DEPARTMENT OF APPLIED SCIENCE AND TECHNOLOGY

ANNA UNIVERSITY, CHENNAI

Vision
Provide the knowledge and prosperity through high quality education to the next generation of visionaries and prepare the students for leadership and management role in diverse careers.

Mission

- To render the highest quality of education through teaching and research excellence, with the state-of the-art educational facilities and innovative programs.

- To provide the students with the knowledge and skills needed to succeed and become leaders of tomorrow.

- To provide the students with multidisciplinary approach to tackle the socio-economic problems.

- To encourage the students for advanced study and research in the field of upstream and downstream sectors in petroleum industry, safety, occupational health and environmental management.
PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I. To inculcate in students, a professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to solve problems encountered in petroleum and petrochemical sector.

II. To make the students conversant with principles of chemical engineering processes, fundamentals of petroleum and petrochemicals sector.

III. Gain knowledge in basic sciences, mathematics and solve engineering problems in petrochemical sector using C, Matlab and other computational tools.

IV. To help the students understand the theory, instrumentation and applications of analytical equipment used in industries for testing the quality of petroleum, intermediates and products.

V. Have a knowledge and competency in petroleum and oil refinery process industries complemented by the appropriate skills and attributes.

PROGRAMME OUTCOMES (POs):

After going through the four years of study, our Petroleum Engineering and Technology Graduates will exhibit ability to:

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<th>Graduate attribute</th>
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<td>PO1 Engineering Knowledge</td>
<td>Apply the knowledge of mathematics, science, engineering fundamentals to extract oil and gas deposits below the earth’s surface.</td>
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<td>PO2 Problem analysis</td>
<td>Identify, formulate, the problems in upstream and downstream sector of petroleum engineer.</td>
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<td>PO3 Design / development of solutions</td>
<td>Design of solutions for complex engineering problems and design system components in the process of drilling the well to extract gas or oil.</td>
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<td>PO4 Conduct investigations of complex problems</td>
<td>Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data.</td>
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<td>PO5 Modern tool usage</td>
<td>Create, select and apply appropriate techniques and software tools problem in such a identification of reservoirs and design the product used for petrochemicals.</td>
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<td>PO6 The Engineer and society</td>
<td>Contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional Engineering Practice.</td>
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<tr>
<td>PO7 Environment and sustainability</td>
<td>Understand the environment impact and assessment in the arena of reservoir drilling and production of oil and gas.</td>
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PO8 | Ethics | Apply ethical principles and commit to the standard of professional to practice behavior.
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PO9 | Individual and team work | Function effectively as an individual, member or leader in diverse teams, to accomplish all spheres of life- interpersonal, social and professional
PO10 | Communication | Communicate effectively on complex engineering activities with the engineering community.
PO11 | Project management and finance | Demonstrate knowledge and understanding of the engineering and management principles and to achieve specific goals and meet specific success criteria at this specified time.
PO12 | Life-long learning | Recognize the need for the preparation, ability to engage independent and life- long learning achievement undertaken throughout life, with the aim of improving knowledge, skill and quality of life.

3. PROGRAM SPECIFIC OUTCOMES (PSOs):

By the completion of Petroleum Engineering and Technology program the student will have following Program specific outcomes.

1. Graduates will have career path as a reservoir, drilling and petroleum production engineer.
2. Graduates will have an ability to characterize and evaluate the subsurface geological formations and their resources.
3. Graduates will have an ability to acquire data of subsurface formation properties and interpret it.
4. Graduates will have an ability to extract oil or gas considering the economic value and environmental safety.
## MAPPING OF COURSE OUTCOMES AND PROGRAMME OUTCOMES

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UNIVERSITY DEPARTMENTS
B.TECH. PETROLEUM ENGINEERING AND TECHNOLOGY
REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM
CURRICULUM AND SYLLABI FOR I TO VIII SEMESTERS

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* Students shall undergo Internship / Training for a minimum period of 2 weeks and assessment of the same will be done during seventh semester
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## AUDIT COURSES (AC)

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### Summary

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OBJECTIVES:
The first semester English course entitled ‘Technical English’ aims to,
- Familiarise first year students of engineering and technology with the fundamental aspects
  of technical English.
- Develop all the four language skills by giving sufficient practice in the use of the skills in real
  life contexts.
- Enhance the linguistic and communicative competence of first year engineering and
  technology students.

UNIT I  INTRODUCING ONESELF  12
Listening: Listening and filling a form, listening to speeches by specialists from various branches of
engineering and completing activities such as answering questions, identifying the main ideas of the
listening text, style of the speaker (tone and tenor) – Speaking: Introducing oneself –introducing
friend/ family - Reading: Descriptive passages (from newspapers / magazines)- Writing: Writing a
paragraph (native place, school life)- Grammar: Simple present, present continuous – Vocabulary
Development: One word substitution

UNIT II  DIALOGUE WRITING  12
Listening: Listening to conversations (asking for and giving directions) –Speaking: making
conversation using (asking for directions, making an enquiry), Role plays-dialogues- Reading: Reading
a print interview and answering comprehension questions-Writing: Writing a checklist,
Dialogue writing- Grammar: Simple past – question formation (Wh- questions, Yes or No questions,
Tag questions)- Vocabulary Development: Stress shift, lexical items related to the theme of the
given unit.

UNIT III  FORMAL LETTER WRITING  12
Listening: Listening to speeches by famous people and identifying the central message of the
speech – answering multiple-choice questions)-Speaking: Giving short talks on a given topic-
Reading: Reading motivational essays on famous engineers and technologists (answering open-
ended and closed questions)- Writing: Writing formal letters/ emails (Complaint letters)-Grammar:
Future Tense forms of verbs, subject and verb agreement-Vocabulary Development: Collocations
– Fixed expressions

UNIT IV  WRITING COMPLAINT LETTERS  12
Listening: Listening to short talks (5 minutes duration and fill a table, gap-filling exercise) note
taking/note making- Speaking: Small group discussion, giving recommendations-Reading:
Reading problem – solution articles/essays drawn from various sources- Writing: Making
recommendations – Writing a letter/ sending an email to the Editor- note making- Grammar:
Modals – Phrasal verbs – cause and effect sentences- Vocabulary Development: Connectives,
use of cohesive devices in writing, technical vocabulary.

UNIT V  WRITING DEFINITIONS AND PRODUCT DESCRIPTION  12
Listening: Listening to a product description (labeling and gap filling) exercises- Speaking:
Describing a product and comparing and contrasting it with other products- Reading:
Reading graphical material for comparison (advertisements)-Writing: Writing Definitions (short and long) –
compare and contrast paragraphs- Grammar: Adjectives – Degrees of comparison - compound
nouns- Vocabulary Development: Use of discourse markers – suffixes (adjectival endings).

TOTAL : 60 PERIODS

Learning Outcomes
At the end of the course the students will have gained,
- Exposure to basic aspects of technical English.
- The confidence to communicate effectively I various academic situations.
- Learnt the use of basic features of Technical English
Textbook:

Assessment Pattern
- Assessments will assess all the four skills through both pen and paper and computer based tests.
- Assessments can be pen and paper based, quizzes.

MA5158 ENGINEERING MATHEMATICS – I
(Common to all branches of B.E. / B.Tech. Programmes in I Semester)

OBJECTIVES:
- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
  - To familiarize the student with functions of several variables. This is needed in many branches of engineering.
  - To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT I MATRICES
12

UNIT II DIFFERENTIAL CALCULUS
12

UNIT III FUNCTIONS OF SEVERAL VARIABLES
12

UNIT IV INTEGRAL CALCULUS
12
Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT V MULTIPLE INTEGRALS
12

TOTAL : 60 PERIODS

OUTCOMES:
At the end of the course the students will be able to
- Use the matrix algebra methods for solving practical problems.
- Apply differential calculus tools n solving various application problems.
• Able to use differential calculus ideas on several variable functions.
• Apply different methods of integration in solving practical problems.
• Apply multiple integral ideas in solving areas, volumes and other practical problems.

TEXTBOOKS:

REFERENCES:

PH5151 ENGINEERING PHYSICS L T P C
(Common to all branches of B.E / B.Tech programmes) 3 0 0 3

OBJECTIVE
• To make the students in understanding the importance of mechanics.
• To equip the students on the knowledge of electromagnetic waves.
• To introduce the basics of oscillations, optics and lasers.
• To enable the students in understanding the importance of quantum physics.
• To elucidate the application of quantum mechanics towards the formation of energy bands in crystalline materials.

UNIT I MECHANICS 9

UNIT II ELECTROMAGNETIC WAVES 9
Gauss’s law – Faraday’s law - Ampere’s law - The Maxwell’s equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

UNIT III OSCILLATIONS, OPTICS AND LASERS 9
Simple harmonic motion - resonance - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect - reflection and refraction of light waves - total internal reflection - interference - interferometers - air wedge experiment. Theory of laser -
characteristics - Spontaneous and stimulated emission - Einstein’s coefficients - population inversion - Nd-YAG laser, CO₂ laser, semiconductor laser - applications.

UNIT IV BASIC QUANTUM MECHANICS 9
Photons and light waves - Electrons and matter waves - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization - Particle in a infinite potential well - Normalization, probabilities and the correspondence principle.

UNIT V APPLIED QUANTUM MECHANICS 9
The harmonic oscillator - Barrier penetration and quantum tunneling - Tunneling microscope - Resonant diode - Finite potential wells - particle in a three dimensional box - Bloch’s theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands.

TOTAL: 45 PERIODS

OUTCOME
After completion of this course, the students should able to
- Understanding the importance of mechanics.
- Express the knowledge of electromagnetic waves.
- Know the basics of oscillations, optics and lasers.
- Understanding the importance of quantum physics.
- Apply quantum mechanical principles towards the formation of energy bands in crystalline materials.

TEXT BOOKS

REFERENCES
OBJECTIVES:

- To introduce the basic concepts of polymers, their properties and some of the important applications.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To facilitate the understanding of the laws of photochemistry, photoprocesses and instrumentation & applications of spectroscopic techniques.
- To familiarize the operating principles and applications of energy conversion, its processes and storage devices.
- To inculcate sound understanding of water quality parameters and water treatment techniques.

UNIT I  POLYMER CHEMISTRY  9

UNIT II  NANOCHEMISTRY  9

UNIT III  PHOTOCHEMISTRY AND SPECTROSCOPY  9

UNIT IV  ENERGY CONVERSIONS AND STORAGE  9
Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant – fast breeder reactor. Solar energy conversion - solar cells. Wind energy. Batteries - types of batteries – primary battery (dry cell), secondary battery (lead acid, nickel-cadmium and lithium-ion-battery). Fuel cells – $H_2$-$O_2$ and microbial fuel cell. Explosives – classification, examples: TNT, RDX, Dynamite; Rocket fuels and propellants – definition and uses.

UNIT V  WATER TECHNOLOGY  9

TOTAL:  45 PERIODS
OUTCOMES:

- To recognize and apply basic knowledge on different types of polymeric materials, their general preparation methods and applications to futuristic material fabrication needs.
- To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
- To identify and apply suitable spectroscopic technique for material analysis and study different forms of photochemical reactions.
- To recognize different forms of energy resources and apply them for suitable applications in energy sectors.
- To demonstrate the knowledge of water and their quality in using at different industries.

TEXT BOOKS:


REFERENCE BOOKS:


GE5151 ENGINEERING GRAPHICS LTPC 1043

COURSE OBJECTIVES: The main learning objective of this course is to prepare the students for:

1. Drawing free hand sketches of basic geometrical shapes and multiple views of objects.
2. Drawing orthographic projections of lines and planes.
3. Drawing orthographic projections of solids.
4. Drawing development of the surfaces of objects.
5. Drawing isometric and perspective views of simple solids.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION) 1

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

UNITI PLANE CURVES AND FREE HANDSKETCHING 14

Basic Geometrical constructions, Curves used in engineering practices-Conics – Construction of ellipse, parabola and hyperbola by different methods – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three-Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

UNITII PROJECTION OF POINTS, LINES AND PLANE SURFACES 15

Orthographic projection- principles-Principle planes-First angle projection-Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes- Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.
UNIT III PROJECTION OF SOLIDS

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

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES

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

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS

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

COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY)

Introduction to drafting packages and demonstration of their use

TOTAL (L: 15 + P: 60)=75 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Draw free hand sketching of basic geometrical shapes and multiple views of objects.
2. Draw orthographic projections of lines and planes.
4. Draw development of the surfaces of objects.
5. Draw isometric and perspective views of simple solids.

TEXT BOOKS:

REFERENCES:

Publication of Bureau of Indian Standards:

Special points applicable to University Examinations on Engineering Graphics:
1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only.
4. The students will be permitted to use appropriate scale to fit solution within A3 size.
5. The examination will be conducted in appropriate sessions on the same day.
PHYSICS LABORATORY: (Any Seven Experiments)

OBJECTIVE

- To inculcate experimental skills to test basic understanding of physics of materials including properties of matter, thermal and optical properties.
- To induce the students to familiarize with experimental determination of velocity of ultrasonic waves and band gap determination.

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc
2. Non-uniform bending - Determination of young's modulus
3. Uniform bending – Determination of young’s modulus
4. Lee’s disc Determination of thermal conductivity of a bad conductor
5. Potentiometer-Determination of thermo e.m.f of a thermocouple
6. Laser- Determination of the wave length of the laser using grating
7. Air wedge - Determination of thickness of a thin sheet/wire
8. a) Optical fibre - Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
10. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
11. Post office box - Determination of Band gap of a semiconductor.
13. Photoelectric effect
14. Michelson Interferometer.
16. Melde’s string experiment

TOTAL: 30 PERIODS

OUTCOME

Upon completion of the course, the students will be able

- To determine various moduli of elasticity and also various thermal and optical properties of materials.
- To determine the velocity of ultrasonic waves, band gap determination and viscosity of liquids.

CHEMISTRY LABORATORY: (Minimum of 8 experiments to be conducted)

OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and polymers by spectroscopy and viscometry methods.

LIST OF EXPERIMENTS:

1. Estimation of HCl using Na2CO3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler’s method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution byiodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
12. Pseudo first order kinetics-ester hydrolysis.
14. Phase change in a solid.

TOTAL: 30 PERIODS

OUTCOMES:
- To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
- To determine the amount of metal ions through volumetric and spectroscopic techniques.
- To determine the molecular weight of polymers by viscometric method.
- To quantitatively analyse the impurities in solution by electroanalytical techniques.
- To design and analyse the kinetics of reactions and corrosion of metals.

TEXTBOOKS:

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES

PLUMBING WORK:
- Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
- Preparing plumbing line sketches.
- Laying pipe connection to the suction side of a pump.
- Laying pipe connection to the delivery side of a pump.
- Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:
- Sawing,
- Planning and
- Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.
Wood Work Study:
   a) Studying joints in door panels and wooden furniture
   b) Studying common industrial trusses using models.

PART II  ELECTRICAL ENGINEERING PRACTICES  15

WIRING WORK:
   a) Wiring Switches, Fuse, Indicator and Lamp etc. such as in basic household,
   b) Wiring Stair case light.
   c) Wiring tube – light.
   d) Preparing wiring diagrams for a given situation.

Wiring Study:
   a) Studying an Iron-Box wiring.
   b) Studying a Fan Regulator wiring.
   c) Studying an Emergency Lamp wiring.

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III  MECHANICAL ENGINEERING PRACTICES  15

WELDING WORK:
   a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
   b) Practicing gas welding.

BASIC MACHINING WORK:
   a) (simple)Turning.
   b) (simple)Drilling.
   c) (simple)Tapping.

ASSEMBLY WORK:
   a) Assembling a centrifugal pump.
   b) Assembling a household mixer.
   c) Assembling an air conditioner.

SHEET METAL WORK:
   a) Making of a square tray

FOUNDRY WORK:
   a) Demonstrating basic foundry operations.

PART IV  ELECTRONIC ENGINEERING PRACTICES  15

SOLDERING WORK:
   a) Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:
   a) Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:
   a) Studying a FM radio.
   b) Studying an electronic telephone.

TOTAL (P: 60) = 60 PERIODS
COURSE OUTCOMES: Upon completion of this course, the students will be able to:

1. Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
2. Wire various electrical joints in common household electrical wire work.
3. Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.
4. Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.
COURSE OBJECTIVES
The course entitles ‘professional communication’aims to,

- Improve the relevant language skills necessary for professional communication.
- Develop linguistic and strategic competence in workplace context.
- Enhance language proficiency and thereby the employability of budding engineers and technologists.

UNIT I TECHNICAL COMMUNICATION 12
Listening: Listening to telephone conversations (intent of the speaker and note taking exercises)-
Speaking: Role play exercises based on workplace contexts, introducing oneself- Reading: Reading the interview of an achiever and completing exercises (skimming, scanning and predicting)- Writing: Writing a short biography of an achiever based on given hints- Grammar: Asking and answering questions, punctuation in writing, prepositional phrases- Vocabulary Development: use of adjectives.

UNIT II SUMMARY WRITING 12
Listening: Listening to talks/lectures both general and technical and summarizing the main points-

UNIT III PROCESS DESCRIPTION 12
Listening: Listening to a process description and drawing a flowchart-Speaking: Participating in Group Discussions, giving instructions- Reading: Reading instruction manuals- Writing: Writing process descriptions- Writing instructions- Grammar: Use of imperatives, active and passive voice, sequence words- Vocabulary Development: Technical jargon.

UNIT IV REPORT WRITING 12
Listening: Listening to a presentation and completing gap-filling exercises- Speaking: Making formal presentations- Reading: Reading and interpreting charts/tables and diagrams- Writing: Interpreting charts/tables and diagrams, writing a report- Grammar: Direct into indirect speech, use of phrases- Vocabulary Development: reporting words.

UNIT V WRITING JOB APPLICATIONS 12
Listening: Listening to a job interview and completing gap=filling exercises- Speaking: Mock interview, telephone interviews- Reading: Reading a job interview, SOP, company profile and completing comprehension exercises- Writing: job applications and resumes and SOPs-Grammar: Present perfect and continuous tenses- Vocabulary Development: Technical vocabulary.

TOTAL : 60 PERIODS

LEARNING OUTCOMES
At the end of the second semester the learners should be able to,

- Read and comprehend technical texts effortlessly.
- Write reports of a technical kind.
- Speak with confidence in interviews and thereby gain employability

Textbook

Assessment Pattern
- Assessments will assess all the four skills through both pen and paper and computer based tests.
- Assessments can be pen and paper based, quizzes.
OBJECTIVES:

- To acquaint the students with the concepts of vector calculus which naturally arises in many engineering problems.
- To develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property.
- To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.
- To acquaint the students with Differential Equations which are significantly used in Engineering problems.
- To make the students appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I VECTOR CALCULUS


UNIT II ANALYTIC FUNCTION

Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions - Bilinear transformation $w = c + z, az, 1/z, z^2$.

UNIT III COMPLEX INTEGRATION


UNIT IV DIFFERENTIAL EQUATIONS

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

UNIT V LAPLACE TRANSFORMS


TOTAL : 60 PERIODS

OUTCOMES:

Upon successful completion of the course, students will be able to:

- Calculate grad, div and curl and use Gauss, Stokes and Greens theorems to simplify calculations of integrals.
- Construct analytic functions and use their conformal mapping property in application problems.
- Evaluate real and complex integrals using the Cauchy’s integral formula and residue theorem.
- Apply various methods of solving differential equation which arise in many application problems.
- Apply Laplace transform methods for solving linear differential equations.
TEXTBOOKS:


REFERENCES:


GE5153 PROBLEM SOLVING AND PYTHON PROGRAMMING

L T P C
3 0 0 3

OBJECTIVES:

- To know the basics of algorithmic problem solving.
- To develop Python programs with conditionals and loops.
- To define Python functions and use function calls.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

UNIT I INTRODUCTION TO COMPUTING AND PROBLEM SOLVING


Suggested Activities:

- Developing Pseudocodes and flowcharts for real life activities such as railway ticket booking using IRCTC, admission process to undergraduate course, academic schedules during a semester etc.
- Developing algorithms for basic mathematical expressions using arithmetic operations.
- Installing Python.
- Simple programs on print statements, arithmetic operations.

