, USA</td>
<td>1995</td>
</tr>
</tbody>
</table>
LIST OF OPEN ELECTIVES
OFFERED BY AEROSPACE ENGINEERING
OBJECTIVES:

To provide in-depth knowledge on various techniques of non-destructive testing.

UNIT I INTRODUCTION

Properties of Materials – Characteristics of Ferrous, Non-ferrous and Alloys. Destructive testing and Non-destructive testing – Classification – Uses and applications. Codes, Standards and Specifications (ASME, ASTM, AWS etc.).

UNIT II PENETRANT TESTING AND MAGNETIC PARTICLE INSPECTION

Introduction to Penetrant Testing – Liquid Penetrants and Dye Penetrants - An Illustration of Penetrant Testing, Advantages of Penetrant Testing, Disadvantages of Penetrant Testing. Introduction to Magnetic Particle Inspection - An Illustration of Magnetic Particle Inspection, Advantages of Magnetic Particle Crack Detection, Disadvantages of Magnetic Particle Crack Detection

UNIT III ULTRASONIC FLAW DETECTION AND RADIOGRAPHY INSPECTION


UNIT IV EDDY CURRENT AND ELECTRO-MAGNETIC METHODS


UNIT V NON-DESTRUCTIVE INSPECTION (NDI) AND ITS APPLICATIONS

Inspection of Raw Products, Inspection For In-Service Damage, Power Plant Inspection, Storage Tank Inspection, Aircraft Inspection, Jet Engine Inspection, Pressure Vessel Inspection, Bridge Inspection, Pipeline Inspection.
# TEXT BOOKS:

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</table>

# WEB REFERENCE:

https://www.asnt.org/MinorSiteSections/AboutASNT/Intro-to-NDT

https://www.asnt.org/

www.bindt.org/

www.ndt.net/

OBJECTIVES:
- Ability to design UAV system
- Ability to identify different hardware for UAV

UNIT I INTRODUCTION TO UAV
History of UAV – classification – Introduction to Unmanned Aircraft Systems--models and prototypes – System Composition-applications

UNIT II THE DESIGN OF UAV SYSTEMS
Introduction to Design and Selection of the System- Aerodynamics and Airframe Configurations- Characteristics of Aircraft Types-Design Standards and Regulatory Aspects-UK, USA and Europe- Design for Stealth--control surfaces specifications.

UNIT III AVIONICS HARDWARE
Autopilot – AGL-pressure sensors-servos-accelerometer –gyros-actuators- power supply-processor, integration, installation, configuration, and testing

UNIT IV COMMUNICATION PAYLOADS AND CONTROLS
Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range –modems-memory system-simulation-ground test-analysis-trouble shooting

UNIT V THE DEVELOPMENT OF UAV SYSTEMS
Waypoints navigation-ground control software- System Ground Testing- System In-flight Testing- Future Prospects and Challenges-Case Studies – Mini and Micro UAVs.
**TEXT BOOKS:**

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<tbody>
<tr>
<td>1.</td>
<td>Reg Austin</td>
<td>Unmanned Aircraft Systems UAV design, development and deployment</td>
<td>John Wiley &amp; Sons, New York</td>
<td>2011</td>
</tr>
<tr>
<td>2.</td>
<td>Jay Gundlach</td>
<td>Designing Unmanned Aircraft Systems</td>
<td>American Institute of Aeronautics and Astronautics, Reston</td>
<td>2014</td>
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**WEB REFERENCE:**

- [rahauav.com/Library/.../Unmanned-Air-Systems](http://rahauav.com/Library/.../Unmanned-Air-Systems)
- [http://ocw.mit.edu/courses/aeronautics-and-astronautics/16-83x](http://ocw.mit.edu/courses/aeronautics-and-astronautics/16-83x)
- [spaceflight.nasa.gov/shuttle/reference/shutref/orbiter/.../plcomm.html](http://spaceflight.nasa.gov/shuttle/reference/shutref/orbiter/.../plcomm.html)
- [www.theuav.com/](http://www.theuav.com/)
OBJECTIVES:
To study the procedure of the formation of aerodrome, its design and the concepts of air transportation.