Suggested Evaluation Methods:

- Assignments on pseudocodes and flowcharts.
- Tutorials on Python programs.

UNIT II CONDITIONALS AND FUNCTIONS


Suggested Activities:
- Simple Python program implementation using Operators, Conditionals, Iterative Constructs and Functions.
- Implementation of a simple calculator.
- Developing simple applications like calendar, phone directory, to-do lists etc.
- Flow charts for GCD, Exponent Functions, Fibonacci Series using conditionals and iterative statements.
- External learning - Recursion vs. Iteration.

**Suggested Evaluation Methods:**
- Tutorials on the above activities.
- Group Discussion on external learning.

**UNIT III SIMPLE DATA STRUCTURES IN PYTHON**

10


**Suggested Activities:**
- Implementing python program using lists, tuples, sets for the following scenario:
  1. Simple sorting techniques
  2. Student Examination Report
- External learning - List vs. Tuple vs. Set – Implementing any application using all the three data structures.

**Suggested Evaluation Methods:**
- Tutorials on the above activities.
- Group Discussion on external learning component.

**UNIT IV STRINGS, DICTIONARIES, MODULES**

10


**Suggested Activities:**
- Implementing Python program by importing Time module, Math package etc.
- Creation of any package (student’s choice) and importing into the application.

**Suggested Evaluation Methods:**
- Tutorials on the above activities.

**UNIT V FILE HANDLING AND EXCEPTION HANDLING**

7

Introduction to Files – File Path – Opening and Closing Files – Reading and Writing Files – File Position – Exception: Errors and Exceptions, Exception Handling, Multiple Exceptions.

**Suggested Activities:**
- Developing modules using Python to handle files and apply various operations on files.
- Usage of exceptions, multiple except blocks -for applications that use delimiters like age, range of numerals etc.
- Implementing Python program to open a non-existent file using exceptions.

**Suggested Evaluation Methods:**
- Tutorials on the above activities.
- Case Studies.

**TOTAL: 45 PERIODS**
OUTCOMES:
On completion of the course, students will be able to:
1. Develop algorithmic solutions to simple computational problems.
2. Develop and execute simple Python programs.
3. Write simple Python programs for solving problems.
4. Decompose a Python program into functions.
5. Represent compound data using Python lists, tuples, dictionaries etc.
6. Read and write data from/to files in Python programs.

TEXT BOOK:

REFERENCES:
OBJECTIVES:

- To understand the basic concepts of electric circuits, magnetic circuits and wiring.
- To understand the operation of AC and DC machines.
- To understand the working principle of electronic devices and circuits.

UNIT I  BASIC CIRCUITS AND DOMESTIC WIRING  9


UNIT II  THREE PHASE CIRCUITS AND MAGNETIC CIRCUITS  9


UNIT III  ELECTRICAL MACHINES  9


UNIT IV  BASICS OF ELECTRONICS  9

Intrinsic semiconductors, Extrinsic semiconductors – P-type and N-type, P-N junction, VI Characteristics of PN junction diode, Zener effect, Zener diode, Zener diode Characteristics-Rectifier circuits-Wave shaping.

UNIT V  CURRENT CONTROLLED AND VOLTAGE CONTROLLED DEVICES  9

Working principle and characteristics - BJT, SCR, JFET, MOSFET.

TOTAL: 45 PERIODS

OUTCOMES:

CO1  To be able to understand the concepts related with electrical circuits and wiring.

CO2  To be able to study the different three phase connections and the concepts of magnetic circuits.

CO3  Capable of understanding the operating principle of AC and DC machines.

CO4  To be able to understand the working principle of electronic devices such as diode and zener diode.

CO 5  To be able to understand the characteristics and working of current controlled and voltage controlled devices.

TEXT BOOKS:


REFERENCES:

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Applying the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.
2. Applying the concept of reaction forces (non-concurrent coplanar and noncoplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force - couple system acting on rigid bodies in 2D and 3D.
3. Applying the concepts of locating centroids/center of gravity of various sections / volumes and to find out area moments of inertia for the sections and mass moment of inertia of solids.
4. Applying the concepts of frictional forces at the contact surfaces of various engineering systems.
5. Applying the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

UNIT I    STATICS OF PARTICLES    (9+3)


UNIT II    EQUILIBRIUM OF RIGID BODIES    (9+3)


UNIT III    DISTRIBUTED FORCES    (9+3)

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies, Determination of Centroids of Volumes by Integration.

Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem, Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates, Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.

UNIT IV    FRICTION    (9+3)


UNIT V    DYNAMICS OF PARTICLES    (9+3)

COURSE OUTCOMES: Upon completion of this course, the students will be able to:
1. Apply the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.
2. Apply the concept of reaction forces (non-concurrent coplanar and noncoplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force - couple system acting on rigid bodies in 2D and 3D.
3. Apply the concepts of locating centroids / center of gravity of various sections / volumes and to find out area moments of inertia for the sections and mass moment of inertia of solids.
4. Apply the concepts of frictional forces at the contact surfaces of various engineering systems.
5. Apply the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

TEXT BOOKS:

REFERENCES:
OBJECTIONS
The course is aimed to
- To learn about oxidation and reduction of organic compounds
- To learn about methods and properties of heterocyclic compounds.
- To learn about preparations and uses of synthetic intermediates.
- To gain the knowledge about synthetic utilities and their preparation.
- To understand the rearrangements for organic reaction.

UNIT I OXIDATION AND REDUCTION OF ORGANIC COMPONENTS
Diastereoselective epoxidation of homoallylic alcohols, synthetic reaction of epoxides and ozonolysis, photosensitised oxidation of akenes, oxidation of ketones: conversion into unsaturated ketones, oxidation of -ketols, oxidative decarboxylation of acids, aromatic rings of phenols, oxidation of amines, aromatization oppenauer oxidation: Reduction by dissolving metals: reduction with metal and acid reduction of carbonyl compounds, reduction with metal in liquid ammonia (Birch reduction) reductive fission of alcohols and halides, reduction by hydride transfer reagents: reduction with borane and dialkylboranes, other methods: Wollff-Kishner reduction, desulphurization of thioacetals, di-imide: WollffKishner reduction, desulphurization of thioacetals, di-imide low-valent titanium species.

UNIT II HETEROCYCLIC COMPOUNDS
Different preparative methods, Physical & Chemical properties (Oxidation, reduction, Electrophilic and nucleophilic) and Uses of Pyrrole, Furan, Furfural, Tetrahydro Furan, Thiophene, Indole, Pyridine, Quinoline and Isoquinoline. Conversion of THF into Nylon 6-6

UNIT III PREPARATION OF SYNTHETIC INTERMEDIATES
Preparations of Benzil from benzyl aldehydes - Furyl from furfural, Vannilin from catechol through guaiacol, Gramine from indole, N-acetyld 5- bromo indoline from indole, Salol from phenol, Alanine from propionic acid, Heteroauxin from indole - Uses, Reaction and mechanism of acyloin condensation, Baeyer-Villigar reaction, Gabriel’s synthesis of phthalimide, Bartoli Indole synthesis

UNIT IV SYNTHETIC ORGANIC CHEMISTRY
Preparation and Synthetic utilities of Grignard reagent, Ethyl acetoacetate and Malonic ester for higher normal dicarboxylic acids, diketones and cyclic compounds etc.

UNIT V REARRANGEMENTS

TOTAL: 45 PERIODS

COURSE OUTCOMES
On completion of the course students are expected to

CO1: Understand the oxidation and reduction of organic compounds.
CO2: Obtain the knowledge of Heterocyclic compounds.
CO3: Gain the knowledge about synthetic intermediates.
CO4: Understand the preparations of synthetic utilities.
CO5: Obtain the knowledge about rearrangement reaction.
TEXT BOOKS

REFERENCE BOOKS

Course Articulation Matrix:

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<td>CO3</td>
<td>Gain the knowledge about synthetic intermediates</td>
<td>3 - - 3 - 2 - - - - - 1 - - - 2 3</td>
</tr>
<tr>
<td>CO4</td>
<td>Understand the preparations of synthetic utilities.</td>
<td>3 3 - 3 - 2 - - - - - 1 - - - 2 3</td>
</tr>
<tr>
<td>CO5</td>
<td>Obtain the knowledge about rearrangement reaction.</td>
<td>3 3 3 2 - 2 - - - - - 1 - - - 2 3</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES:
- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To articulate where computing strategies support in providing Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

EXPERIMENTS:
1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same.
2. Python programming using simple statements and expressions.
3. Scientific problems using Conditionals and Iterative loops.
4. Implementing real-time/technical applications using Lists, Tuples.
5. Implementing real-time/technical applications using Sets, Dictionaries.
6. Implementing programs using Functions.
7. Implementing programs using Strings.
9. Implementing real-time/technical applications using File handling.
10. Implementing real-time/technical applications using Exception handling.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

OUTCOMES:
On completion of the course, students will be able to:
- Develop algorithmic solutions to simple computational problems
- Develop and execute simple Python programs.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python data structures.

Apply Python features in developing software applications.
OBJECTIVES

1. To impart hands on experience in verification of circuit laws and measurement of circuit parameters
2. To train the students in performing various tests on electrical motors.
3. It also gives practical exposure to the usage of CRO, power sources & function generators

List of Experiments

1. Verification of Kirchhoff’s Law.
2. Steady state response of AC and DC circuits (Mesh, Node Analysis)
3. Frequency response of RLC circuits.
5. Regulation of single phase transformer.
6. Performance characteristics of DC shunt generator.
7. Performance characteristics of single phase induction motor.
8. Characteristics of PN diode and Zener diode
9. Characteristics of Zener diode
10. Half wave and full wave Rectifiers
11. Application of Zener diode as shunt regulator.
12. Characteristics of BJT and JFET

TOTAL: 60 PERIODS

OUTCOMES:

1. To become familiar with the basic circuit components and know how to connect them to make a real electrical circuit;
2. Ability to perform speed characteristic of different electrical machines
3. Ability to use logic gates and Flip flop
OBJECTIVES:

- To provide the mathematical foundations of numerical techniques for solving Eigen value problems and linear system of equations.
- To apply the techniques of interpolation for equal and unequal intervals for the given data.
- To understand and to apply the techniques of numerical integration and differentiation for solving and ODE in applying day today life.
- To familiar in solving initial value problems and ODE for given initial and boundary conditions.
- To demonstrate the utility of Numerical techniques for solving Partial Differential Equations in Heat and Fluid problems.

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS


UNIT II INTERPOLATION AND APPROXIMATION

Interpolation with unequal intervals - Lagrange interpolation – Newton’s divided difference interpolation – Cubic Splines - Interpolation with equal intervals - Newton’s forward and backward difference formulae – Least square method - Linear curve fitting.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION


UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS


UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS

Finite difference methods for solving two-point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace’s and Poisson’s equations on rectangular domain – One dimensional heat-flow equation by explicit and implicit (Crank-Nicholson) methods - One dimensional wave equation by explicit method.

TOTAL:60 PERIODS

OUTCOMES:

Upon completion of this course, the students will be able to:

- Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to the algebraic and transcendental equations.
- Apply numerical methods to obtain approximate solutions to mathematical problems using interpolation.
- Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
- Analyse and evaluate the accuracy of common numerical methods in solving ODE of First and Second order equations.
- Understand various numerical techniques for solving PDE, for given conditions in Heat flow and Wave problems.

TEXT BOOKS:

OBJECTIVES
The course is aimed to
- To learn about the basic units, degrees of freedom and unit conversions.
- To formulate and solve material balance in the petrochemical industries.
- To understand the Phase equilibria, Single and Multiple component phase systems.
- To formulate and solve energy balance in the petrochemical industries.
- To understand the unsteady state material and energy balance.

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

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

UNIT III
Ideal gases, Real gases, Single component two phase systems, Multiple component phase systems, Phase rule, Phase equilibria, Combustion processes.

UNIT IV

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

TOTAL : 45 PERIODS

COURSE OUTCOMES:
On completion of the course students are expected to
CO1: Understand the concepts of dimensional consistency and effective application of units and dimensions.
CO2: Analyze a problem statement and balance the material flowing through single and various operations.
CO3: Understand the gas behavior and its properties and vapor-liquid pattern
CO4: Understand general energy balance, simplify and apply to open and closed systems
CO5: Write material and energy balance for unsteady state how material and energy balances are formulated for equation- and modular based flow sheeting codes

TEXT BOOKS:

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<td>Understand the concepts of dimensional consistency and effective application of units and dimensions.</td>
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</tr>
<tr>
<td>CO2</td>
<td>Analyze a problem statement and balance the material flowing through single and various operations.</td>
<td>2 3 3 2 - 2 - - - - - - - - 2 3 -</td>
</tr>
<tr>
<td>CO3</td>
<td>Understand the gas behavior and its properties and vapor-liquid pattern</td>
<td>3 - 2 3 - 2 3 - - - - 3 3 - -</td>
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<tr>
<td>CO4</td>
<td>Understand general energy balance, simplify and apply to open and closed systems</td>
<td>3 2 3 - - - 3 - - - 2 - - 3 - 3</td>
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<tr>
<td>CO5</td>
<td>Write material and energy balance for unsteady state how material and energy balances are formulated for equation- and modular based flow sheeting codes</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES
The course is aimed to
- To learn classifications of fluids and their properties.
- To study about flow of fluid in pipeline and their boundary conditions.
- To analyze the size of various materials and laws of crushing and grinding.
- To learn about flow regime of fluid in fluidized and packed bed.
- To study about techniques of solid – fluid separation.

UNIT I  PROPERTIES OF FLUID
Newtonian fluids Classification of fluid motion Fluid statics – equilibrium of fluid element – pressure variation in a static fluid – Differential analysis of fluid motion – continuity, Euler’s and Bernoulli equation

UNIT II  FLOW THROUGHPIPES & BOUNDARY LAYER CONCEPTS
Reynolds number regimes, Flow through pipes – pressure drop under laminar and turbulent flow conditions; boundary layer concepts; different types of flowmeters; Valves, pumps, compressors – characteristics and sizing; Agitation and Mixing;

UNIT III  SIZE ANALYSIS
General characteristics of solids, techniques of size analysis; Laws of size reduction, equipments for size reduction

UNIT IV  FLOW THROUGHFLUIDIZED BEDS
Flow over a sphere – friction and pressure drag - flow through fixed and fluidized beds. Filtration – batch and continuous, filtration equipment - selection, operation

UNIT V  CLASSIFIERS
Screening, gravity separation - sedimentation, thickening, elutriation, classifiers - Centrifugal separation - continuous centrifuges, cyclones and hydro cyclones, electrostatic and magnetic separators

TOTAL : 45 PERIODS

COURSE OUTCOMES:
On completion of the course students are expected to
- CO1: Understand the fundamental properties of fluids, stress-strain relationship in fluids, and its characteristics under static conditions and establish force balance in static systems.
- CO2: Students will be able to apply Bernoulli’s principle, Navier – Stokes’ equation and compute pressure variation in static fluid.
- CO3: Obtain the knowledge about the size reduction techniques.
- CO4: Understand about the fluidized bed, flows of fluids in their beds.
- CO5: Understand various separation and purification techniques employed in solid particles.

TEXT BOOKS:
2. S. Pushpavanam, "Introduction to Chemical Engineering", PHI learning private limited, 2012

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<tr>
<td>CO3</td>
<td>Obtain the knowledge about the size reduction techniques.</td>
<td>3 2 2 3 - 1 1 - - - - - 3 - - 3</td>
</tr>
<tr>
<td>CO4</td>
<td>Understand about the fluidized bed, flows of fluids in their beds.</td>
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<tr>
<td>CO5</td>
<td>Understand various separation and purification techniques employed in solid particles.</td>
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**Overall CO**

| 3 2 3 3 3 1 2 - 1 - 2 2 3 3 3 3 |

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE
The course is aimed to
- To analyse the origin and the types of rocks.
- To study about reservoir geometry and traps.
- To learn about the sedimentology and their types.
- To learn about exploration and geophysical methods.
- To analyse the deep study of logging equipment.

UNIT I

UNIT II
Structural Geology – Geometric classification of folds, faults and joints, unconformity, outcrops-topography– Petroleum Traps definition and types-Identification of structural and stratigraphic traps in the field and in geological section (surface and subsurface).

UNIT III
Sedimentary basins – types and classification of sedimentary basins- introduction to stratigraphy-types (Litho, Bio, Chrono) -geological time scale. Sedimentology of petroleum bearing sequences, generation and migration of petroleum- Reservoir rock, cap rock, source rock.

UNIT IV
Elements of geological, geophysical and geochemical methods of exploration. Geophysics as a tool for mapping of subsurface geological features, Geophysical methods - Gravity, Magnetic, electromagnetic.

UNIT V
Seismic Wave theory - reflection and refraction and their use in data acquisition, Land and Marine geophysical methods. Electrical methods - Earth resistivity, SP, Induced Polarization. Electrical mapping and anisotropic earth and logging- Reservoir Evaluation- 3D interpretation (Structural mapping stratigraphic interpretation) - 4D reservoir characterization.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course students are expected to
- CO1: Understand the rock types and their birth place.
- CO2: Gain the knowledge about reservoir geometry.
- CO3: Obtain the concepts of sedimentary rocks and their classifications.
- CO4: Understand the concepts of exploration methods and method to analyze their features.
- CO5: Obtain the techniques and theories of seismic instruments.

TEXT BOOKS:

REFERENCE:
1. Petroleum geology, William Russel and A I Leverson
3. Elements of Petroleum Geology By Richard C Selley
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<tr>
<td>CO2</td>
<td>Gain the knowledge about reservoir geometry.</td>
<td>3  3  2  2  3  3</td>
</tr>
<tr>
<td>CO3</td>
<td>Obtain the concepts of sedimentary rocks and their classifications.</td>
<td>3  3  2  2  3  3</td>
</tr>
<tr>
<td>CO4</td>
<td>Understand the concepts of exploration methods and method to analyze their features.</td>
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<td>CO5</td>
<td>Obtain the techniques and theories of seismic instruments.</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES
The course is aimed to

- To analyse the properties of reservoir fluids and their classification.
- To study about the fundamentals reservoir rock properties.
- To determine the fundamentals of fluid flow in reservoir.
- To learn about the fluid recovery system in reservoir by their material balance equation.
- To study about the reservoir fluid coning and their techniques.

UNIT I FUNDAMENTALS OF RESERVOIR AND RESERVOIR FLUIDS 9
Classification of Reservoirs and Reservoir Fluids - Properties of Natural Gases - Behaviour of Ideal Gases - Behaviour of Real Gases - Properties of Crude Oil Systems - Properties of Reservoir Water.

UNIT II FUNDAMENTALS OF ROCK PROPERTIES 9

UNIT III FUNDAMENTALS OF RESERVOIR FLUID FLOW 9

UNIT IV RECOVERY MECHANISM AND MATERIAL BALANCE EQUATION 9

UNIT V CONING AND DECLINE CURVE 9

TOTAL: 45 PERIODS.

COURSE OUTCOMES:
On completion of the course students are expected to

CO1: Gain the knowledge about the reservoir fluids and their properties.
CO2: Obtain the knowledge of rocks present over the reservoir.
CO3: Understand the mathematical relationships that are designed to describe the flow behaviour of the reservoir fluids.
CO4: Understand the concepts of the oil/gas recovery techniques.
CO5: Gain the knowledge about the coning in reservoir and their techniques.