UNIT - I INTRODUCTION
Development of air transportation, comparison with other modes of transport – Role of IATA, ICAO – The general aviation industry airline – Factors affecting general aviation, use of aircraft, airport: airline management and organization – levels of management, functions of management, Principles of organization planning the organization – chart, staff departments & line departments.

UNIT - II AIRLINE ECONOMICS
Forecasting – Fleet size, Fleet planning, the aircraft selection process, operating cost, passenger capacity, load factor etc. – Passenger fare and tariffs – Influence of geographical, economic & political factors on routes and route selection.

UNIT - III PRINCIPLES OF AIRLINES SCHEDULING
Equipment maintenance, Flight operations and crew scheduling, Ground operations and facility limitations, equipments and types of schedule – hub & spoke scheduling, advantages / disadvantages & preparing flight plans – Aircraft scheduling in line with aircraft maintenance practices.

UNIT - IV AERODROME DATA, PHYSICAL CHARACTERISTICS AND OBSTACLE RESTRICTION

UNIT - V VISUAL AIDS FOR NAVIGATION, VISUAL AIDS FOR DENOTING OBSTACLES EMERGENCY AND OTHER SERVICES
Visual aids for navigation Wind direction indicator – Landing direction indicator – Location and characteristics of signal area – Markings, general requirements – Various markings – Lights, general requirements – Aerodrome beacon, identification beacon – Simple approach lighting system and various lighting systems – VASI & PAPI - Visual aids for denoting obstacles; object to be marked and lighter – Emergency and other services.
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### WEB REFERENCE:

- [www.grc.nasa.gov/WWW/k-12/airplane/](http://www.grc.nasa.gov/WWW/k-12/airplane/)
- [www.history.navy.mil/branches/car-toc.html](http://www.history.navy.mil/branches/car-toc.html)
- [www.britannica.com/EBchecked/topic/.../Aircraft-configurations](http://www.britannica.com/EBchecked/topic/.../Aircraft-configurations)
- [www.brown.edu/Departments/EEB/EML/.../principles_flight.html](http://www.brown.edu/Departments/EEB/EML/.../principles_flight.html)
OBJECTIVES:
To introduce the basic concepts of various avionicssystems of aircraft.

UNIT I INTRODUCTION TO AVIONICS

Need for avionics in civil and military aircraft and space systems – integrated avionics and weapon systems – typical avionics subsystems, design, technologies – Introduction to digital computer and memories.

UNIT II DIGITAL AVIONICS ARCHITECTURE


UNIT III FLIGHT DECKS AND COCKPITS

Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS .

UNIT IV INTRODUCTION TO NAVIGATION SYSTEMS


UNIT V AIR DATA SYSTEMS AND AUTO PILOT

Air data quantities – Altitude, Air speed, Vertical speed, Mach Number, Total air temperature, Mach warning, Altitude warning – Auto pilot – Basic principles, Longitudinal and lateral auto pilot.
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<tbody>
<tr>
<td>1.</td>
<td>Albert Helfrick,D</td>
<td>Principles of Avionics</td>
<td>Avionics Communications Inc, Leesburg, USA</td>
<td>2009</td>
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<tr>
<td>1.</td>
<td>Ian Moir, Allan Seabridge, Malcolm Jukes</td>
<td>Civil Avionics Systems</td>
<td>John Wiley &amp; Sons,New Jersey, USA.</td>
<td>2013</td>
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</table>

WEB REFERENCES:

www.ntps.edu/courses/116-introduction-to-avionics-systems-course
www.ece.ucsb.edu/courses/ECE152/152A_Su11Shynk/Lec1.pdf
www.pbase.com/bruceleibowitz/cockpit
www.cranfield.ac.uk/soe/shortcourses/.../avionics-introduction.html
OPEN ELECTIVES OFFERED BY DEPARTMENT OF AUTOMOBILE ENGINEERING
INTENDED OBJECTIVES:

- This course enables the students to know about all the main and auxiliary systems of automobile with its base construction and working.