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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES
The course is aimed to
• To learn experimentally to calibrate flow meters
• To find pressure loss for fluid flow in pipes
• To determine pump characteristics.
• To learn about fluidization
• To develop a sound working knowledge on different types of crushing equipments and separation characteristics of different mechanical operation separators.

LIST OF EXPERIMENTS - Phase - I
1. Calibration of constant and variable head meters
2. Open drum orifice and draining time
3. Flow through straight pipe
4. Flow through annular pipe
5. Flow through helical coil and spiral coil
6. Characteristic curves of pumps
7. Pressure drop studies in packed column

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

LIST OF EXPERIMENTS - Phase- II
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

COURSE OUTCOME:
On completion of the course students are expected to

CO1: Use variable area flow meters and variable head flow meters
CO2: Analyze the flow of fluids through closed conduits, open channels and flow past immersed bodies. Select pumps for the transportation of fluids based on process conditions/requirements and fluid properties.

CO3: Determine work index, average particle size through experiments by crushers, ball mill and conducting sieve analysis.

CO4: Design size separation equipment such as cyclone separator, sedimentation, Filters etc.

CO5: Able to study the flow through fluidized bed.

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<td>Determine work index, average particle size through experiments by crushers, ball mill and conducting sieve analysis.</td>
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<td>Design size separation equipment such as cyclone separator, sedimentation, Filters etc.</td>
<td>3 - 3 3 3 2 2 - - - 1 - - - 3 3</td>
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<td>CO5</td>
<td>Able to study the flow through fluidized bed.</td>
<td>- - 3 3 3 2 3 - 2 - 1 - 3 - 3 -</td>
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OBJECTIVES
The course is aimed to

- To learn basic principles involved in analysis and synthesis of different organic derivatives.
- To identify the functional groups
- To know the separation of organic mixtures
- To prepare simple organic compounds
- To study the preparation of dyes

LIST OF EXPERIMENTS
1. Identification and characterization of various functional groups by their characteristic reactions: a) alcohol, b) aldehyde, c) ketone, d) carboxylic acid, e) phenol f) primary, secondary and tertiary amines
2. Preparation of solid derivatives: a) 2,4 tri nitro phenyl hydrazone for aldehydes and ketones, b) acetyl and benzoyl derivatives for amine and phenol c) diazotization of aromatic amine
3. Preparation of Methyl red and Fluorescein
4. Separation of organic mixtures: a) aldehyde and acid, b) amine and phenol
5. Recrystallization of benzoic acid and acetonilide
7. Detection of peroxide in ether and its removal

TOTAL: 60 PERIODS

COURSE OUTCOMES:
On completion of the course students are expected to

- CO1: Conduct simple experiments to identify the functional group
- CO2: Prepare derivatives for aldehydes, ketones, sugars, amine and phenol
- CO3: Analyzing various procedure to separate organic mixtures
- CO4: Steps to carry out recrystallization
- CO5: Preparation of synthetic organic compounds like
  a) Naphthalene – Nitro naphthalene – 4 nitro – 1 – amino naphthalene
  b) Benzene – Benzil – benzylic acid.

REFERENCE:
2. Practical chemistry, V K Ahluwalia, University press. 2011
4. Practical Organic Chemistry by Dey and Raman
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<td>P O O O O O O O</td>
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<tr>
<td>CO1</td>
<td>Conduct simple experiments to identify the functional group.</td>
<td>- - 3 3 3 2 2 1</td>
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<tr>
<td>CO2</td>
<td>Prepare derivatives for aldehydes, ketones, sugars, amine and phenol</td>
<td>3 - 3 - 2 2 - 1</td>
</tr>
<tr>
<td>CO3</td>
<td>Analyzing various procedure to separate organic mixtures</td>
<td>- 3 3 1 - - 2 -</td>
</tr>
<tr>
<td>CO4</td>
<td>Steps to carry out recrystallization</td>
<td>- - 3 3 2 1 -</td>
</tr>
<tr>
<td>CO5</td>
<td>Preparation of synthetic organic compounds like a) Naphthalene – Nitro naphthalene – 4 nitro – 1 – amino naphthalene b) Benzene – Benzil – benzylic acid.</td>
<td>3 - 3 2 2 - 1 - 3 - 3 -</td>
</tr>
<tr>
<td>Overall CO</td>
<td></td>
<td>3 3 3 3 3 3 2 2 1 1 3 3 3 2</td>
</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:

- Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- Explain the TQM Principles for application.
- Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
- Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
- Illustrate and apply QMS and EMS in any organization.

UNIT I  INTRODUCTION  9
Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM– Basic concepts of TQM —Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II  TQM PRINCIPLES  9

UNIT III  TQM TOOLS & TECHNIQUES I  9

UNIT IV  TQM TOOLS & TECHNIQUES II  9
Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures- Cost of Quality - BPR.

UNIT V  QUALITY MANAGEMENT SYSTEM  9

TOTAL: 45 PERIODS

OUTCOMES:
CO1: Ability to apply TQM concepts in a selected enterprise.
CO2: Ability to apply TQM principles in a selected enterprise.
CO3: Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
CO4: Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.

CO5: Ability to apply QMS and EMS in any organization.

TEXT BOOK:

REFERENCES:

GE5251    ENVIRONMENTAL SCIENCES                                   L  T  P  C
3  0  0  3

OBJECTIVES:
- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and non-renewable resources, causes of their degradation and measures to preserve them.
- To familiarize the influence of societal use of resources on the environment and introduce the legal provisions, National and International laws and conventions for environmental protection.
- To inculcate the effect of population dynamics on human and environmental health and inform about human right, value education and role of technology in monitoring human and environmental issues.

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

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

UNIT III NATURAL RESOURCES

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land 47 degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT


UNIT V HUMAN POPULATION AND THE ENVIRONMENT


OUTCOMES:

- To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
- To identify the causes, effects and environmental pollution and natural disasters and contribute to the preventive measures in the immediate society.
- To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
- To recognize different forms of energy and apply them for suitable applications in for technological advancement and societal development.
- To demonstrate the knowledge of societal activity on the long and short term environmental issues and abide by the legal provisions, National and International laws and conventions in professional and personal activities and to identify and analyse effect of population dynamics on human value education, consumerism and role of technology in environmental issues.

TEXT BOOKS:


REFERENCE BOOKS:

AS5401 DRILLING OPERATIONS L T P C 300 3

OBJECTIVES.
The course is aimed to
- To learn about drill rigs and their types.
- To study about the drilling components and systems.
- To analyze the methods and techniques while drilling.
- To study about the rheology, drill bit and mud classification.
- To analyze about the drill rig problems and prevention techniques.

UNIT I
Drilling operations – Location to Rig. Release Well Bore Diagram, Crews – Operator – Drilling, contractor – Third Party Services – Rig Types – Land Types – Marine types

UNIT II

UNIT III

UNIT IV

UNIT V
Origin of Overpressure, Kick Signs, shut –in Procedures, Kill sheets, Kill Procedures, Driller’s Methods – Engineer’s Method (Wait and Weight)

TOTAL: 45 PERIODS

COURSE OUTCOMES
On completion of the course students are expected to
- CO1: Understand the concepts of rig crews and rig types.
- CO2: Obtain the concepts of on-site drill systems and components while using.
- CO3: Gain knowledge of drilling techniques and deep study of drill mud.
- CO4: Understand the concepts of hydraulic techniques and hole cleaning criteria
- CO5: Obtain the knowledge about rig accidents and their risks.
TEXT BOOKS

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Understand the concepts of rig crews and rig types.</td>
<td>PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PSO1 PSO2 PSO3 PSO4</td>
</tr>
<tr>
<td>CO2</td>
<td>Obtain the concepts of on-site drill systems and components while using.</td>
<td>PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PSO1 PSO2 PSO3 PSO4</td>
</tr>
<tr>
<td>CO3</td>
<td>Gain knowledge of drilling techniques and deep study of drill mud.</td>
<td>PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PSO1 PSO2 PSO3 PSO4</td>
</tr>
<tr>
<td>CO4</td>
<td>Understand the concepts of hydraulic techniques and hole cleaning criteria</td>
<td>PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PSO1 PSO2 PSO3 PSO4</td>
</tr>
<tr>
<td>CO5</td>
<td>Obtain the knowledge about rig accidents and their risks.</td>
<td>PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PSO1 PSO2 PSO3 PSO4</td>
</tr>
<tr>
<td>Overall CO</td>
<td></td>
<td>PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PSO1 PSO2 PSO3 PSO4</td>
</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
The course is aimed to

- To study about the fundamentals refining units and their components.
- To understand the different sulphur removal techniques and desalting of crudes.
- To learn about the catalytic process takes place in the refineries.
- To study about the various reaction mechanisms that takes place in refinery.
- To learn about the production techniques of the various petrochemical products.

UNIT I

Exploration and Refining of Crude Oil: Introduction, Indian and world reserve of crude oil and its processing capacity, Market demand & supply of petroleum Fractions, engineering data of crude and fractions. Characterization factor, Key Fraction Number and correlation index methods for evaluation of crude & fractions. TBP, ASTM, EFV, and their inter-convertibility, yield Curve etc.

UNIT II

Desalting of crude, Atmospheric and vacuum distillation units, different types of Reflux arrangements, Test methods and specifications, Different Hydro treatment (Hydro desulfurization processes, Merox process, Doctor's sweetening, DHDS, Claus process, Amine treatment)

UNIT III


UNIT IV

Steam reforming, Hydrogen, Synthesis gas, cracking of gaseous and liquid for stocks, Olefins, Diolefins, Acetylene and Aromatics and their separation, Alkylation, Oxidation, Dehydrogenation, Nitration, Chlorination, Sulphonation and Isomerization

UNIT V

Modes and techniques, Production of Polyethylene, PVC, Polypropylene, SAN, ABS, SBR, Polyacrylonitrile, Polycarbonates, Polyurethane, Nylon, PET

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course students are expected to

CO1: Establish the crude oil and their techniques economically.

CO2. Know the sulphur removal techniques and their causes.

CO3. Understand the concepts about catalytic refining units.

CO4. Get conversant with the various process for the production of petrochemicals.

CO5: Obtain petrochemical products from various refinery units.

TEXT BOOKS:


REFERENCES:

**Course Articulation Matrix:**

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<th>Course Outcomes</th>
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</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Establish the crude oil and their techniques economically.</td>
<td>3 - - - - - - - - - - -</td>
</tr>
<tr>
<td>CO2</td>
<td>Know the sulphur removal techniques and their causes.</td>
<td>- 3 - 3 2 - - - - - - - -</td>
</tr>
<tr>
<td>CO3</td>
<td>Understand the concepts about catalytic refining units.</td>
<td>3 - 3 2 - - - - - - - -</td>
</tr>
<tr>
<td>CO4</td>
<td>Get conversant with the various process for the production of petrochemicals.</td>
<td>- - - 3 3 - - - - - - - -</td>
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<tr>
<td>CO5</td>
<td>Obtain petrochemical products from various refinery units.</td>
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<tr>
<td><strong>Overall CO</strong></td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE:
The course is aimed to
- To study about the fundamentals of heat transfer.
- To analyze about the modes of heat transfer and their co-efficient.
- To study about the various heat transfer empirical relations for different applications.
- To learn about the deep study of heat transfer through radiation
- To understand the concepts of various parameter scale and their techniques.

UNIT I
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
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
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

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

TOTAL : 45 PERIODS

COURSE OUTCOMES
On completion of the course students are expected to

CO1: To familiarize the students with the fundamental concepts of Heat Transfer. provide the student with knowledge about heat transfer by conduction in solids for steady state.

CO2: Students will understand convective heat transfer and use of heat transfer coefficients for laminar and turbulent flows.
CO3: Students will be able to calculate and use overall heat transfer coefficients in designing heat exchangers.

CO4: The course provides the student with knowledge about heat transfer with phase change (boiling and condensation) and evaporation.

CO5: Students will understand radiative heat transfer including blackbody radiation and Kirchhoff’s law, and will be able to solve radiative problems apply knowledge of heat transfer to solve thermal engineering problems.

TEXT BOOKS:

REFERENCES:

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<td>To familiarize the students with the fundamental concepts of Heat Transfer, provide the student with knowledge about heat transfer by conduction in solids for steady state.</td>
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<td></td>
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<td><strong>PO 1</strong> <strong>PO 2</strong> <strong>PO 3</strong> <strong>PO 4</strong> <strong>PO 5</strong> <strong>PO 6</strong> <strong>PO 7</strong> <strong>PO 8</strong> <strong>PO 9</strong> <strong>PO 10</strong> <strong>PO 11</strong> <strong>PO 12</strong> <strong>PSO 1</strong> <strong>PSO 2</strong> <strong>PSO 3</strong> <strong>PSO 4</strong></td>
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<td>3 2 - - 2 - - - - - - - - 2 3 - - 3</td>
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<tr>
<td>CO2</td>
<td>Students will understand convective heat transfer and use of heat transfer coefficients for laminar and turbulent flows.</td>
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<td><strong>PO 1</strong> <strong>PO 2</strong> <strong>PO 3</strong> <strong>PO 4</strong> <strong>PO 5</strong> <strong>PO 6</strong> <strong>PO 7</strong> <strong>PO 8</strong> <strong>PO 9</strong> <strong>PO 10</strong> <strong>PO 11</strong> <strong>PO 12</strong> <strong>PSO 1</strong> <strong>PSO 2</strong> <strong>PSO 3</strong> <strong>PSO 4</strong></td>
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<td>3 2 2 - - - - - - - - - - - - - - 2 - - 2</td>
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<tr>
<td>CO3</td>
<td>Students will be able to calculate and use overall heat transfer coefficients in designing heat exchangers.</td>
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<td><strong>PO 1</strong> <strong>PO 2</strong> <strong>PO 3</strong> <strong>PO 4</strong> <strong>PO 5</strong> <strong>PO 6</strong> <strong>PO 7</strong> <strong>PO 8</strong> <strong>PO 9</strong> <strong>PO 10</strong> <strong>PO 11</strong> <strong>PO 12</strong> <strong>PSO 1</strong> <strong>PSO 2</strong> <strong>PSO 3</strong> <strong>PSO 4</strong></td>
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<td>- 3 2 3 3 - - - - - - - - - - - - 2 - - -</td>
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<tr>
<td>CO4</td>
<td>The course provides the student with knowledge about heat transfer with phase change (boiling and condensation) and evaporation</td>
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<td><strong>PO 1</strong> <strong>PO 2</strong> <strong>PO 3</strong> <strong>PO 4</strong> <strong>PO 5</strong> <strong>PO 6</strong> <strong>PO 7</strong> <strong>PO 8</strong> <strong>PO 9</strong> <strong>PO 10</strong> <strong>PO 11</strong> <strong>PO 12</strong> <strong>PSO 1</strong> <strong>PSO 2</strong> <strong>PSO 3</strong> <strong>PSO 4</strong></td>
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<td>- 3 2 3 3 - - - - - - - - - - 3 - - -</td>
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<tr>
<td>CO5</td>
<td>Students will understand radiative heat transfer</td>
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<td><strong>PO 1</strong> <strong>PO 2</strong> <strong>PO 3</strong> <strong>PO 4</strong> <strong>PO 5</strong> <strong>PO 6</strong> <strong>PO 7</strong> <strong>PO 8</strong> <strong>PO 9</strong> <strong>PO 10</strong> <strong>PO 11</strong> <strong>PO 12</strong> <strong>PSO 1</strong> <strong>PSO 2</strong> <strong>PSO 3</strong> <strong>PSO 4</strong></td>
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including blackbody radiation and Kirchhoff's law, and will be able to solve radiative problems apply knowledge of heat transfer to solve thermal engineering problems

| Overall CO | 3 | 3 | 2 | 3 | 3 | - | - | - | - | 2 | 2 | - | - | 3 |

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

AS5404 CHEMICAL ENGINEERING THERMODYNAMICS

OBJECTIVE:
The course is aimed to
• To study the basic laws of thermodynamics and charts.
• To learn about the first and second law applications in thermodynamics.
• To understand the concepts of various cycles and equilibrium conditions in thermodynamics.
• To learn about pure component properties by the way of various scientific equation.
• To study about phase equilibria and intensive properties in deep manner.

UNIT I ZEROTH AND FIRST LAWS, PROPERTIES OF PURE SUBSTANCES

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

UNIT III POWER CYCLES, THERMODYNAMIC POTENTIALS, EQUILIBRIA AND STABILITY

UNIT IV PROPERTIES OF PURE COMPONENTS AND MIXTURES

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

COURSE OUTCOMES:

TOTAL: 45 PERIODS
On completion of the course students are expected to

CO1: Understand the fundamental concepts of thermodynamics and its related functions

CO2: Relate PVT behavior of fluids and understand the real gas behavior

CO3: Apply second law and analyze the feasibility of system/devices

CO4: Analyze the thermodynamic property relations and their application to fluid flow

CO5: Develop the significance of thermodynamic potentials and their use in the analysis of processes

TEXT BOOKS:

REFERENCES:

Course Articulation Matrix:

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<tbody>
<tr>
<td>CO1</td>
<td>Understand the fundamental concepts of thermodynamics and its related functions.</td>
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<td>-</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>CO2</td>
<td>Relate PVT behavior of fluids and understand the real gas behavior</td>
<td>-</td>
<td>3</td>
<td>2</td>
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<td>2</td>
<td>2</td>
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</tr>
<tr>
<td>CO3</td>
<td>Apply second law and analyze the feasibility of system/devices</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
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<td>-</td>
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<td>2</td>
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<tr>
<td>CO4</td>
<td>Analyze the thermodynamic property relations and their application to fluid flow.</td>
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<td>2</td>
<td>3</td>
<td>-</td>
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</tbody>
</table>
Develop the significance of thermodynamic potentials and their use in the analysis of processes

Overall CO

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

AS5413 PROCESS HEAT TRANSFER LABORATORY

OBJECTIVES
The course is aimed to
- To learn the basic principles involved in heat transfer equipment
- To apply the concepts of heat transfer and fluid dynamics to the unit operations
- To know about the use of fins in heat exchangers
- To estimate heat transfer coefficients and rates
- To study the performance of heat transfer equipment

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

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

TOTAL: 60 PERIODS

COURSE OUTCOMES:
On completion of the course students are expected to
CO1: Apply the concepts of heat transfer and fluid dynamics to the operation of heat transfer equipment.
CO2: Estimate the heat transfer rate and heat transfer co-efficient
CO3: To perform heat transfer operation and to compare observed with predicted performance.
CO4: Evaluate the performance/calculate the parameters in heat transfer equipment.

CO5: Collect and analyse the heat transfer data practically.

CO6: Conduct experiments to solve complex engineering problems effectively as an individual as well as team work.

Course Articulation Matrix:

<table>
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</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Apply the concepts of heat transfer and fluid dynamics to the operation of heat transfer equipment.</td>
<td>P O 1 3 3 - 2 2 2 - - 3 3 - - 3 - - 2</td>
</tr>
<tr>
<td>CO2</td>
<td>Estimate the heat transfer rate and heat transfer coefficient</td>
<td>- 3 2 3 3 2 - - 2 2 - - 2 - - -</td>
</tr>
<tr>
<td>CO3</td>
<td>To perform heat transfer operation and to compare observed with predicted performance.</td>
<td>3 2 - 2 2 2 - - 3 2 - - - - 2 2</td>
</tr>
<tr>
<td>CO4</td>
<td>Evaluate the performance/calculate the parameters in heat transfer equipment.</td>
<td>- 2 3 3 3 2 2 2 - 3 3 - - - - 3 2</td>
</tr>
<tr>
<td>CO5</td>
<td>Collect and analyse the heat transfer data practically.</td>
<td>- 3 2 3 - - - - 3 3 - - 3 - 2 -</td>
</tr>
<tr>
<td>Overall CO</td>
<td></td>
<td>3 3 2 3 2 2 2 2 - 3 3 - - 3 - 2 2</td>
</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES
The course is aimed to
- To demonstrate various methods involved in the preparation of structural maps and interpretation
- To calculate the thickness of the beds,
- To study depositional environment using grain size analysis
- To find out sediment types using Sand – Silt – Clay ratio.
- To learn about surveying techniques

LIST OF EXPERIMENTS
1. Calculation of true and apparent dip.
2. Estimation of thickness, distance and depth of over body.
4. Interpretation of surface geology using contours.
5. Grain size analysis.
6. Identification of sedimentary rocks in hand specimen.
7. Identification of sedimentary rocks in microscopic level.
8. Resistivity Survey

EQUIPMENT REQUIRED
1. Petrological Microscope
2. Pipette, Burette, Conical Flask
3. Hot oven
4. Measuring Tape
5. Brunton Compass
8. Magnetometer.
9. Radioactivity meter – Geiger muller counter, Scintillation Counter
10. Torson Gravimeter.

TOTAL : 60 PERIODS

COURSE OUTCOMES:
On completion of the course students are expected to
CO1: Determine the true and apparent dip.
CO2: Able to handle petrological microscope and identify the samples.
CO3: Use resistivity tools and determine the water saturation.
CO4: Create grain size distribution.
CO5: Understand subsurface structures using contours.
## Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Determine the true and apparent dip.</td>
<td>3 3 2 3 - - - - 3 3 - - 3 2 - -</td>
</tr>
<tr>
<td>CO2</td>
<td>Able to handle petrological microscope and identify the samples</td>
<td>3 3 3 2 2 - - - 2 2 - - 3 2 - -</td>
</tr>
<tr>
<td>CO3</td>
<td>Use resistivity tools and determine the water saturation.</td>
<td>3 2 2 2 3 - - - 3 3 - - 3 2 - -</td>
</tr>
<tr>
<td>CO4</td>
<td>Create grain size distribution.</td>
<td>3 2 2 3 - - - - 3 2 - - 3 2 - -</td>
</tr>
<tr>
<td>CO5</td>
<td>Understand subsurface structures using contours.</td>
<td>2 3 2 3 - - - - 3 2 - - 3 3 - -</td>
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<td>Overall CO</td>
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<td>3 3 2 3 3 - - - 3 2 - - 3 2 - -</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES
The course is aimed to

- To analyze well design and managing conditions.
- To study about the designing of drill string and material properties.
- To learn about the completion types and performance of the equipment’s.
- To study about the tubing design and selection of string equipment’s.
- To learn about perforation and sand control techniques.

UNIT I
Well design: Prediction of formation pore pressure and stress gradients-Determination of safety mud weight bounds for different in-situ stress conditions-Design and planning well trajectory-Surveying tools and methods.

UNIT II
Design of drill string including bottom hole assembly-(BHA) Drilling methods and equipment for directional, horizontal and multilateral wells-Selection of casing shoes, material properties and design of casing program.

UNIT III
Well Completion and Stimulations: Well completion design, types of completion, completion selection and design criteria-Interval selection and productivity considerations: effects of producing mechanisms-Inflow performance and multiple tubing performance analyses using commercial software.

UNIT IV
Well stimulation and workover planning-Tubing-packer movement and forces-Tubing design: graphical tubing design and simplified tensional strength design-Selection of down-hole equipment, tubing accessories and wellhead equipment.

UNIT V
Basics of perforation, selection of equipment and procedure for perforation oil and gas wells-Technology of sand control: gravel packing-Fundamentals of well stimulation technologies: acidization and hydraulic fracturing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course students are expected to

CO1: Understand the concept of well completion basics and managing conditions.
CO2: Obtain the knowledge about the drill string designing.
CO3: Gain the knowledge about completion types and design criteria
CO4: Understand the concept of pressure maintenance and material properties.
CO5: Obtain the knowledge about the perforation techniques.

TEXT BOOKS:
## Course Articulation Matrix:

<table>
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<tbody>
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<td>CO1</td>
<td>Understand the concept of well completion basics and managing conditions.</td>
<td>3</td>
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<tr>
<td>CO2</td>
<td>Obtain the knowledge about the drill string designing</td>
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<tr>
<td>CO3</td>
<td>Gain the knowledge about completion types and design criteria</td>
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<td>CO4</td>
<td>Understand the concept of pressure maintenance and material properties.</td>
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<tr>
<td>CO5</td>
<td>Obtain the knowledge about the perforation techniques</td>
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<td>Overall CO</td>
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</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVE:
The course is aimed to
- To know about the properties of natural gas.
- To understand salient features of a gas reservoir.
- To develop production systems for natural gas.
- To study about the natural gas treating techniques.
- To learn about the natural gas recovery techniques.

UNIT I  PROPERTIES AND COMPOSITION OF NATURAL GAS  9

UNIT II  ESTIMATION AND PRODUCTION OF NATURAL GAS  9

UNIT III  GAS FROM CONDENSATE OIL FIELDS  9
Processing of condensate well fluids – Cycling of gas condensate reservoirs – Sweep patterns – Katy cycling plant.

UNIT IV  ACID GAS TREATING OF NATURAL GAS  9
Acid gas removal: Metal oxide process – Slurry process – Amine process –Carbonate washing process – Methanol based process and other process – Sulphur recovery process.

UNIT V  DEHYDRATION OF NATURAL GAS AND NGL RECOVERY  9

TOTAL: 45 PERIODS

COURSE OUTCOMES
On completion of the course students are expected to

CO1. Understand the properties of natural gas.

CO2. Apply different measures in the recognition of reservoir performance.

CO3. Understand and apply flow behaviour of gas in production tubing

CO4. Conversant with different methods of processing of gas

CO5. Understand and apply gas compression fundamentals

CO6. Conversant with the system of gathering stations, modes of transportation and problems associated.

TEXT BOOKS:

REFERENCES:

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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES
The course is aimed to
- To analyse the well equipment’s and testing
- To learn about the various well structures and their productions.
- To study separation and treatment of produced oil and associated surface facilities.
- To study offshore production technology.
- To understand well investigation techniques and remediation of well production problems

UNIT I
Well Head Equipment: Christmas tree, valves, hangers, flow control devices, packers, tubular and flow lines-Well completion Methods-Perforating Oil & Gas Wells- Conventional and Unconventional techniques viz. through tubing and tubing conveyed underbalanced perforating techniques, type size and orientation of perforation holes- Well activation, use of compressed air & liquid Nitrogen- Down-hole equipment: selection, servicing, installation & testing, smart wells- Intelligent completions.

UNIT II

UNIT III
Well Production Problems and mitigation: Scale formation, paraffin deposition, formation damage, water production, gas production, sand deposition etc. - Designing Gravel Pack for Sand Control- Sand control techniques- Formation Sand Size analysis-Optimum gravel - sand ratio-Gravel pack thickness-Gravel selection-Gravel packing fluid-Gravel pack techniques.

UNIT IV
Well Stimulation Techniques - Type & description of stimulation techniques-Design of matrix acidization and acid fracturing-Design of hydraulic fracturing, Multistage Fracturing-Wave technology & microbial stimulation

UNIT V

TOTAL: 45 PERIODS

COURSE OUTCOMES
On completion of the course students are expected to

CO1: Demonstrate working principle and design of separators

CO2: Illustrate various equipment and processes for the treatment on produced emulsion

CO3: Understand mechanism and factors of oil field corrosion and methods for prevention.

CO4: Understand and apply production logging operations.

CO5: Do problem well analysis and apply new techniques to sustain production rates and comprehend emerging and peripheral technologies for lifelong learning.
REFERENCES:

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<td>Demonstrate working principle and design of separators.</td>
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<td>3 - 3 - 2</td>
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<td>CO2</td>
<td>Illustrate various equipment and processes for the treatment on produced</td>
<td>3 - 3 - 2</td>
</tr>
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<td>emulsion</td>
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<td>3 - 3 - 3</td>
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<tr>
<td>CO3</td>
<td>Understand mechanism and factors of oil field corrosion and methods for</td>
<td>3 - 3 - 2</td>
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<td>prevention.</td>
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<td>3 - 3 - 3</td>
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<tr>
<td>CO4</td>
<td>Understand and apply production logging operations</td>
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<td>3 - 3 - 3</td>
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<tr>
<td>CO5</td>
<td>Do problem well analysis and apply new techniques to sustain production</td>
<td>3 - 3 - 2</td>
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<td>rates and comprehend emerging and peripheral technologies for lifelong</td>
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<td>learning.</td>
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</tr>
<tr>
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</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE:
The course is aimed to
- To provide a basic introduction to the molecular diffusive and convective mass transfer.
- To learn deeply about Gas absorption and stripping.
- To study the detailed view of Distillation.
- To learn the different types of extractor and its applications
- To learn about various membrane separation process involved in the industry

UNIT I  DIFFUSION AND MASS TRANSFER COEFFICIENT 9
Introduction to mass transfer operations; Molecular diffusion in gases, liquids and solids; diffusivity measurement and prediction; multi-component diffusion. Eddy diffusion, concept of mass transfer coefficients, theories of mass transfer, different transport analogies, application of correlations for mass transfer coefficients, interphase mass transfer, relationship between individual and overall mass transfer coefficients.

UNIT II  ABSORPTION 9
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 III  DISTILLATION 9
Vapour liquid equilibria - Raoult’s law, vapor-liquid equilibrium diagrams for ideal and non-ideal systems, enthalpy concentration diagrams. Principle of distillation - flash distillation, differential distillation, steam distillation, multistage continuous rectification. Number of ideal stages by McCabe - Thiele method and Ponchan - Savarit method, Total reflux, minimum reflux ratio, optimum reflux ratio. Introduction to multi-component distillation, azeotropic and extractive distillation

UNIT IV  LIQUID-LIQUID EXTRACTION 9
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 V  ADSORPTION AND ION EXCHANGE & MEMBRANE SEPARATION PROCESS 9
Adsorption - Types of adsorption, nature of adsorbents, adsorption equilibria, effect of pressure and temperature on adsorption isotherms, Adsorption operations - stage wise operations, steady state moving bed and unsteady state fixed bed adsorbers, break through curves. Principle of ion exchange, techniques and applications. Solid and liquid membranes; concept of osmosis; reverse osmosis; electro dialysis; ultra-filtration.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
On completion of the course students are expected to
CO1: Understand the fundamentals, types and mechanism of mass transfer operations
CO2: Understand the theories of mass transfer and the concept of inter-phase mass transfer
CO3: Understand the basics of distillation process and its application
CO4: Describe core principles of extraction, setting up mass balances, use graphical methods to estimate the number of ideal stages in leaching operation.
CO5: Understand the concept of adsorption techniques, various isotherms, membrane separation
techniques and ion exchange process.

TEXT BOOKS:

REFERENCES:

Course Articulation Matrix:

<table>
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<tr>
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<tbody>
<tr>
<td>CO1</td>
<td>Understand the fundamentals, types and mechanism of mass transfer operations</td>
<td>P O 1 2 3 4 5 6 7 8 9 10 11 12 P S O 1 2 3 4</td>
</tr>
<tr>
<td>CO2</td>
<td>Understand the theories of mass transfer and the concept of inter-phase mass transfer</td>
<td>2 3 - 2 - - - - - - - - - - - - - - 2 - - - 2</td>
</tr>
<tr>
<td>CO3</td>
<td>Understand the basics of distillation process and its application</td>
<td>3 - - - - 3 - - - - - - - - - - - - - - 3 - - - 3</td>
</tr>
<tr>
<td>CO4</td>
<td>Describe core principles of extraction, setting up mass balances, use graphical methods to estimate the number of ideal stages in leaching operation.</td>
<td>3 2 3 2 - - - - - - - - - - - - - - - - - - - - 3 - - - 2</td>
</tr>
<tr>
<td>CO5</td>
<td>Understand the concept of adsorption techniques, various isotherms, membrane separation techniques and ion exchange process</td>
<td>3 2 2 3 - - - - - - - - - - - - - - - - - - - - 3 - - 2</td>
</tr>
</tbody>
</table>
OBJECTIVES

The course is aimed to

- To learn the basic principles involved in mass transfer equipment
- To apply the concepts of mass transfer to the extraction and absorption processes
- To study the drying characteristics of various types of dryers
- To use different distillation methods to separate a binary mixture
- To study the performance of mass transfer equipment

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
10. Demonstration Gas – liquid Absorption

EQUIPMENTS REQUIRED

1. Simple distillation setup
2. Steam distillation setup
3. Packed column Liquid-liquid extractor
4. Liquid – Liquid Extractor
5. Vacuum Dryer
6. Tray dryer
7. Rotary dryer
8. Rotating Disc Contactor
9. Cooling Tower
10. Absorption Column

Minimum 10 experiments shall be offered.

TOTAL : 60 PERIODS

COURSE OUTCOMES

On completion of the course students are expected to

CO1: Determine the diffusivity practically and compare the results with the empirical correlations.
CO2: Estimate the mass transfer rate and mass transfer co-efficient
CO3: Evaluate the performance/calculate the parameters in different distillation processes
CO4: Evaluate the performance/calculate the parameters in leaching and extraction operations
CO5: Estimate the drying characteristics
## Course Articulation Matrix:

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<tr>
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<td>CO1</td>
<td>Determine the diffusivity practically and compare the results with the empirical correlations.</td>
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</tr>
<tr>
<td>CO2</td>
<td>Estimate the mass transfer rate and mass transfer coefficient</td>
<td>-    3    2    2    2    -    -    -    3    2    -    -    2    -    3    -</td>
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<tr>
<td>CO3</td>
<td>Evaluate the performance/calculate the parameters in different distillation processes</td>
<td>-    -    3    -    -    2    -    -    2    3    -    -    2    -    2    -</td>
</tr>
<tr>
<td>CO4</td>
<td>Evaluate the performance/calculate the parameters in leaching and extraction operations</td>
<td>2    -    -    3    -    -    -    -    2    3    -    -    2    -    3    -</td>
</tr>
<tr>
<td>CO5</td>
<td>Estimate the drying characteristics</td>
<td>-    3    -    -    3    -    -    -    3    2    -    -    2    -    2    -</td>
</tr>
<tr>
<td>Overall CO</td>
<td></td>
<td>2    3    3    3    3    2    -    -    2    3    -    -    2    -    2    -</td>
</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES:
The course is aimed to
- To be conversant with the theoretical principles and experimental procedures for quantitative estimation.
- To measure viscosity of oil samples using various types of viscometers
- To test the samples for the study of engine performance
- To study the properties of oil samples
- To do the qualitative testing of fuels

LIST OF EXPERIMENT
1. Determination of flash point.
2. Carbon residue determination of petroleum products.
3. Distillation of crude oil
4. Determination of viscosity capillary viscometer.
5. Density of crude oil by hydrometer.
6. Pour point of crude oil and petroleum products.
7. Determination of calorific value of fuels.
8. Determination of refractive index of the petroleum products.
9. Determination of salacity of oil field waters
10. Characterization of formation waters
11. Water content in crude oil
12. Moisture content in crude oil and products
13. BS&W in crude oil

LIST OF EQUIPMENT
1. Flash point apparatus.
2. Centrifuge
3. Dean and Stark Apparatus
4. API standard distillation apparatus
5. Capillary Viscometer
6. Gas Chromatograph
7. Bomb calorimeter
8. Refractometer
9. Junker gas calorimeter
10. Glass wares, balance, hot plate and heating mantle
11. Pour Point Apparatus
12. Karl Fisher Apparatus

COURSE OUTCOME:
On completion of the course students are expected to

CO1: Understand the basic principles involved in testing of Petroleum products by different techniques.
CO2: Be expertise in the testing equipment.
CO3: Be well versed in properties of oil and gas products.
CO4: Acquire the data from the testing equipment and interpret it.
CO5: Understand the industrial application of concept.
## Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>PO 1</th>
<th>PO 2</th>
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<td>Understand the basic principles involved in testing Petroleum products by different techniques</td>
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<tr>
<td>CO2</td>
<td>Be expertise in the testing equipment.</td>
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<tr>
<td>CO3</td>
<td>Be well versed in properties of oil and gas products.</td>
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<tr>
<td>CO4</td>
<td>Acquire the data from the testing equipment and interpret it.</td>
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<tr>
<td>CO5</td>
<td>Understand the industrial application of concept.</td>
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<td><strong>Overall CO</strong></td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
AS5601 PETROLUEM FORMATION AND EVALUATION

3 0 0 3

OBJECTIVE:
The course is aimed to
- To apply quick look methods of log interpretation.
- To analyse open hole logs and integrate log and core data to obtain properties of rocks and fluids.
- To learn about the types of tools and its applications
- To gain the knowledge on DSI and NMR logging principles.
- To analyse the log interpretation and techniques.

UNIT I
Petrophysical measurements to sub-surface engineering.

UNIT II
Indirect Methods: SP and resistivity logs, radioactive logs, acoustic logs (principles, types of tools, limitation and applications). Evaluation of CBL/VDL, USIT, SFT, RFT.

UNIT III
Production Logging: Introduction, type of tools, principles, limitations and applications.

UNIT IV
Special Type of Logging Tools: Casing inspection tools (principles, application and limitation), Formation micro scanner (FMS), DSI, NMR logging principles. Logging in high-angle wells.

UNIT V

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course students are expected to
CO1. Apply different logging methods for the evaluation of subsurface formations
CO2. Apply principles of mud logging in the recognition of oil and gas show
CO3. Apply principles of physics in the recognition and calculation of different parameters of formations
CO4. Apply quick look interpretation methods in the evaluation of hydrocarbon recognition
CO5. Interpret broad depositional environment from log signatures.
TEXT BOOKS:

REFERENCE:

Course Articulation Matrix:

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<td>CO1</td>
<td>Apply different logging methods for the evaluation of subsurface formations</td>
<td>3 - 3 2 2 2 - - - - - 2 3 3 2 -</td>
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<tr>
<td>CO2</td>
<td>Apply principles of mud logging in the recognition of oil and gas show</td>
<td>3 2 3 1 2 2 - - - - - - 3 2 2 -</td>
</tr>
<tr>
<td>CO3</td>
<td>Apply principles of physics in the recognition and calculation of different parameters of formations</td>
<td>3 - 3 2 - - - - - - - - - - 2 3 2 -</td>
</tr>
<tr>
<td>CO4</td>
<td>Apply quick look interpretation methods in the evaluation of hydrocarbon recognition</td>
<td>3 2 2 - 3 - - - - - - - - 3 3 2 -</td>
</tr>
<tr>
<td>CO5</td>
<td>Interpret broad depositional environment from log signatures</td>
<td>3 - 3 - 3 - - - - - - - - 2 3 2 -</td>
</tr>
</tbody>
</table>
OBJECTIVES

The course is aimed to

- To learn the fundamentals in flow assurance.
- To gain knowledge on the hydraulics.
- To know about transfer of heat in flow assurance.
- To characterize the formation mechanism for organic deposits.
- To learn about the removal and prevention methods of organic deposits.

UNIT I  INTRODUCTION TO FLOW ASSURANCE 9
Flow Assurance concerns and challenges; Economic impact of Flow Assurance problems, components of typical Flow Assurance process; Composition and Properties of Hydrocarbons; Equations of State; Phase behaviour of hydrocarbons, Compositional and Physical Characterization of Crude oil.

UNIT II  HYDRAULICS IN FLOW ASSURANCE 9
Hydrocarbon flow, single phase and multiphase flow, Two phase flow correlations; Slugging and Liquid Handling, Types of slugs, Slug prediction, detection and control systems; Pressure surge analysis; Hydraulic/Pressure drop calculations.