UNIT I  ENGINE AND FUEL FEED SYSTEMS
Classification of Engine, construction and working of four stroke petrol and diesel engine, firing order and its significance. Carburettor working principle, requirements of an automotive carburettor, Petrol injection Systems (MPFI, TBI), Diesel fuel injection systems (CRDI)

UNIT –II  TRANSMISSION SYSTEMS

UNIT –III  SUSPENSION SYSTEM

UNIT-IV  BRAKES

UNIT -V  ELECTRICAL SYSTEM
Principle and construction of lead acid battery. Lighting system: details of head light and side light, LED lighting system, head light dazzling and preventive methods – Horn, wiper system and trafficator. Starting System and charging system.

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<tr>
<td>3.</td>
<td>Dr.Kirpal Singh</td>
<td>Automobile Engineering</td>
<td>Standard Publishes</td>
<td>2011</td>
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<td>AUTHOR(S)</td>
<td>TITLE OF THE BOOK</td>
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INTENDED OBJECTIVES:

- The objective of this course is to make the students to know and understand the constructional details, operating characteristics and design aspects of Two and Three wheelers.

UNIT I INTRODUCTION
Classifications- design considerations – weight and dimension limitations – requirements stability problems, gyroscopic effect- pendulum effect of two and three wheelers.

UNIT II POWER UNITS, IGNITION SYSTEMS AND OTHER ELECTRICAL SYSTEMS
2 stoke and 4 stoke SI engines and CI engines design criteria– design of cylinders, cylinder head, cooling fins, crank case, connecting rod and crank shaft. Carburettor types and design. Battery coil ignition, magneto ignition and electronic ignition. Lighting and other electrical system.

UNIT III CLUTCHES AND TRANSMISSION
Types of clutches for 2 and 3 wheelers. Design of clutch system. Gears for two and three wheelers. Design of gear box and gear change mechanism. Belt, chain and shaft drive. Freewheeling devices, starting systems.

UNIT IV FRAMES, SUSPENSION, WHEELS AND TYRES
Types of frames used for two wheelers and three wheelers. Wheel frames- construction design of frames for fatigue strength torsional stiffness and lateral stability. Front and rear forks. Springs for suspension, Dampers, constructional details of wheel and tyres.

UNIT V THREE WHEELERS
Auto rickshaws, different types, Pick-Ups and delivery type vehicle, frames and transmission for 3 wheelers wheel types, wheel attachment tyre types. Brakes and their operating mechanism.

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INTENDED OBJECTIVES:

- The objective of this course is to make the students to know and understand the maintenance and fault diagnosis of basic systems in Automobile.

UNIT I MAINTENANCE OF RECORDS AND SCHEDULES
Importance of maintenance, preventive (scheduled) and breakdown (unscheduled) maintenance, requirements of maintenance, preparation of check lists, Inspection schedule, maintenance of records, log sheets and other forms, safety precautions in maintenance.

UNIT II ENGINE MAINTENANCE
Dismantling of engine components and cleaning, cleaning methods, visual and dimensional inspections, minor and major reconditioning of various components, reconditioning methods, engine assembly, special tools used for maintenance overhauling, engine tune up.

UNIT III CHASSIS MAINTENANCE
Mechanical and automobile clutch and gear box, servicing and maintenance, maintenance servicing of propeller shaft and differential system, Maintenance servicing of suspension systems. Brake systems, types and servicing techniques, Steering systems, overhauling and maintenance. Wheel alignment, computerized alignment and wheel balancing.

UNIT IV ELECTRICAL SYSTEM MAINTENANCE
Testing methods for checking electrical components, checking battery, starter motor, charging systems, DC generator and alternator, ignitions system, lighting systems, Fault diagnosis and maintenance of modern electronic controls, checking and servicing of dash board instruments.