UNIT III  HEAT TRANSFER IN FLOW ASSURANCE 9
Buried pipeline heat transfer, Temperature prediction along the pipeline in steady state and transient modes; Thermal management strategy like external coating systems, direct heating, pipe in pipe, etc.; Insulation performance.

UNIT IV  CHARACTERIZATION AND FORMATION MECHANISMS FOR ORGANIC DEPOSITS 9
Characterization, Formation mechanism, prediction and models for deposition and stability for wax (Paraffins), Asphaltenes and Gas Hydrates.

UNIT V  ORGANIC DEPOSITS REMOVAL AND PREVENTION METHODS 9
Mechanical Removal Methods like Coiled Tubing, Pigging, Pressurization Depressurization etc.; Chemical Solvents and Dispersants, Other techniques like Ultrasonic, Laser Technology, etc., Bacterial Removal Methods, Heating in Wellbore and Piping; Cold flow methods; Chemical inhibitors for waxes, asphaltenes and hydrates; Dehydration of Natural Gas; Special Materials and Coatings.

COURSE OUTCOMES

On completion of the course students are expected to

CO1: Predict the phase behaviour of hydrocarbons under different operating conditions.
CO2: Perform slug handling and pressure surge analysis
CO3: Implement a thermal management strategy in pipelines transporting hydrocarbons
CO4: Predict the formation of paraffin waxes, asphaltenes and hydrates in crude oil
CO5: Apply the appropriate method for prevention and removal of organic deposits.

REFERENCE


Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
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<tbody>
<tr>
<td>CO1</td>
<td>Predict the phase behaviour of hydrocarbons under different operating conditions.</td>
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<td>2</td>
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<td>3</td>
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</tr>
<tr>
<td>CO2</td>
<td>Perform slug handling and pressure surge analysis.</td>
<td>-</td>
<td>2</td>
<td>-</td>
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<td>2</td>
<td>2</td>
<td>-</td>
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<td>3</td>
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</tr>
<tr>
<td>CO3</td>
<td>Implement a thermal management strategy in pipelines transporting hydrocarbons</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2</td>
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<td>3</td>
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</tr>
<tr>
<td>CO4</td>
<td>Predict the formation of paraffin waxes, asphaltenes and hydrates in crude oil</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
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<td>-</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>Apply the appropriate method for prevention and removal of organic deposits.</td>
<td>3</td>
<td>-</td>
<td>-</td>
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<td>3</td>
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<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

**OBJECTIVES**
- To enhance the employability skills of students with a special focus on presentation skills, group discussion skills and interview skills
- To help them improve their reading skills, writing skills, and soft skills necessary for the workplace situations
- To make them employable graduates

**UNIT I  WRITING SKILLS**
Preparation of job applications—writing covering letter and résumé—applying for job online—email etiquette—writing official letters (placing an order, letter to consumers, etc.)

**UNIT II  SOFT SKILLS**
Hard skills & soft skills—soft skills: self-management skills & peopleskills—training in soft skills—persuasive skills—sociability skills—interpersonal skills—teambuilding skills—leadership skills—problem solving skills—adaptability—motivation techniques—lifeskills.

**UNIT III  PRESENTATION SKILLS**
Preparing slides with animation related to the topic—organizing the material—Introducing oneself to the audience—introducing the topic—answering questions—individual presentation practice—presenting the visuals effectively—5 minute presentation.

**UNIT IV  GROUP DISCUSSION SKILLS**
Participating in group discussions—understanding group dynamics—brainstorming the topic—questioning and clarifying—GD strategies (expressing opinions, accepting or refusing others opinions, turn taking)—activities to improve GD skills—viewing recorded GD—mock GD.

**UNIT V  INTERVIEW SKILLS**
Interview etiquette—dress code—body language—mock interview—attending job interviews—answering questions confidently—technical interview—telephone/Skype interview—one to one interview & panel interview—FAQs related to job interview—Emotional and cultural intelligence.

**TOTAL: 60 PERIODS**

**Teaching Methods**
Seminar, Presentation, Group Discussion, Employability skills practice in the language laboratory

**Evaluation**
Continuous Assessment—100 marks

a) Group Discussion Skills - 25 marks
b) Presentations Skills - 25 marks
Interview skills - 25 marks d)
Assignment (Job Application and official letters) - 25 marks
Total - 100 marks
End Semester examination – NIL

OUTCOMES
After the completion of the course, the learners will be able to,
• Perform well at placement interviews, group discussions and other recruitment exercises
• Acquire adequate competence in speaking, reading and writing skills needed for workplace related situations
• Gain a comprehensive knowledge about soft skills

REFERENCES:

WEB RESOURCES
1. www.humanresources.about.com
2. www.careerride.com
OBJECTIVES
The course is aimed to

- To study the various properties of drilling fluid
- To learn the preparation of cement slurries
- To learn the underlying principles of the equipments used
- To prepare a drilling fluid based on the given specifications
- To learn about the additives which are used to alter the properties

LIST OF EXPERIMENTS
Determination of Properties

I. Mud weight  
II. Plastic viscosity  
III. Gel strength  
IV. Filtration loss  
V. Sand content  
VI. Salt contents etc.

1. Practical related to the setting point and the consistency of cement slurry

TOTAL: 30 PERIODS

LIST OF EQUIPMENT

1. Mud weight – Mud Balance  
2. Viscosity  
3. Filtration Loss  
4. pH Meter – Generic (Can be used in all Labs)  
5. Sand Content  
6. Cement Consistency – Consistometer  
7. Cement Mechanical Properties  
8. Porosity- Porosimeter  
9. Permeability- Permeameter  
10. BHP Chart analysis

COURSE OUTCOME:

On completion of the course students are expected to

CO1: Understand the design of mud balance and how to be able to determine the density of drilling fluids.
CO2: Able to handle the Fann Viscometer and to determine PV and gel strength.
CO3: Handle API filtration loss equipment and determine the mud cake thickness.
CO4: Determine the sand content in the drilling fluids.
CO5: Determine the salt content in the drilling fluids.

### Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
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</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Understand the design of mud balance and how to be able to determine the density of drilling fluids.</td>
<td>P O 1 P O 2 P O 3 P O 4 P O 5 P O 6 P O 7 P O 8 P O 9 P O 10 P O 11 P S O 1 P S O 2 P S O 3 P S O 4</td>
</tr>
<tr>
<td>CO2</td>
<td>Able to handle the Fann Viscometer and to determine PV and gel strength.</td>
<td>3 2 2 3 2 - - - 2 3 - - 3 - 2 -</td>
</tr>
<tr>
<td>CO3</td>
<td>Handle API filtration loss equipment and determine the mud cake thickness.</td>
<td>2 3 3 2 2 - - - 3 2 - - 3 -</td>
</tr>
</tbody>
</table>
Determine the salt content in the drilling fluids.

Overall CO

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

AS5701 PETROLEUM EQUIPMENT DESIGN LT P C

OBJECTIVE
The course is aimed to
- To learn about heat transfer operations.
- To study about the separation equipment.
- To study about mass transfer process equipment's.
- To learn about design of storage and reactor vessel.
- To analyse about plant layout and construction.

UNIT I HEAT TRANSFER OPERATIONS
Fired heaters, Heat Exchangers, Condensers, Evaporators, Reboilers,

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

UNIT III MASS TRANSFER OPERATIONS
Absorption column, Distillation Column, Extraction Column, Cooling tower, Dryer, Crystallizer

UNIT IV REACTORS AND STORAGE VESSELS
Packed bed Reactors, FCC units, Pressure Vessel, Storage Vessel

UNIT V MATERIALS OF CONSTRUCTION AND PLANT LAYOUT
Design of Plant Layout, Pipe Lines and Pipe Layouts, Design Schematics and Presentation, Materials of Construction and Selection of process

COURSE OUTCOMES:
On completion of the course students are expected to
CO1: Understand the piping fundamentals, codes and standards
CO2: Understand pipe fittings, selections, drawings and dimensioning
CO3: Understand Pipe Material specifications
CO4: Understand pressure design of pipe systems
CO5: Understand the materials of constrictions and plant layout.

REFERENCES

Course Articulation Matrix:

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<tbody>
<tr>
<td>CO1</td>
<td>Understand the piping fundamentals, codes and standards</td>
<td>P O 1 2 3 2 - 2 - - 2 2 - - 3 - 3 - - 2</td>
</tr>
<tr>
<td>CO2</td>
<td>Understand pipe fittings, selections, drawings and dimensioning.</td>
<td>P O 3 2 3 3 2 - 3 - - - - - 3 - 2 2</td>
</tr>
<tr>
<td>CO3</td>
<td>Understand Pipe Material specifications.</td>
<td>P O 4 3 2 - 2 - 2 - - 2 - - 3 1 - 3</td>
</tr>
<tr>
<td>CO4</td>
<td>Understand pressure design of pipe systems.</td>
<td>P O 5 3 2 3 - - 3 - - - 1 - 3 - - 2</td>
</tr>
<tr>
<td>CO5</td>
<td>Understand the materials of constrictions and plant layout.</td>
<td>P O 6 3 3 3 - 3 - 2 - - - - - 3 - - 3</td>
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<tr>
<td>Overall CO</td>
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<td>P O 7 3 2 3 2 - 2 - - 2 2 - - 2 3 - 3 1 2 2</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES
The course is aimed to
- To analyze the different types of parameter
- To introduce dynamic response of open and close system.
- To analyze the instruments handling while processing.
- To study about the frequency-based loop system.
- To analyze the modern and advanced control systems.

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

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

UNIT III  CLOSED LOOP SYSTEMS
Closed loop control systems, development of block diagram for feedback 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 controller settings

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course students are expected to

CO1: Understand process industry as it allows real-time measurement and control of process variables such as levels, flow, pressure, temperature, pH, and humidity.
CO2: Develop transient models for chemical processes using material and/or energy balance equations by incorporating constitutive relationships and seek their solution using Laplace Transforms.

CO3: Develop transient models for chemical processes using material and/or energy balance equations by incorporating constitutive relationships and seek their solution using Laplace Transforms.

CO4: Understand Frequency response of control systems and tune the PID controllers

CO5: Appreciate the performance augmentation of PID controllers by using advanced control strategies such as Cascade, Feed forward, Dead time compensation.

TEXT BOOKS

REFERENCES

Course Articulation Matrix:

<table>
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<tr>
<th>Course Outcomes</th>
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</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Understand process industry as it allows real-time measurement and control of process variables such as levels, flow, pressure, temperature, pH, and humidity.</td>
<td>P O 1</td>
</tr>
<tr>
<td>CO2</td>
<td>Develop transient models for chemical processes using material and/or energy balance equations by incorporating constitutive relationships and seek their solution using Laplace Transforms.</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>Develop transient models for chemical processes using material and/or energy balance equations by incorporating constitutive relationships and seek their solution using Laplace Transforms.</td>
<td>2</td>
</tr>
</tbody>
</table>
1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
suitable for that particular field.

CO4: Understand the flooding mechanisms.

CO5: Understand how gas injection works to maintain the reservoir pressure and to understand the mechanism leading to positive skin.

REFERENCE:

Course Articulation Matrix:

<table>
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<td>P S O 4</td>
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<tr>
<td>CO1</td>
<td>Understand the purpose of enhanced recovery process.</td>
<td>3  -  -  -  2  -  2  -  -  -  -  -  3  -  2  -</td>
</tr>
<tr>
<td>CO2</td>
<td>Understand the concept of capillary force, viscous force and how it traps the oil.</td>
<td>2  3  -  3  -  -  3  -  -  -  3  -  2  -  -  2</td>
</tr>
<tr>
<td>CO3</td>
<td>Understand the sampling and analysis of reservoir fluid and to develop flooding fluid which is suitable for that particular field.</td>
<td>3  2  -  2  -  -  2  -  -  -  -  -  3  1  -  -</td>
</tr>
<tr>
<td>CO4</td>
<td>Understand the flooding mechanisms.</td>
<td>3  2  -  2  -  -  3  -  -  -  2  -  2  -  1  2</td>
</tr>
<tr>
<td>CO5</td>
<td>Understand how gas injection works to maintain the reservoir pressure and to understand the mechanism leading to positive skin.</td>
<td>2  2  -  3  -  -  2  -  -  -  -  -  3  -  -  2</td>
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</table>
**OBJECTIVES**

The course is aimed to

- To solve chemical engineering problems using C, Excel and MATLAB programming and also using computational tools like Aspen.
- To understand the open loop and closed loop system
- To understand the concept of P, PI, PID controllers
- To study the characteristics of control valves

**LIST OF EXPERIMENTS:**

1. **Programming in C**

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

2. **Microsoft Excel Software**

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

3. **Programming in MATLAB**

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

4. **ASPEEN Software**

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

5. **Open loop and Closed loop study on a level system**
6. Open loop study and Closed loop study on a thermal system
7. Open loop and Closed loop study on a flow system
8. Response of first order system and second order system
9. Response of Non-Interacting level System and Interacting level System
10. Characteristics of different types of control valves

TOTAL: 60 PERIODS

**COURSE OUTCOME:**
On completion of the course students are expected to

**CO1:** Solve chemical engineering problems using C and MATLAB programming and Microsoft Excel software.
**CO2:** Solve chemical engineering problems and design the process using ASPEN PLUS Process Simulator.
**CO3:** Able to determine the response of a first order and second order system for various input and an interacting and non-interacting system for various input.
**CO4:** Understand the difference between an open loop and closed loop system and the concept of three classical controller P, PI, PID controller.

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<tr>
<td><strong>CO1</strong></td>
<td>Solve chemical engineering problems using C and MATLAB programming and Microsoft Excel software.</td>
<td><strong>PO1</strong> P O 1 2 3 4 5 6 7 8 9 10 <strong>PO1</strong> P O 1 2 3 4 5 6 7 8 9 10 <strong>PSO1</strong> PS PO 1 2 3 4 5 6 7 8 9 10 <strong>PSO1</strong> PS PO 1 2 3 4 5 6 7 8 9 10 <strong>PSO1</strong> PS PO 1 2 3 4 5 6 7 8 9 10 <strong>PSO1</strong> PS PO 1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td><strong>CO2</strong></td>
<td>Solve chemical engineering problems and design the process using ASPEN PLUS Process Simulator.</td>
<td><strong>PO1</strong> P O 1 2 3 4 5 6 7 8 9 10 <strong>PO1</strong> P O 1 2 3 4 5 6 7 8 9 10 <strong>PSO1</strong> PS PO 1 2 3 4 5 6 7 8 9 10 <strong>PSO1</strong> PS PO 1 2 3 4 5 6 7 8 9 10 <strong>PSO1</strong> PS PO 1 2 3 4 5 6 7 8 9 10 <strong>PSO1</strong> PS PO 1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td><strong>CO3</strong></td>
<td>Able to determine the response of a first order and second order system for various input and an interacting and non-interacting system for various input.</td>
<td><strong>PO1</strong> P O 1 2 3 4 5 6 7 8 9 10 <strong>PO1</strong> P O 1 2 3 4 5 6 7 8 9 10 <strong>PSO1</strong> PS PO 1 2 3 4 5 6 7 8 9 10 <strong>PSO1</strong> PS PO 1 2 3 4 5 6 7 8 9 10 <strong>PSO1</strong> PS PO 1 2 3 4 5 6 7 8 9 10 <strong>PSO1</strong> PS PO 1 2 3 4 5 6 7 8 9 10</td>
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<tr>
<td><strong>CO4</strong></td>
<td>Understand the difference between an open loop and closed loop system and the concept of three classical controller P, PI, PID controller.</td>
<td><strong>PO1</strong> P O 1 2 3 4 5 6 7 8 9 10 <strong>PO1</strong> P O 1 2 3 4 5 6 7 8 9 10 <strong>PSO1</strong> PS PO 1 2 3 4 5 6 7 8 9 10 <strong>PSO1</strong> PS PO 1 2 3 4 5 6 7 8 9 10 <strong>PSO1</strong> PS PO 1 2 3 4 5 6 7 8 9 10 <strong>PSO1</strong> PS PO 1 2 3 4 5 6 7 8 9 10</td>
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Overall CO

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.

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<tbody>
<tr>
<td>CO1</td>
<td>Show competence in identifying relevant information, defining and explaining topics under discussion</td>
<td>P O 1</td>
</tr>
<tr>
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</tr>
<tr>
<td>CO2</td>
<td>Demonstrate depth of understanding, use primary and secondary technical sources.</td>
<td>2</td>
</tr>
</tbody>
</table>
OBJECTIVES

The Project is aimed to make use of the knowledge gained by the student at various stages of the degree course.

COURSE OUTCOMES

On completion of the course students are expected to

- CO1: Apply the fundamental concept learnt during the theory courses to solve industrial problems

- CO2: Design a manufacturing Petrochemical process industry Prepare clear concise project reports with the help of graphs, charts and pictorial representation.

- CO3: Each student is required to submit a report on the project assigned to him by the department.

- CO4: The report should be based on the information available in the literature or data obtained in the laboratory/industry.

- CO5: Students, in addition to the home problem will be permitted to undertake industrial / consultancy project work, outside the department, in industries / Research labs for which proportional weightage will be given in the final assessment.
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<td>Apply the fundamental concept learnt during the theory courses to solve industrial problems</td>
<td>P O O 1 P O O 2 P O O 3 P O O 4 P O O 5 P O O 6 P O O 7 P O O 8 P O O 9 P O O 10 P O O 11 P S O 1 P S O 2 P S O 3 P S O 4</td>
</tr>
<tr>
<td>CO2</td>
<td>Design a manufacturing Petrochemical process industry Prepare clear concise project reports with the help of grape, charts and pictorial representation.</td>
<td>2 3 - 3 - 3 - 3 - 3 - 3 - 3 - 2 - 2 - 2</td>
</tr>
<tr>
<td>CO3</td>
<td>Each student is required to submit a report on the project assigned to him by the department.</td>
<td>3 3 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 1 - 1</td>
</tr>
<tr>
<td>CO4</td>
<td>The report should be based on the information available in the literature or data obtained in</td>
<td>3 2 - 2 - 2 - 3 - 3 - 3 - 2 - 2 - 1 - 2</td>
</tr>
</tbody>
</table>
Students, in addition to the home problem will be permitted to undertake industrial/consultancy project work, outside the department, in industries/research labs for which proportional weightage will be given in the final assessment.

<table>
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<tr>
<th>CO5</th>
<th>Students, in addition to the home problem will be permitted to undertake industrial/consultancy project work, outside the department, in industries/research labs for which proportional weightage will be given in the final assessment.</th>
</tr>
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<tr>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.

AS5015 PETROLEUM CHEMISTRY

OBJECTIVE:
The course is aimed to
- To learn about the composition and properties of Hydrocarbons.
- To learn about cracking process and mechanism.
- To learn about upgradation technologies.
- To learn about instability and incompatibility of Petroleum processes.
- To obtain knowledge on petroleum analysis and evaluation.

UNIT I
Composition of petroleum, Chemical Structure of important hydrocarbons, aromatic compounds found in crude oils, preparation and physical and chemical properties and uses of Heterocyclic compounds - Pyrrole, Furan, Furfural, Tetrahydrofuran, Thiophene, Indole, Pyridine, Quinoline and Iso Quinoline.

UNIT-II
Thermal Chemistry of petroleum constituents - Cracking Free radical Mechanism, Hydro cracking Chemistry, Hydrogenation catalyst - Strong acid cracking of hydrocarbons - Bronsted acid, Lewis acid, Solid strong acid catalyst, Nitrogen basis and hydro denitrogenation, Poisoning by Coke deposit.

UNIT-III
Heavy oil upgradation process - Carbon rejection, Hydrogen addition, Chemistry of upgrading. Upgrading Technologies - Hydrogen addition process, Thermal rearrangements and carbon rejection.