UNIT V MAINTENANCE OF FUEL SYSTEM, COOLING SYSTEMS, LUBRICATION SYSTEM AND VEHICLE BODY
Servicing and maintenance of fuel system of different types of vehicles, calibration and tuning of engine for optimum fuel supply, Cooling systems, water pump, radiator, thermostat, anticorrosion and antifreeze additives, Lubrication maintenance, lubricating oil changing, greasing of parts, Vehicle body maintenance, minor and major repairs. Door locks and window glass actuating system maintenance.

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<td>3.</td>
<td>Service Manuals from Different Vehicle Manufacturers</td>
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INTENDED OBJECTIVES:

- This course enables the students to have a knowledge about the recent technologies that is in use in automobile.

UNIT I       TRENDS IN POWER PLANTS

UNIT II      DRIVER ASSISTANCE SYSTEMS
Collision Avoidance Systems, Adaptive cruise control, adaptive noise control, anti spin regulation, traction control systems, cylinder cut-off technology, ABS, Driver Drowsiness Detection system

UNIT III     SUSPENSION BRAKES AND SAFETY
Air suspension - Closed loop suspension - antiskid braking system, Retarders, Regenerative braking safety cage - air bags - crash resistance - passenger comfort.

UNIT IV       NOISE & POLLUTION
Reduction of noise - Internal & external pollution control through alternate fuels/power plants – Catalytic converters and filters for particulate emission.

UNIT VTELEMATICS
Global positioning systems, geographical information systems, navigation systems, automotive vision system, road recognition

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LIST OF OPEN ELECTIVES
OFFERED BY CIVIL ENGINEERING
OBJECTIVE:
At the end of this course the students should have learnt the basic terms of housing programmes, planning and designing of housing projects, construction techniques and cost effective materials and housing finance and project appraisal techniques.

UNIT I INTRODUCTION TO HOUSING
Definition of Basic Terms – House, Home, Household, Apartments, Multi storeyed Buildings, Special Buildings, Objectives and Strategies of National Housing Policies, Principle of Sustainable Housing, Housing Laws at State level, Bye-laws at Urban and Rural Local Bodies – levels - Development Control Regulations, Institutions for Housing at National, State and Local levels

UNIT II HOUSING PROGRAMMES
Basic Concepts, Contents and Standards for Housing Programmes - Sites and Services, Neighbourhoods, Open Development Plots, Apartments, Rental Housing, Co-operative Housing, Slum Housing Programmes, Role of Public, Private and Non-Government Organisations.

UNIT III PLANNING AND DESIGN OF HOUSING PROJECTS
Formulation of Housing Projects – Site Analysis, Layout Design, Design of Housing Units (Design Problems)

UNIT IV CONSTRUCTION TECHNIQUES AND COST-EFFECTIVE MATERIALS
New Constructions Techniques – Cost Effective Modern Construction Materials, Building Centers – Concept, Functions and Performance Evaluation

UNIT V HOUSING FINANCE AND PROJECT APPRAISAL

TOTAL HRS : 45

TEXT BOOKS

REFERENCES
2. UNCHS, National Experiences with Shelter Delivery for the Poorest Groups, UNCHS (Habitat), Nairobi, 2000.
OBJECTIVE:

At the end of this course the students should have learnt various machineries of construction, electrical systems in building, design and principle of illumination, refrigeration principle and application and various fire safety installations.

UNIT I MACHINERIES

Hot Water Boilers – Lifts and Escalators – Special features required for physically handicapped and elderly – Conveyors – Vibrators – Concrete mixers – DC/AC motors – Generators – Laboratory services – Gas, water, air and electricity

UNIT II ELECTRICAL SYSTEMS IN BUILDINGS


UNIT III PRINCIPLES OF ILLUMINATION & DESIGN


UNIT IV REFRIGERATION PRINCIPLES & APPLICATIONS


UNIT V FIRE SAFETY INSTALLATION


TOTAL HRS : 45
TEXT BOOKS

REFERENCES
OBJECTIVE:
At the end of this course the students should have learnt the irrigation system requirements, irrigation scheduling, strategies in water use management, canal operation places and involvement of stake holder

UNIT I. IRRIGATION SYSTEM REQUIREMENTS 9

UNIT II. IRRIGATION SCHEDULING 9
Time of irrigation – Critical stages of water need of crops – Criteria for scheduling irrigation – Frequency and interval of irrigation

UNIT III. MANAGEMENT 9
Structural and non-structural strategies in water use and management – Conjunctive use of surface and ground waters – Quality of irrigation water.

UNIT IV. OPERATION 9
Operational plans – Main canals, laterals and field channels – Water control and regulating structures – Performance indicators – Case study

UNIT V. INVOLVEMENT OF STAKE HOLDERS 9
Farmer’s participation in System operation – Water user’s associations – Farmer councils – Changing paradigms on irrigation management – Participatory irrigation management

TOTAL HRS : 45

TEXT BOOKS

REFERENCES
OBJECTIVE:

At the end of this course, the students should have learnt the modern construction methods, methods for special structures, modern equipments used for excavation, conveyance etc and principles and practices of temporary structures.

UNIT - I MODERN CONSTRUCTION METHODS

Open Excavation, Shafts and Tunnels- Preparation of foundation, Cofferdams, Caisson, Piled Foundation, Prestressed Concrete Construction, Pre-cast Concrete Construction.

UNIT - II CONSTRUCTION METHODS FOR SPECIAL STRUCTURES


UNIT - III MODERN CONSTRUCTION EQUIPMENTS -I

Construction Equipment used for Earth Moving, Excavating, Drilling, Blasting, Tunneling and hoisting

UNIT - IV MODERN CONSTRUCTION EQUIPMENTS -II

Construction Equipment used for Conveying, Hoisting, Dredging, Dewatering Systems, Paving and concreting Plant

UNIT - V PRINCIPLES AND PRACTICES OF TEMPORARY STRUCTURES

Principles and Practices of Temporary structures, Shoring, and Strutting, Underpinning, Principles and Design of Formwork, Scaffolding, Operation and maintenance of construction equipments

TOTAL HRS : 45

TEXT BOOKS

REFERENCE
2. Nunnaly, S.W., Construction Methods and Management, Prentice – Hall, 2000
LIST OF OPEN ELECTIVES OFFERED BY MECHANICAL ENGINEERING
OBJECTIVE

1. To provide an overview of how computers are being used in mechanical component design

UNIT I OVERVIEW OF CAD SYSTEMS
Conventional and computer aided design processes-advantages and disadvantages. Subsystems of CAD-CAD hardware and software, analytical and graphics packages, CAD workstations. Networking of CAD systems.

UNIT II INTERACTIVE COMPUTER GRAPHICS AND GRAPHICS TRANSFORMATIONS

UNIT III GEOMETRIC MODELING

UNIT IV PARAMETRIC DESIGN AND OBJECT REPRESENTATION

UNIT V PRODUCT DESIGN AND DEVELOPMENT

TOTAL 45

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<td>2</td>
<td>Radhakrishnan P and Subramanyan S</td>
<td>CAD/CAM/CIM</td>
<td>New Age International Pvt. Ltd</td>
<td>2004</td>
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OBJECTIVE

1. Upon completion of this course, the students can able to understand the role of logistics and understand the phases of supply chain.

UNIT I  INTRODUCTION TO LOGISTICS
Logistics - concepts, definitions and approaches, factors influencing logistics - Supply chain: basic tasks, definitions and approaches, influencing supply chain - a new corporate model.

UNIT II  PHASES OF SUPPLY CHAIN
The new paradigm shift - The modular company - The network relations - Supply processes - Procurement processes - Distribution management.

UNIT III  EVOLUTION OF SUPPLY CHAIN MODELS

UNIT IV  SUPPLY CHAIN ACTIVITIES
Structuring the SC, SC and new products, functional roles in SC - SC design frame- work - Collaborative product commerce (CPC).