UNIT-IV
UNIT-V  
Petroleum analysis and evaluations - Separation by molecular weight and molecular type - ASTM Evaluation, Carbon residue, Metal content, Viscosity, Density, Specific gravity, Volatility - Spectroscopic method-infrared, Nuclear, Magnetic resonance, Mass Spectrometry

TOTAL 45: PERIODS

COURSE OUTCOMES:
On completion of the course students are expected to
CO1: Know about the preparation and structures of hydrocarbons.
CO2: Understand the cracking mechanisms and techniques.
CO3: Know about Chemistry behind the upgradation process.
CO4: Know about the influence of hetero atoms in petroleum products
CO5: Understand the petroleum evaluation techniques and methods.

TEXT BOOK:

REFERENCE

Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
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<tbody>
<tr>
<td>CO1</td>
<td>Know about the preparation and structures of hydrocarbons.</td>
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<td>P O P O P O P O</td>
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<td>1 2 3 2 1 3 2</td>
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<tr>
<td>CO2</td>
<td>Understand the cracking mechanisms and techniques.</td>
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<td>P O P O P O P O</td>
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<td>1 2 3 1 2 3 2</td>
</tr>
<tr>
<td>CO3</td>
<td>Know about Chemistry behind the upgradation process.</td>
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<td>P O P O P O P O</td>
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<td>1 2 3 2 1 3 2</td>
</tr>
<tr>
<td>CO4</td>
<td>Know about the influence of hetero atoms in petroleum products.</td>
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<td></td>
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<td>P O P O P O P O</td>
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<td>1 2 3 1 2 3 2</td>
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<tr>
<td>CO5</td>
<td>Understand the petroleum evaluation techniques and methods.</td>
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<td>P O P O P O P O</td>
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Overall CO 3 - 2 - 2 - - - - 1 1 - 3 - 2 -

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE
The course is aimed to

- To learn about fluid flow characteristics.
- To gain knowledge on analysis of well tests data.
- To gain knowledge on DST studies.
- To analyse well test using curves.
- To learn about gas well tests.

UNIT I

UNIT II
Pressure Transient Tests: Drawdown and build up-test analysis, determination of permeability and skin factor, Analysis of pressure-build-up tests distorted by phase redistribution, Well-test interpretation in hydraulically fractured wells, Interpretation of well-test data in naturally fractured reservoirs, Wellbore effects, Multilayer reservoirs, Injection well testing, Multiple well testing, Wireline formation testing. Wireline while drilling formation testing. Interference testing, Pulse testing.

UNIT III
Drill Stem Testing: Equipment, DST chart observation and preliminary interpretation. Well preparation for testing, Multiple well testing. Effect of reservoir heterogeneities & Well bore conditions, fractured reservoir application.

UNIT IV
Well-test analysis by use of type curves: Fundamentals of type curves, Ramey’s type curve, McKinleTy’s and Gringarten et al type curves.

UNIT V
Gas well testing: Basic theory of gas flow in reservoir, Flow-after-flow test, Isochronal test, etc.

COURSE OUTCOMES:
On completion of the course students are expected to

CO1: Understand the basic concepts and various principles of fluid flow and superposition.

CO2: Understand the various experiments on wells and data analysis.

CO3: Know the equipment used for DST and its characterization.

CO4: Understand the different types of curves for well tests.

CO5: Understand the basic concepts of gas well testing.

TEXT BOOK

REFERENCE
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<th>Statement</th>
<th>Program Outcome</th>
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</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Understand the basic concepts and various principles of fluid flow and superposition</td>
<td>2 3 2 - 2 - - - 3 2 - - 3 - 2 -</td>
</tr>
<tr>
<td>CO2</td>
<td>Understand the various experiments on wells and data analysis.</td>
<td>- 2 3 2 3 - - - 2 3 - - 3 2 3 -</td>
</tr>
<tr>
<td>CO3</td>
<td>Know the equipment used for DST and its characterization.</td>
<td>2 3 2 3 2 - - - 3 2 - - 3 3 2 -</td>
</tr>
<tr>
<td>CO4</td>
<td>Understand the different types of curves for well tests.</td>
<td>- 2 3 2 3 - - - 2 3 - - 3 2 3 -</td>
</tr>
<tr>
<td>CO5</td>
<td>Understand the basic concepts of gas well testing.</td>
<td>- 3 2 3 2 - - - 3 2 - - 3 3 2 -</td>
</tr>
<tr>
<td>Overall CO</td>
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<td>2 3 2 3 2 - - - 3 2 - - 3 3 2 -</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE
The course is aimed to
- To learn about the important aspects of offshore structural design.
- To know about description and operation techniques.
- To understand about the types and installation.
- To learn about offshore drilling platforms.
- To understand about the offshore production and storage.

UNIT I 9
Introduction to offshore oil and gas operations-Sea States and Weather-Meteorology, oceanography, ice, sea bed soil.

UNIT II 9

UNIT III 9
Offshore Mobile Units: Types, description and installation-Station keeping methods like conventional mooring and dynamic positioning system.

UNIT IV 9
Offshore Drilling-Difference in drilling from land, from fixed platform, jack up, ships and semi submersibles-Use of conductors and risers-Deep sea drilling-Offshore Well Completion- Platforms and subsea completions-Deep water applications of subsea technology.

UNIT V 9

TOTAL: 45 PERIODS

COURSE OUTCOMES
On completion of the course students are expected to
CO1: Know about basic concepts of offshore drilling.
CO2: Know about the off-shore platforms.
CO3: Know about the installation of equipment.
CO4: Gain Knowledge about the subsea technologies.
CO5: Learn the equipment involved in the Production practices.

REFERENCES:
Course Articulation Matrix:

<table>
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<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
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<tbody>
<tr>
<td>CO1</td>
<td>Know about basic concepts of offshore drilling.</td>
<td>PO1:3 PO2:- PO3:- PO4:3 PO5:3 PO6:- PO7:- PO8:- PO9:- PO10:- PO11:- PO12:3 PSO1:- PSO2:- PSO3:- PSO4:-</td>
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<tr>
<td>CO2</td>
<td>Know about the offshore platforms.</td>
<td>PO1:3 PO2:- PO3:2 PO4:2 PO5:- PO6:- PO7:- PO8:- PO9:- PO10:3 PO11:2 PO12:- PSO1:- PSO2:- PSO3:- PSO4:-</td>
</tr>
<tr>
<td>CO3</td>
<td>Know about the installation of equipment.</td>
<td>PO1:3 PO2:- PO3:3 PO4:2 PO5:2 PO6:3 PO7:- PO8:- PO9:- PO10:3 PSO1:1 PSO2:- PSO3:- PSO4:-</td>
</tr>
<tr>
<td>CO4</td>
<td>Gain Knowledge about the subsea technologies.</td>
<td>PO1:3 PO2:2 PO3:3 PO4:3 PO5:2 PO6:- PO7:- PO8:- PO9:- PO10:- PSO1:- PSO2:- PSO3:- PSO4:-</td>
</tr>
<tr>
<td>CO5</td>
<td>Learn the equipment involved in the Production practices.</td>
<td>PO1:2 PO2:3 PO3:2 PO4:2 PO5:3 PO6:- PO7:- PO8:- PO9:- PSO1:- PSO2:- PSO3:- PSO4:-</td>
</tr>
<tr>
<td>Overall CO</td>
<td></td>
<td>PO1:3 PO2:3 PO3:2 PO4:3 PO5:3 PO6:- PO7:- PO8:- PO9:- PSO1:1 PSO2:2 PSO3:- PSO4:-</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE:
The course is aimed to
- To know about the reservoir characterization and modelling.
- To learn about the recognition and well log techniques.
- To learn about seismic survey techniques
- To learn about the reservoir characteristics and behaviour
- To learn workstations and Software’s used in reservoir characterization and modeling

UNIT I                          9
Overview of reservoir characterization and modeling problems. Reservoir mapping.3D modeling. Univariate, bivariate and multivariate statistics for geological data analysis.

UNIT II                          9
Pattern recognition techniques. Petrophysical predictions from well logs. Introduction to petroleum geostatistics. Variograms. Kriging. Uncertainty quantification. Finite difference approximations to the diffusivity equation and the application of those approximations for reservoir simulations

UNIT III                         9

UNIT IV                          9
Reservoir simulation – Investigation of petroleum reservoir characteristics and behavior, including: pore volume, fluid distribution and movement, and recovery. Optimized field development and management plans.

UNIT V                          9

TOTAL: 45 PERIODS

COURSE OUTCOMES
On completion of the course students are expected to
CO1: Know about the reservoir modelling and geological data
CO2: Gain the knowledge about well logging
CO3: Work on reservoir simulation.
CO4: Know about the behaviour and characteristics of petroleum reservoirs.
CO5: Know about the software used for the reservoir modelling.

TEXT BOOK:

REFERENCE:
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<th>Course Outcomes</th>
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<th>Program Outcome</th>
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<tbody>
<tr>
<td>CO1</td>
<td>Know about the reservoir modelling and geological data.</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>Gain the knowledge about well logging.</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>Work on reservoir simulation.</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>Know about the behaviour and characteristics of petroleum reservoirs.</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>Know about the software used for the reservoir modelling.</td>
<td>2</td>
</tr>
<tr>
<td><strong>Overall CO</strong></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE:
The course is aimed to
- To know about fundamentals of management concepts.
- To gain knowledge on reservoir management and its applications.
- To learn about reservoir model in gas reservoir management.
- To gain knowledge on various mathematical techniques.
- To know about risk evaluation and uncertainties in reservoir management.

UNIT I
Introduction-Scope and Objectives-Reservoir management concepts: Definition and history-
Fundamentals of reservoir management, synergy and team-Integration of geosciences and
engineering- Integration of exploration and development technology

UNIT II
Reservoir management process-Setting goals, developing plans and economics, surveillance and
monitoring, evaluation Data acquisition, analysis and management-Classification of data,
aquision, analysis and application, validation, storing and retrieval

UNIT III
Reservoir model-Role of reservoir model in reservoir management-Integration of G & G and
reservoir model.

UNIT IV
Reservoir performance analysis and prediction-Naturally producing mechanism, reserves and role
of various forecasting tools- Volumetric method, MBE, Decline curve and mathematical simulation

UNIT V
Matured field reservoir Management-Reservoir Management Economics-Evaluation, risk and
uncertainties Reservoir management plans-Strategy for newly developed field, Secondary and EOR
operated field.

COURSE OUTCOMES:
On completion of the course students are expected to
CO1: Understand the basic concepts of reservoir management and developmental studies.
CO2: Understand the data classification and application of reservoir management process.
CO3: Know about the gas reservoir model and integration.
CO4: Understand the mathematical simulation reservoir performance.
CO5: Do the cost value for newly developed fields through reservoir management plans.

REFERENCE
1. Hydrocarbon Exploration and Production by Frank John.

TEXT BOOKS:
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<tr>
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<th>Statement</th>
<th>Program Outcome</th>
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</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Understand the basic concepts of reservoir management and developmental studies.</td>
<td>P O 1 P O 2 P O 3 P O 4 P O 5 P O 6 P O 7 P O 8 P O 9 P O 10 P O 11 P O 12 P S O 1 P S O 2 P S O 3 P S O 4</td>
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<tr>
<td>CO2</td>
<td>Understand the data classification and application of reservoir management process.</td>
<td>P O 1 P O 2 P O 3 P O 4 P O 5 P O 6 P O 7 P O 8 P O 9 P O 10 P O 11 P O 12 P S O 1 P S O 2 P S O 3 P S O 4</td>
</tr>
<tr>
<td>CO3</td>
<td>Know about the gas reservoir model and integration.</td>
<td>P O 1 P O 2 P O 3 P O 4 P O 5 P O 6 P O 7 P O 8 P O 9 P O 10 P O 11 P O 12 P S O 1 P S O 2 P S O 3 P S O 4</td>
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<tr>
<td>CO4</td>
<td>Understand the mathematical simulation reservoir performance</td>
<td>P O 1 P O 2 P O 3 P O 4 P O 5 P O 6 P O 7 P O 8 P O 9 P O 10 P O 11 P O 12 P S O 1 P S O 2 P S O 3 P S O 4</td>
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<tr>
<td>CO5</td>
<td>Do the cost value for newly developed fields through reservoir management plans.</td>
<td>P O 1 P O 2 P O 3 P O 4 P O 5 P O 6 P O 7 P O 8 P O 9 P O 10 P O 11 P O 12 P S O 1 P S O 2 P S O 3 P S O 4</td>
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<td>Overall CO</td>
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<td>P O 1 P O 2 P O 3 P O 4 P O 5 P O 6 P O 7 P O 8 P O 9 P O 10 P O 11 P O 12 P S O 1 P S O 2 P S O 3 P S O 4</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE:
The course is aimed to
- To learn about the supply and demands of the petroleum products
- To study about the oil and gas markets
- To study about the evaluation of the petroleum projects and important parameters.
- To know about the petroleum exploration and contracts.
- To learn about the economics case studies in oil industries

UNIT I
Supply and demand curves, the elasticity of supply and demand, public finance concepts such as consumer surplus, excise and export taxes. Forecasting techniques for the energy industry, including energy prices. Demand and supply for natural gas, cured oil and pipeline transportation, determinants of energy demand, energy markets, energy pricing, stability and performance of energy markets.

UNIT II
The economics of investment, Discounted cash flow analysis, Cost Benefit Analyses, Internal Rate of Return, NPV, Profitability Index, Natural Monopoly theory, National competition Policy, Gas Market Regulation, taxation of the oil and gas industry, government policy and trade permits, Monte Carlo analysis, Net Back Pricing, Transfer Pricing and regulatory aspects.

UNIT III
Application of petroleum engineering principles and economics to the evaluation of oil and gas projects, evaluation principles, time value of money concepts, investment measures, cost estimation, price and production forecasting, risk and uncertainty, project selection and capital budgeting inflation, escalation, operating costs, depreciation, cost recovery

UNIT IV
Petroleum exploration and production contracts. Sharing of the economic rent, portfolio management. Value creation, corporate finance & return on capital, economic appraisal methods for oil filed development, reservoir model costs and calculations.

UNIT V
Case studies: Economic study of an oil filed development project, petrochemical plant project, natural gas break-even price, natural gas liquefaction cost, LGN transport cost, investment profitability study for a gas pipeline.

TOTAL: 45 PERIODS

COURSE OUTCOMES
On completion of the course students are expected to
- CO1: Integrate knowledge on financial statements, Depreciation and Accounting.
- CO2: Gain Knowledge about the oil and gas marketing, oil and gas market circulations
- CO3: Understand the concept of economics in a process plant, time value of money and cost indices
- CO4: Understand the basics of exploration and about the various contracts in oil fields.
- CO5: Do any kind of case study in the oil field.

TEXT BOOKS:
REFERENCES:

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<tbody>
<tr>
<td>CO1</td>
<td>Integrate knowledge on financial statements, Depreciation and Accounting.</td>
<td>P O 1 3 - 3 - 2 3 - 3 - - 2 - - - - 2</td>
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<tr>
<td>CO2</td>
<td>Gain Knowledge about the oil and gas marketing, oil and gas market</td>
<td>P O 2 2 - - 2 - 2 - 2 - - 3 - 2 - - - - 3</td>
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<td>circulations</td>
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<tr>
<td>CO3</td>
<td>Understand the concept of economics in a process plant, time value of</td>
<td>P O 3 3 - 2 2 - 2 - - - - 3 - - 1 - 2</td>
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<td>money and cost indices</td>
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<tr>
<td>CO4</td>
<td>Understand the basics of exploration and about the various contracts in</td>
<td>P O 4 2 - - - 2 - - 3 - - 2 - - - - 3</td>
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<td>oil fields.</td>
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<tr>
<td>CO5</td>
<td>Do any kind of case study in the oil field.</td>
<td>P O 5 2 - 2 - - 3 - 2 - - 3 - - - - 2</td>
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<td>Overall CO</td>
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<td>P S S S 2 - 2 2 3 - 3 - - 3 - 2 1 - 2</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES
The course is aimed to

- To gain knowledge about chemical kinetics of homogeneous reactions.
- To obtain knowledge about performance equations for ideal reactors.
- To understand the design of reactor for multiple reactions.
- To study about the residence time distribution function and analyze the non-ideality in the reactor.
- To understand the gas solid catalytic reaction and their mechanism.

UNIT I CHEMICAL KINETICS AND IDEAL REACTORS 12
Rate equation, elementary, non-elementary reactions, theories of reaction rate and Prediction; Design equation for constant and variable volume batch reactors, Design of continuous reactors - stirred tank and tubular flow reactor.

UNIT II DESIGN FOR MULTIPLE REACTIONS 12
Design of reactors for multiple reactions - consecutive, parallel and mixed reactions - factors affecting choice, optimum yield and conversion, selectivity, reactivity and yield. Recycle reactor, size comparison of reactors.

UNIT III TEMPERATURE AND PRESSURE EFFECTS 12
Non-isothermal homogeneous reactor systems, adiabatic reactors, rates of heat exchanges for different reactors, design for constant rate input and constant heat transfer coefficient, operation of batch and continuous reactors, optimum temperature progression.

UNIT IV BASICS OF NON-IDEAL FLOW 12
The residence time distribution as a factor of performance; residence time functions and relationship between them in reactor; basic models for non-ideal flow; conversion in non-ideal reactors.

UNIT V HETEROGENEOUS CATALYTIC AND NON-CATALYTIC REACTIONS 12

TOTAL : 60 PERIODS

COURSE OUTCOMES:
On completion of the course students are expected to

CO1: Understand the kinetics of homogenous reaction.
CO2: Develop performance equation and determine the conversion for different reactors.
CO3: Understand the reactor arrangement in series and parallel configuration.
CO4: Understand the basic of non-ideal flow
CO5: Understand the concepts of effectiveness factor, Thiele modulus and Design of catalytic reactor for gas solid reaction.

TEXT BOOKS
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<td>PO1</td>
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<tr>
<td>CO1</td>
<td>Understand the kinetics of homogenous reaction.</td>
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<tr>
<td>CO2</td>
<td>Develop performance equation and determine the conversion for different reactors.</td>
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</tr>
<tr>
<td>CO3</td>
<td>Understand the reactor arrangement in series and parallel configuration.</td>
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</tr>
<tr>
<td>CO4</td>
<td>Understand the basic of non-ideal flow.</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>Understand the concepts of effectiveness factor, Thiele modulus and Design of catalytic reactor for gas solid reaction.</td>
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<td>Overall CO</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.

REFERENCE
OBJECTIVES:
The course is aimed to

- To know about the basic corrosion principles.
- To understand the types of corrosion found in the petroleum industries.
- To gain knowledge on corrosion in oil fields.
- To learn about corrosion prevention methods and its applications.
- To understand the various treatment process on oil/gas pipelines.

UNIT I

UNIT II

UNIT III
Role of oxygen in oil filed corrosion- down hole and surface equipment - water flood. Removal of oxygen, analysis and criteria for control. Role of carbon dioxide (CO₂) in corrosion-Effect of temperature and pressure - Corrosion of well tubing and other equipment. Role of hydrogen sulphide (H₂S)-Corrosion in downhole, surface, storage and pipelines.

UNIT IV

UNIT V
Inspection and corrosion monitoring. Oil treatment corrosion - crude oil properties - desalting- sweetening processes. Corrosion in oil storage tank corrosion- oilfield and oil treating facilities-oil/ gas pipelines -offshore platforms- subsea systems.

COURSE OUTCOME:
On completion of the course students are expected to
CO1: Understand the basic concepts of corrosion involved and its various parameters.
CO2: Know the various types of corrosion in petroleum processes.
CO3: Gain knowledge on removal techniques of various gases.
CO4: Understand the principle of operation and applications.
CO5: Identify and define the various types of petroleum corrosion and prevention technologies.