UNIT V  SCM ORGANISATION AND INFORMATION SYSTEM
The management task - Logistics organization - The logistics information systems - Topology of SC application - Product Data Management - Warehouse management system MRP- I, MRP - II, ERP,.. - Case study, ERP Software's

TOTAL  45

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OBJECTIVE

1. Upon completion of this course, the students can understand the relationship between free energy, entropy, internal energy, and enthalpy.

UNIT I INTRODUCTION AND BASIC CONCEPTS
General overview of transport phenomena including various applications, Transport of momentum, heat and mass, Transport mechanism, Level of transport, Driving forces, Molecular transport (diffusion), convective transport (microscopic).

UNIT II PROPERTIES, UNITS AND OTHER PHYSICAL PARAMETERS
Unit systems, temperature, mole, concentration, pressure, Gas laws, laws of conservation, energy and heat units.

UNIT III MOMENTUM TRANSPORT
Basic concepts in fluid mechanics, Force, unit and dimensions, pressure in fluid, head of fluid, Molecular transport for momentum, heat and mass transfer, Viscosity of fluids, Newton's law, Momentum transfer, Newtonian and non-Newtonian fluids, Fluid flow and Reynolds number, Overall mass balance, Control volume and Continuity equation, Overall energy balance, Bernoulli’s equation, Overall momentum balance, Drag coefficient, Stokes law, Flow in packed beds, Flow in fluidized bed.

UNIT IV ENERGY TRANSPORT
Basic concepts in heat transfer, Heat transfer mechanisms, Fourier's law of heat conduction, thermal conductivity, convective heat transfer coefficient, Conduction heat transfer - through flat slab/wall and through hollow cylinder, Conduction through solids in series, Forced convection heat transfer inside pipes, Heat transfer outside various geometrics in forced convection, General discussion on natural convection heat transfer, Heat exchangers, General discussion on radiation heat transfer.

UNIT V MASS TRANSPORT
Basic concepts in mass transfer, Some application examples, Modes of mass transfer, Molecular diffusion-Fick's law, Analogy between mass, heat and momentum transfer, Dispersion, Hydraulic or Darcy's flow in porous media, Chemical kinetics and activation energy, Film theory, Convective mass transfer, Liquid-solid mass transfer, Liquid-liquid mass transport, Gas-liquid mass transfer, Aeration and oxygen transport, Air stripping.

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<td>1</td>
<td>Geankoplis, C. J</td>
<td>Transport Processes and Separation Processes Principles</td>
<td>Prentice Hall</td>
<td>2003</td>
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WEB REFERENCE

1. https://laulima.hawaii.edu/portal
OBJECTIVE

1. Biomechanics provides key information on the most effective and safest movement patterns, equipment, and relevant exercises to improve human movement.

UNIT I INTRODUCTION
Biomechanics - Improving Performance – Applications - Preventing And Treating Injury - Qualitative And Quantitative Analysis - Scholarly Societies - Computer Searches – Biomechanical Knowledge versus Information - Kinds of Sources - Evaluating Sources

UNIT II KEY MECHANICAL CONCEPTS
Mechanics - Basic Units - Nine Fundamentals of Biomechanics - Principles and Laws - Nine Principles for Application of Biomechanics

UNIT III HUMAN ANATOMY AND SOME BASIC TERMINOLOGY

UNIT IV ANATOMICAL DESCRIPTION
Key Anatomical Concepts - Directional Terms - Joint Motions - Muscle Actions - Active and Passive Tension of Muscle - Limitations of Functional Anatomical Analysis - Mechanical Method of Muscle Action Analysis - The Need for Biomechanics to Understand Muscle Actions - Sports Medicine and Rehabilitation Applications

UNIT V MECHANICS OF THE MUSCULOSKELETAL SYSTEM

TOTAL 45

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<td>1</td>
<td>Duane Knudson</td>
<td>Fundamentals of Biomechanics</td>
<td>Springer Science+ Business Media, LLC</td>
<td>2007</td>
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<tr>
<td>2</td>
<td>C. Ross Ethier Craig A. Simmons</td>
<td>Introductory Biomechanics</td>
<td>Cambridge University Press</td>
<td>2007</td>
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