TEXT BOOKS:

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<tr>
<td>CO1</td>
<td>Understand the basic concepts of corrosion involved and its various parameters.</td>
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<tr>
<td>CO2</td>
<td>Know the various types of corrosion in petroleum processes.</td>
<td>2</td>
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<td>3</td>
<td>2</td>
<td>2</td>
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<tr>
<td>CO3</td>
<td>Gain knowledge on removal techniques of various gases.</td>
<td>3</td>
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<tr>
<td>CO4</td>
<td>Understand the principle of operation and applications.</td>
<td>2</td>
<td>3</td>
<td>3</td>
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<td>2</td>
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<td>CO5</td>
<td>Identify and define the various types of petroleum corrosion and prevention technologies.</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVE
The course is aimed to
- To understand the concepts behind the multicomponent distillation
- To learn about the Distillation process in Refineries
- To learn about the various columns used in industries.
- To study about the furnace and its types.
- To study the concepts in pumps and compressors

UNIT I  MULTICOMPONENT DISTILLATION
Dew point and bubble point for multi component mixtures. Design of multi component distillation column, Number of variables, Selection of key components, Selection of column pressure, Feed condition, Plate-to-plate calculations, Empirical short cut methods, Introduction to rigorous solution procedures.

UNIT II  PETROLEUM REFINERY DISTILLATION
TBP, EFV, ASTM distillation curves and their relevance, Material balance and flash zone calculations for petroleum refinery distillation columns, Pump around and pump back calculations, Overall energy requirements, Estimation of number of equilibrium stages, Design using Packie charts and Watkins method, Introduction to rigorous solution procedure based on pseudo components.

UNIT III  COLUMN DESIGN

UNIT IV  FIRED HEATERS
Heat load calculations for furnace heaters used in crude refining, Basic constructional features, Different furnace types, Review of factors to be considered in the design of fired heaters, Introduction to manual calculations methods.

UNIT V  PUMPS AND COMPRESSORS
Types of pumps and compressors. Selection criteria. Power rating calculations based on process duty. Use of operating curves of centrifugal pump. NPSHR and NPSHA. Pump Cavitation. Surge problem in compressors.

COURSE OUTCOMES
On completion of the course students are expected to
CO1: Know the concept of multicomponent distillation in design.
CO2: Know about the distillation columns and their design methods.
CO3: Understand about the packing types.
CO4: Understand about the furnace and their types used in refineries
CO5: Know the concept behind pumps and compressors and their selection criteria.

TEXT BOOKS
<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>P O 1</th>
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<tr>
<td>CO2</td>
<td>Know about the distillation columns and their design methods.</td>
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<tr>
<td>CO3</td>
<td>Understand about the packing types.</td>
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<tr>
<td>CO4</td>
<td>Understand about the furnace and their types used in refineries.</td>
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<td>CO5</td>
<td>Know the concept behind pumps and compressors and their selection criteria.</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVE
The course is aimed to
- To understand about basic concepts behind the product design.
- To know the concept behind the selection and testing of the design.
- To learn about the product architecture.
- To know about the Industrial design.
- To understand the manufacturing design.

UNIT I INTRODUCTION
Strategic importance of Product development - integration of customer, designer, material supplier and process planner, Competitor and customer - behavior analysis. Understanding customer-promoting customer understanding-involve customer in development and managing requirements - Organization process management and improvement.

UNIT II CONCEPT GENERATION, SELECTION AND TESTING

UNIT III PRODUCT ARCHITECTURE
Product development management - establishing the architecture - creation - clustering - geometric layout development - Fundamental and incidental interactions - related system level design issues - secondary systems -architecture of the chunks - creating detailed interface specifications-Portfolio Architecture.

UNIT IV INDUSTRIAL DESIGN
Integrate process design - Managing costs - Robust design - Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically – Need for industrial design-impact – design process - investigation of customer needs - conceptualization - refinement - management of the industrial design process.

UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT
Definition - Estimation of Manufacturing cost-reducing the component costs and assembly costs – Minimize system complexity - Prototype basics - Principles of prototyping – Planning for prototypes - Economic Analysis.

COURSE OUTCOMES:
On completion of the course students are expected to
CO1: Know the basic concepts and importance of product design.
CO2: Understand the planning, selection criteria of the design and products.
CO3: Gain knowledge about the product management and architecture.
CO4: Understand the industrial design and tools for designs.
CO5: Understand the economic analysis of the design.

TEXT BOOK

REFERENCES
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<tr>
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<td>Know the basic concepts and importance of product design.</td>
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<td>CO2</td>
<td>Understand the planning, selection criteria of the design and products</td>
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<td>CO3</td>
<td>Gain knowledge about the product management and architecture.</td>
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<td>CO4</td>
<td>Understand the industrial design and tools for designs.</td>
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<td>CO5</td>
<td>Understand the economic analysis of the design.</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES
The course is aimed to
- To understand the geographic distribution of unconventional hydrocarbon resources
- To understand characterization of source and reservoir rocks
- To understand methodology to produce these reserves
- To understand environmental consequences of producing these reserves
- Demonstrate awareness related to environmental issues involved in the development of non-conventional hydrocarbon resources.

UNIT I    NON-CONVENTIONAL OIL:  
Continuous Accumulation System
Introduction, geology of Heavy oil, extra heavy oil, Tar Sand and bituminous, oil shales, their origin and occurrence worldwide, resources, reservoir characteristics, new production technologies.

UNIT II    SHALE GAS/ OIL RESERVOIR  
Introduction to shale gas & basin centered gas, tight reservoirs. Shale gas geology, important occurrences in India, petrophysical properties, Development of shale gas, design of hydro fracturing job, horizontal wells, production profiles.

UNIT III    COAL BED METHANE  
Formation and properties of coal bed methane. Thermodynamics of coal bed methane. Exploration and Evaluation of CBM. Hydro-fracturing of coal seam. Production installation and surface facilities. Well operations and production equipment.

UNIT IV    GAS HYDRATES  

UNIT V    COAL AND GAS CONVERSION TO OIL  
Introduction, classification and principles, pyrolysis, theoretical aspect of processes involved in conversion. Technological development of direct conversion and indirect processes and sustainability of conversions.

COURSE OUTCOMES
On completion of the course students are expected to
CO1: Recognize and apply the concept of continuous accumulation system.
CO2: Apply the concepts related to exploration and development of Shale Gas Reservoirs.
CO3: Apply the concepts related to exploration and development of Coal Bed Methane.
CO4: Understand the formation of gas hydrates.
CO5: Apply different conversion processes for the production of Hydrocarbons.

REFERENCE BOOKS
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<th>Course Outcomes</th>
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<tbody>
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<td>Recognize and apply the concept of continuous accumulation system.</td>
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<td>CO2</td>
<td>Apply the concepts related to exploration and development of Shale Gas Reservoirs.</td>
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<tr>
<td>CO3</td>
<td>Apply the concepts related to exploration and development of Coal Bed Methane.</td>
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<td>CO4</td>
<td>Understand the formation of gas hydrates.</td>
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<td>CO5</td>
<td>Apply different conversion processes for the production of Hydrocarbons.</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES
The course is aimed to
- To determine the stresses and its applications.
- To know the types of pressure vessels.
- To know about the designing of vessels.
- To learn about buckling phenomenon.
- To understand the design procedure of pressure vessels and the piping layout.

UNIT I  DETERMINATION OF STRESS  

UNIT II  STRESSES IN PRESSURE VESSELS  

UNIT III  DESIGN OF VESSELS  
Design of Tall cylindrical self-supporting process columns –Supports for short, vertical and horizontal vessels – stress concentration – at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement – pressure vessel Design. Introduction to ASME pressure vessel codes

UNIT IV  BUCKLING OF VESSELS  
Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

UNIT V  PIPING  

TOTAL: 45 PERIODS

COURSE OUTCOMES
On completion of the course students are expected to
CO1: Predict the stresses in pressure vessels.
CO2: Gain knowledge on vessel design.
CO3: Know about the vessel buckling and its phenomenon.
CO4: Get familiarized with the various theories and practices on pressure vessel and piping design
CO5: Solve the industrial practical problems in the field of pressure vessel design.

REFERENCES
## Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
<th>Overall CO</th>
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</thead>
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<tr>
<td>CO1</td>
<td>Predict the stresses in pressure vessels.</td>
<td>PO 1 PO 2 PO 3 PO 4 PO 5 PO 6 PO 7 PO 8 PO 9 PO 10 PO 11 PO 12 PSO 1 PSO 2 PSO 3 PSO 4</td>
<td>3 3 2 - 2 - - - - - - - 3 - - 2</td>
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<tr>
<td>CO2</td>
<td>Gain knowledge on vessel design.</td>
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<tr>
<td>CO3</td>
<td>Know about the vessel buckling and its phenomenon.</td>
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<tr>
<td>CO4</td>
<td>Get familiarized with the various theories and practices on pressure vessel and piping design.</td>
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<tr>
<td>CO5</td>
<td>Solve the industrial practical problems in the field of pressure vessel design.</td>
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<tr>
<td>Overall CO</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES
The course is aimed to
- To learn the basic concept of Supply Chain Management.
- To know about the Logistics Management.
- To learn the Network design in supply Design.
- To understand the sourcing and pricing concepts.
- To know the various technologies used in supply chains.

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

UNIT II LOGISTICS MANAGEMENT

UNIT III SUPPLY CHAIN NETWORK DESIGN

UNIT IV SOURCING, AND PRICING IN SUPPLY CHAIN
Supplier selection and Contracts - Design collaboration - Procurement process. Revenue management in supply chain

UNIT V COORDINATION AND TECHNOLOGY IN SUPPLY CHAIN
Supply chain coordination - Bullwhip effect – Effect of lack of co-ordination and obstacles – IT and SCM - supply chain IT frame work. E Business & SCM. Metrics for SC performance – Case Analysis

COURSE OUTCOMES:
On completion of the course students are expected to
CO1: Understand basic concepts of logistics and SCM
CO2: Know about the logistic management and analysis.
CO3: Know about the Distribution, Design and managing supply chain network.
CO4: Do the selection of supplier and contract through Revenue management.
CO5: Understand the technologies in supply chain.

REFERENCES
2. Logistics, David J. Bloomberg, Stephen Lemay and Joe B. Hanna, PHI 2002
Course Articulation Matrix:

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<tr>
<th>Course Outcomes</th>
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<td>CO1</td>
<td>Understand basic concepts of logistics and SCM</td>
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<tr>
<td>CO2</td>
<td>Know about the logistic management and analysis.</td>
<td>P O 2 : 2 3 3 - 2 2 - - - - 2 - - - 3 3</td>
</tr>
<tr>
<td>CO3</td>
<td>Know about the Distribution, Design and managing supply chain network.</td>
<td>P O 3 : 3 2 3 - 3 - - - - - 3 - 2 - -</td>
</tr>
<tr>
<td>CO4</td>
<td>Do the selection of supplier and contract through Revenue management.</td>
<td>P O 4 : 2 2 3 - 3 3 - - - - 3 - - - 1 -</td>
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<tr>
<td>CO5</td>
<td>Understand the technologies in supply chain.</td>
<td>P O 5 : 3 - 3 - 2 2 - - - - 2 - - 2 - -</td>
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<tr>
<td>Overall CO</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES
The course is aimed to

• To understand the water as a plant utility
• To understand the use of steam in process plants.
• To know about the Refrigeration systems.
• To understand the compressor and their types.
• To understand the type of fuel used in chemical process industries.

UNIT I  WATER  9
Hard and Soft water, Requisites of Industrial Water and its uses. Methods of water Treatment such as Chemical Softening and Demineralization, Resins used for Water Softening and Reverse Osmosis. Effects of impure Boiler Feed Water.

UNIT II  STEAM  9
Properties of Steam, problems based on Steam, Types of Steam Generator such as Solid Fuel Fired Boiler, Waste Gas Fired Boiler and Fluidized Bed Boiler. Scaling and Trouble Shooting. Steam Traps and Accessories.

UNIT III  REFRIGERATION  9
Refrigeration Cycles, Methods of Refrigeration used in Industry and Different Types of Refrigerants such as Monochlorodifluoro Methane, Chlorofluoro Carbons and Brines. Refrigerating Effects and Liquefaction Processes.

UNIT IV  COMPRESSORS AND COOLING TOWERS  9

UNIT V  FUEL AND WASTE DISPOSAL  9

TOTAL: 45 PERIODS

COURSE OUTCOMES
On completion of the course students are expected to

CO1: Know the chemical water treatment and use of industrial water.

CO2: Understand the properties of steam and steam generators types.

CO3: Know about the method of refrigeration used in industries and types of refrigerants.

CO4: Know about the classification and types of refrigeration systems.

CO5: Know about the Types of fuels used in industries and waste disposal.

TEXT BOOKS

REFERENCES
### Course Articulation Matrix:

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<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
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</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Know the chemical water treatment and use of industrial water.</td>
<td>3   -   -   3   3   -   -   -   -   -   -   1   2   2   -   -   -   1   -   -   -</td>
</tr>
<tr>
<td>CO2</td>
<td>Understand the properties of steam and steam generators types.</td>
<td>2   -   -   2   2   2   -   -   -   -   -   -   -   -   1   -   -   -   -   -   -   -</td>
</tr>
<tr>
<td>CO3</td>
<td>Know about the method of refrigeration used in industries and types of refrigerants.</td>
<td>3   -   2   3   -   -   -   -   -   -   -   -   -   2   -   -   -   -   -   -   -   -</td>
</tr>
<tr>
<td>CO4</td>
<td>Know about the classification and types of refrigeration systems.</td>
<td>2   -   -   2   3   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -</td>
</tr>
<tr>
<td>CO5</td>
<td>Know about the Types of fuels used in industries and waste disposal.</td>
<td>3   -   -   -   2   -   -   -   -   -   -   -   -   2   -   -   -   -   -   -   -   -   -</td>
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<td><strong>Overall CO</strong></td>
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<td>3   -   2   3   3   -   -   -   -   -   -   1   2   2   1   1</td>
</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES
The course is aimed to
- To understand the need of safety in industries.
- To understand the safety regulations.
- To identify the hazards in the process plants.
- To Know about safety audit
- To understand the risk analysis techniques.

UNIT I  NEED FOR SAFETY IN INDUSTRIES
Importance & objectives of safety- Safety Programmes – components and realization; Potential hazards – extreme operating conditions, toxic chemicals; safe handling

UNIT II  PLANT SAFETY AND SAFETY REGULATION
Implementation of safety procedures – periodic inspection and replacement; Accidents - identification and prevention; Criteria for setting & layout of chemical plant, Factories Act and Safety Regulations.

UNIT III  PLANT HAZARDS & RISK ANALYSIS
Fire hazards- Chemical hazards, Toxic hazards, Explosion hazards, Electrical hazards, Mechanical hazards, Radiation hazards, Noise hazards-Overall risk analysis--emergency planning-on site & off site emergency planning, risk management ISO 14000, EMS models case studies. Quantitative risk assessment - rapid and comprehensive risk analysis; Risk due to Radiation, explosion due to over pressure, jet fire-fire ball.

UNIT IV  SAFETY AUDIT
Objective of safety audit- Hazard identification safety audits, checklist, what if analysis, vulnerability models event tree analysis fault tree analysis, Hazan past accident analysis Fixborough-Mexico-Madras-Vizag Bopal analysis

UNIT V  RISK ANALYSIS TECHNIQUES
Hazard & Operability (HAZOP) studies- Hazard Analysis (HAZAN)-Fault Tree Analysis Consequence Analysis.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
On completion of the course students are expected to
CO1: Understand the importance of safety and its objectives.
CO2: Understand the implementation of safety and identification and prevention of Accidents.
CO3: Know about the types of hazards, emergency plan and ISO standards for safety studies.
CO4: Do the safety audit in plants.
CO5: Do the risk analysis in industries using the various techniques.

TEXT BOOKS

REFERENCES

### Course Articulation Matrix:

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<tr>
<th>Course Outcomes</th>
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<tbody>
<tr>
<td>CO1</td>
<td>Understand the importance of safety and its objectives.</td>
<td>3 -  2 -  3 -  3 -  - - - - - - - - - - - - - -</td>
</tr>
<tr>
<td>CO2</td>
<td>Understand the implementation of safety and identification and prevention of Accidents.</td>
<td>2  2 - -  2 -  2 - - - - - - - - - - - - - -</td>
</tr>
<tr>
<td>CO3</td>
<td>Know about the types of hazards, emergency plan and ISO standards for safety studies.</td>
<td>3 -  3  2 - -  3 - - - - - - - - - - 2 -</td>
</tr>
<tr>
<td>CO4</td>
<td>Do the safety audit in plants.</td>
<td>2  3  2 - - -  2 - - - - - - - - - - 1 - -</td>
</tr>
<tr>
<td>CO5</td>
<td>Do the risk analysis in industries using the various techniques.</td>
<td>3  3 - -  3 -  3 - - - - - - - - 3 - - -</td>
</tr>
<tr>
<td>Overall CO</td>
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</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE
The course is aimed to
- To learn about the principles of thermodynamics.
- To know the properties of thermodynamics for evaluation.
- To estimate the minimum reflux ratio for MCD system.
- To know various methods of MCD column design.
- To gain knowledge on various types of MCD column.

UNIT I THERMODYNAMIC PRINCIPLES 9

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

UNIT III MINIMUM REFLUX RATIO FOR MCD SYSTEM 9

UNIT IV VARIOUS METHODS OF MCD COLUMN DESIGN 9
Theta method of convergence – Kb method and the constant composition method – Application of the Theta method to complex columns and to system of columns – Lewis Matheson method – Stage and reflux requirements – Short cut methods and Simplified graphical procedures.

UNIT V VARIOUS TYPES OF MCD COLUMNS 9
Design of sieve, bubble cap, valve trays and structured packing columns for multi component distillation – computation of plate efficiencies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course students are expected to
CO1: Understand the principles of thermodynamics involving calculation of multicomponent properties.
CO2: Determine the thermodynamic properties of multicomponent mixtures.
CO3: Estimate the minimum reflux ratio of MCD column.
CO4: Predict the design of MCD using various methods.
CO5: Select from the various types of MCD columns for particular process.

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<td>CO1</td>
<td>Understand the principles of thermodynamics involving calculation of multicomponent properties.</td>
<td>P O 1 P O 2 P O 3 P O 4 P O 5 P O 6 P O 7 P O 8 P O 9 P O 10 P O 11 P O 12 P S O 1 P S O 2 P S O 3 P S O 4</td>
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<tr>
<td>CO2</td>
<td>Determine the thermodynamic properties of multicomponent mixtures.</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>Estimate the minimum reflux ratio of MCD column.</td>
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</tr>
<tr>
<td>CO4</td>
<td>Predict the design of MCD using various methods.</td>
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</tr>
<tr>
<td>CO5</td>
<td>Select from the various types of MCD columns for particular process.</td>
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<tr>
<td>Overall CO</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE
The course is aimed to

- To know the modern safety concepts
- To ensure that potential hazards are identified
- To learn the mitigation measures
- To do the investigation of accidents
- To learn the methods involved in safety education and training

UNIT I CONCEPTS
Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety.

UNIT II TECHNIQUES
Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit.

UNIT III ACCIDENT INVESTIGATION AND REPORTING
Concept of an accident, reportable and non-reportable accidents, unsafe act and condition – principles of accident prevention, Supervisory role- Role of safety committee – Accident causation models - Cost of accident. Overall accident investigation process - Response to accidents, India reporting requirement, Planning document, Planning matrix, Investigators Kit, functions of investigator, four types of evidences, Records of accidents, accident reports-Class exercise with case study.

UNIT IV SAFETY PERFORMANCE MONITORING
permanent total disabilities, permanent partial disabilities, temporary total disabilities - Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety “t” score, safety activity rate – problems.

UNIT V SAFETY EDUCATION AND TRAINING

TOTAL : 45 PERIODS

COURSE OUTCOMES
On completion of the course students are expected to
CO1: Understand the importance of developing Environment, Health and Safety systems in work places.
CO2: Investigate accidents and provide the mitigation measures
CO3: Learn the procedures involved in safety training
CO4: Do the safety performance monitoring
CO5: Know about the various safety policies

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<td>CO1</td>
<td>Understand the importance of developing Environment, Health and Safety systems in work places.</td>
<td>PO 1 PO 2 PO 3 PO 4 PO 5 PO 6 PO 7 PO 8 PO 9 PO 10 PO 11 PO 12 PSO 1 PSO 2 PSO 3 PSO 4</td>
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<td>3 - - 3 - 3 3 3 - - - - 3 - 1 -</td>
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<tr>
<td>CO2</td>
<td>Investigate accidents and provide the mitigation measures.</td>
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<td></td>
<td></td>
<td>3 - 2 2 - 3 3 3 - - - - - 2 - 1</td>
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<tr>
<td>CO3</td>
<td>Learn the procedures involved in safety training.</td>
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<td></td>
<td></td>
<td>3 - 3 2 2 - 2 3 - - - - - - - -</td>
</tr>
<tr>
<td>CO4</td>
<td>Do the safety performance monitoring.</td>
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<td></td>
<td>3 - 2 - 2 - 3 3 - - 1 - - - - -</td>
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<tr>
<td>CO5</td>
<td>Know about the various safety policies.</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVE:
The course is aimed to
- To understand the basic concepts behind oil and gas facilities.
- To understand the fundamentals in process engineering.
- To know about the process design.
- To understand the flow diagrams used in industries.
- To know about the equipment used in process plants.

UNIT I  INTRODUCTION TO OIL AND GAS FACILITIES
Introduction to Oil and Gas Industry-Process description- Piping elements- Instruments: field instruments, control valves- Process equipments- Role of Process Engineer.

UNIT II  INTRODUCTION TO PROJECT ENGINEERING

UNIT III  PROCESS SIMULATION AND DESIGN
Introduction and purpose- Software used for Simulation, Simulation inputs- Steady state simulation- Typical operation in simulation schemes- Heat and material balance generation, Dynamic Simulation Study and its uses. Introduction to Relief and Blow down Studies, Pipeline Flow assurance Study-Steady State and Transient, software used in Flow assurance Studies, Introduction to AIV/FIV studies, CFD analysis

UNIT IV  ENGINEERING DIAGRAMS

UNIT V  FACILITIES ENGINEERING
Process Design Basis and Design Criteria, Overview of various process equipment and its design principles: Separators, Pumps, Compressors, Heat exchangers, Absorber column, Heaters, Air coolers, Storage Tanks, Line hydraulics (Gas, Liquid and Multiphase lines)- Pump Hydraulics- Control valve hydraulics, software used in Equipment design (Column, Heat Exchanger etc.). Introduction to various Codes and Standards followed in a PROJECT (API, TEMA, ISA etc.).

COURSE OUTCOME: TOTAL: 45 PERIODS
On completion of the course students are expected to
CO1: Know about the basic concept of equipment in oil and gas industry.
CO2: Know about the project execution, different phases in a project.
CO3: Understand the software used for simulation and flow studies.
CO4: Understand the PFD, P&ID for various processes.
CO5: Understand the works in an EPC company.

REFERENCES
4. ISA Standards
5. TEMA standards, Tubular Exchanger Manufacturers Association, Inc.
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<td>Know about the basic concept of equipment in oil and gas industry.</td>
<td>P O 1 2 3 3 3 3 - - - - 3 1 -</td>
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<tr>
<td>CO2</td>
<td>Know about the project execution, different phases in a project.</td>
<td>3 - 2 2 3 3 3 - - 2 1</td>
</tr>
<tr>
<td>CO3</td>
<td>Understand the software used for simulation and flow studies.</td>
<td>3 - 3 2 2 2 3 - - - - - -</td>
</tr>
<tr>
<td>CO4</td>
<td>Understand the PFD, P&amp;ID for various processes.</td>
<td>3 - 2 2 3 3 - - 1 - - - -</td>
</tr>
<tr>
<td>CO5</td>
<td>Understand the works in an EPC company.</td>
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<tr>
<td>Overall CO</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES
The course is aimed to
• To learn about classification of energy sources.
• To know about the conventional energy resources.
• To know about the non-conventional energy resources.
• To gain knowledge about biomass energy.
• To understand the energy conservation.

UNIT I ENERGY 9
Introduction to energy – Global energy scene – Indian energy scene - Units of energy, conversion factors, general classification of energy, energy crisis, energy alternatives

UNIT II CONVENTIONAL ENERGY 9
Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

UNIT III NON-CONVENTIONAL ENERGY 9
Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV BIOMASS ENERGY 9
Biomass origin - Resources – Biomass estimation. Thermochemical conversion – Biological conversion, Chemical conversion – Hydrolysis & hydrogenation, solvolysis, biocrude, biodiesel power generation gasifier, biogas, integrated gasification.

UNIT V ENERGY CONSERVATION 9
Energy conservation - Act; Energy management importance, duties and responsibilities; Energy audit – Types methodology, reports, instruments. Benchmarking and energy performance, material and energy balance, thermal energy management.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
On completion of the course students are expected to
CO1: Describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.
CO2: Excel as professionals in the various fields of energy engineering
CO3: Compare different renewable energy technologies and choose the most appropriate based on local conditions.
CO4: Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies
CO5: Develop in-depth technical understanding of energy problems at an advanced level.

TEXTBOOKS

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<td>sources and their differences compared to fossil fuels.</td>
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<tr>
<td>CO2</td>
<td>Excel as professionals in the various fields of energy engineering</td>
<td>2</td>
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<tr>
<td>CO3</td>
<td>Compare different renewable energy technologies and choose the most</td>
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<td></td>
<td>appropriate based on local conditions.</td>
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<tr>
<td>CO4</td>
<td>Identify and critically evaluate current developments and emerging</td>
<td>2</td>
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<td></td>
<td>trends within the field of renewable energy technologies</td>
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<tr>
<td>CO5</td>
<td>Develop in-depth technical understanding of energy problems at an advanced</td>
<td>3</td>
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<td>level.</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES:
The course is aimed to

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

UNIT I  INTRODUCTION TO DISASTERS  9
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don’ts during various types of Disasters.

UNIT II  APPROACHES TO DISASTER RISK REDUCTION (DRR)  9
Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III  INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT  9
Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV  DISASTER RISK MANAGEMENT IN INDIA  9
Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V  DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS  9
Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS
**COURSE OUTCOMES:**
On completion of the course students are expected to
CO1: Understand foundations of hazards, disasters and associated natural/social phenomena and to provide knowledge on response during different types of Disasters
CO2: Manage the Public Health aspects and Humanitarian Assistance of the disasters and Capacity to describe analyze various aspects influencing vulnerabilities and capacities.
CO3: Understand the Technological innovations and their usage during various phases of Disaster
CO4: To enhance awareness of institutional process, vulnerability profile, Policies, Law, and methods of assessment in the country
CO5: Gain the capacity to obtain, analyze, and communicate information on risks, relief needs and lessons learned from earlier disasters in order to formulate strategies for mitigation in future scenarios.

**TEXTBOOKS:**

**REFERENCES**
1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005
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</tr>
<tr>
<td>CO2</td>
<td>Manage the Public Health aspects and Humanitarian Assistance of the disasters and Capacity to describe analyze various aspects influencing vulnerabilities and capacities.</td>
<td>2 3 2 - - - - - - - - - - - -</td>
</tr>
<tr>
<td>CO3</td>
<td>Understand the Technological innovations and their usage during various phases of Disaster</td>
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<td>CO4</td>
<td>To enhance awareness of institutional process, vulnerability profile, Policies, Law, and methods of assessment in the country</td>
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</tr>
<tr>
<td>CO5</td>
<td>Gain the capacity to obtain, analyze, and communicate information on risks, relief needs and lessons learned from earlier disasters in order to formulate strategies for mitigation in future scenarios.</td>
<td>2 - 3 - - - - - - - - - - - -</td>
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<td>Overall CO</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE
The course is aimed to

- To describe the heat, mass, momentum transfer in various parameters.
- To gain knowledge on energy transport.
- To learn about temperature distribution.
- To learn about concentration distribution.
- To determine velocity, temperature and concentration profiles.

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

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

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

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

UNIT V  ANALOGIES BETWEEN TRANSPORT PROCESSES

TOTAL: 45 PERIODS

COURSE OUTCOMES
On completion of the course students are expected to

CO1: Understand the mechanisms of momentum, heat and mass transfer each at molecular, micro and macro levels.

CO2: Develop mathematical models to determine transfer fluxes and velocity, temperature and concentration distribution for flow channels, heat sources and systems involving diffusion and reactions.

CO3: Determine the interrelationship between the molecular, microscopic and macroscopic descriptions of transport processes and compare the various coordinate systems to formulate equations of change.

CO4: Apply the equation of change for different coordinate systems and solve of momentum, mass and heat transport problems.
CO5: Analyze the analogy between the transports and understand the turbulence and boundary layer concept in heat and mass transport.

TEXT BOOKS

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<td>P O O 1</td>
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<tr>
<td>CO1</td>
<td>Understand the mechanisms of momentum, heat and mass transfer each at molecular, micro and macro levels.</td>
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<td>P O O 3</td>
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<td>CO2</td>
<td>Develop mathematical models to determine transfer fluxes and velocity, temperature and concentration distribution for flow channels, heat sources and systems involving diffusion and reactions</td>
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<td>CO3</td>
<td>Determine the interrelationship between the molecular, microscopic and macroscopic descriptions of transport processes and compare the various coordinate systems to formulate equations of change.</td>
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<td>P O O 11</td>
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<tr>
<td>CO4</td>
<td>Apply the equation of change for different coordinate systems and solve of momentum, mass and heat transport problems.</td>
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<td>Analyze the analogy between the transports and understand the turbulence and boundary layer concept in heat and mass transport.</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES
The course is aimed to
- To understand the concept of spectroscopy and analysis method.
- To learn the concept of UV and Visible Spectroscopy.
- To learn the Quantitative spectroscopy.
- To understand the concept of IR spectroscopy.
- To understand the atomic spectroscopic studies.

UNIT I INTRODUCTION TO SPECTROSCOPIC METHODS OF ANALYSIS
Electromagnetic radiation - Various ranges, Dual properties, Various energy levels, Interaction of photons with matter, Classifications of Instrumental methods - absorbance & transmittance and their relationship - Permitted energy levels for the electrons of an atom and simple molecule - Jablonski diagrams - Various electronic transitions in organic and inorganic compounds effected by UV and Visible radiations - Various energy level diagrams of saturated, unsaturated and carbonyl compounds, excitation by UV and Visible radiations - Choice of solvents, cut off wavelengths for solvents - Effects of auxochromes and effects of conjugation on the absorption maxima, Different shifts of absorption peaks (Bathochromic, hypsochromic, hypochromic, hyperchromic).

UNIT II UV AND VISIBLE SPECTROSCOPY
Qualitative Spectroscopy- Lambda max and epsilon max rules, Woodward -Fieser rules for the calculation of absorption maxima (Lambda max) for dienes and carbonyl compounds, Fieser and Kuhn rules - Instrumentation for UV and Visible spectrophotometer (source, optical parts and detectors)-Applications of UV and Visible spectroscopy.

UNIT III QUANTITATIVE SPECTROSCOPY
Beer-Lambert's law, Limitations, Deviations (Real, Chemical, Instrumental) problems based on Beer-Lamberts equation- Estimation of inorganic ions such as Fe$^{2+}$, Fe$^{3+}$, Ni$^{2+}$ and estimation of Nitrite using Beer-Lambert's Law- Multicomponent analysis (no overlap, single way overlap and two way overlap) -Photometric titrations (Experimental set-up and various types of titrations and their corresponding curves).

UNIT IV IR SPECTROSCOPY
Theory of IR spectroscopy, various stretching and vibration modes for diatomic and triatomic molecules (both linear and nonlinear), various ranges of IR (Near, Mid, Finger print and Far) and their usefulness, Instrumentation (Only the sources and detectors used in different regions), sample preparation techniques. Qualitative analysis of alkanes, alkenes and carbonyl compounds.

UNIT V ATOMIC SPECTROSCOPY
Atomic absorption spectrophotometry: Principle, Instrumentation (Types of burners, Types of fuels, Hollow cathode lamp, Chopper only) and Applications, Various interferences observed in AAS (Chemical, radiation and excitation) Flame photometry: Principle, Instrumentation, quantitative analysis (Standard addition method and internal standard method) and applications, Differences between AAS and FES

COURSE OUTCOME:
On completion of the course students are expected to
CO1: Understand the concept of spectroscopy and its types.
CO2: Know about UV and visible spectroscopy, Qualitative spectroscopy.
CO3: Understand Beer-lambert's, limitation and deviation.
CO4: Do the analysis using various spectroscopy methods
CO5: Understand the concept of Atomic spectroscopy, its principle and applications
REFERENCES

Course Articulation Matrix:

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<td>Understand the concept of spectroscopy and its types.</td>
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<td>Know about UV and visible spectroscopy, Qualitative spectroscopy.</td>
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<td>Understand Beer-lambert’s, limitation and deviation</td>
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<td>Do the analysis using various spectroscopy methods.</td>
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<td>Understand the concept of Atomic spectroscopy, its principle and applications.</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVE:
The course is aimed to
- To study about macromolecules and its theory.
- To know about various polymerization techniques.
- To learn the preparation of polymers using the techniques
- To determine the molecular weight of polymers
- To gain knowledge on 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  CONDENSATION POLYMERIZATION

UNIT IV  MOLECULAR WEIGHTS OF POLYMERS

UNIT V  TRANSITIONS IN POLYMERS

COURSE OUTCOMES:
On completion of the course students are expected to
CO1: Understand the fundamentals of polymers and mechanism of polymerization techniques.
CO2: Apply the mechanism and effectiveness of polymerization in making finished materials.
CO3: Understand the knowledge of polymer stability and unique definition of the product by evaluating molecular weight
CO4: Understand the manufacture and properties of application oriented industrial polymers.
CO5: Acquire knowledge on different tests for characterization of polymer for applications in R & D work

TEXTBOOKS:

REFERENCES:

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<td>Understand the manufacture and properties of application oriented industrial polymers.</td>
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<td>Acquire knowledge on different tests for characterization of polymer for applications in R &amp; D work.</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
AUDIT COURSES (AC)

AD5091  CONSTITUTION OF INDIA

OBJECTIVES:

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT I  INTRODUCTION
History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features

UNIT II  CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES

UNIT III  ORGANS OF GOVERNANCE
Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions

UNIT IV  EMERGENCY PROVISIONS

UNIT V  LOCAL ADMINISTRATION
District’s Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction- PRI- Zila Pachayat-Elected officials and their roles- CEO ZilaPachayat- Position and role-Block level-Organizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Able to understand history and philosophy of Indian Constitution.
CO2: Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
CO3: Able to understand powers and functions of Indian government.
CO4: Able to understand emergency rule.
CO5: Able to understand structure and functions of local administration.

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TEXTBOOKS:
4. The Constitution of India (Bare Act), Government Publication, 1950
OBJECTIVES:
• Develop knowledge of self-development
• Explain the importance of Human values
• Develop the overall personality through value education
• Overcome the self destructive habits with value education
• Interpret social empowerment with value education

UNIT I          INTRODUCTION TO VALUE EDUCATION  9
Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgements

UNIT II         IMPORTANCE OF VALUES             9
Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline

UNIT III        INFLUENCE OF VALUE EDUCATION      9
Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship
Happiness Vs suffering, love for truth.

UNIT IV         REINCARNATION THROUGH VALUE EDUCATION  9

UNIT V          VALUE EDUCATION IN SOCIAL EMPOWERMENT   9
Equality, Non violence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively

TOTAL: 45 PERIODS

OUTCOMES:
CO1 – Gain knowledge of self-development
CO2 – Learn the importance of Human values
CO3 – Develop the overall personality through value education
CO4 – Overcome the self destructive habits with value education
CO5 – Interpret social empowerment with value education

REFERENCES:
OBJECTIVES:
- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

UNIT I   INTRODUCTION AND METHODOLOGY: 9
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT II   THEMATIC OVERVIEW 9
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III   EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES 9
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV   PROFESSIONAL DEVELOPMENT 9
Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V   RESEARCH GAPS AND FUTURE DIRECTIONS 9
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 45 PERIODS

OUTCOMES:
- Understand the methodology of pedagogy.
- Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Know the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

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REFERENCES:
OBJECTIVES:
- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do’s and Don’t’s in life through Yam
- Categorize Do’s and Don’t’s in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

UNIT I INTRODUCTION TO YOGA
Definitions of Eight parts of yog.( Ashtanga )

UNIT II YAM
Do’s and Don’t’s in life.
Shaucha, santosh, tappa, swadhyay, ishwarpranidhan

UNIT III NIYAM
Do’s and Don’t’s in life.
Ahinsa, satya, astheya, bramhacharya and aparigraha

UNIT IV ASAN
Various yog poses and their benefits for mind & body

UNIT V PRANAYAM
Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 45 PERIODS

OUTCOMES:
CO1 – Develop healthy mind in a healthy body thus improving social health also improve efficiency
CO2 – Learn Do’s and Don’t’s in life through Yam
CO3 – Learn Do’s and Don’t’s in life through Niyam
CO4 – Develop a healthy mind and body through Yog Asans
CO5 – Learn breathing techniques through Pranayam

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REFERENCES:
1. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
2. ‘Yogic Asanas for Group Tarining-Part-I” : Janardan Swami Yogabhyasi Mandal, Nagpur
OBJECTIVES:
- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind, pleasing personality and determination
- Discover wisdom in students

UNIT I  NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I 9
Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue)

UNIT II  NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II 9
Verses- 52,53,59 (dont’s) - Verses- 71,73,75,78 (do’s)

UNIT III  APPROACH TO DAY TO DAY WORK AND DUTIES 9
Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6- Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48

UNIT IV  STATEMENTS OF BASIC KNOWLEDGE – I 9
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18

UNIT V  PERSONALITY OF ROLE MODEL - SHRIMAD BHAGWADGEETA 9
Chapter2-Verses 17, Chapter 3-Verses 36,37,42 -  Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 45PERIODS

OUTCOMES:
CO1: To develop basic personality skills holistically
CO2: To develop deep personality skills holistically to achieve happy goals
CO3: To rewrite the responsibilities
CO4: To reframe a person with stable mind, pleasing personality and determination
CO5: To awaken wisdom in students

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REFERENCES:
1. Gopinath,Rashtriya Sanskrit Sansthanam P, Bharthrihari’s ThreeSatakam , Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram,Publication Department, Kolkata,2016
COURSE OBJECTIVES
The course will introduce the students to
- get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT I   INTRODUCTION TO CULTURE         9
Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India.

UNIT II  INDIAN LANGUAGES AND LITERATURE                              9
Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature

UNIT III RELIGION AND PHILOSOPHY                     9
Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)

UNIT IV  FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING)             9
Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

UNIT V  EDUCATION SYSTEM IN INDIA                              9
Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India

TOTAL: 45PERIODS

COURSE OUTCOMES
After successful completion of the course the students will be able to
- Understand philosophy of Indian culture.
- Distinguish the Indian languages and literature.
- Learn the philosophy of ancient, medieval and modern India.
- Acquire the information about the fine arts in India.
- Know the contribution of scientists of different eras.
- Understand education systems in India

REFERENCES:
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
Course Objectives: The main learning objective of this course is to make the students an appreciation for:

1. Introduction to Sanga Tamil Literature.
2. ‘Agathinai’ and ‘Purathinai’ in Sanga Tamil Literature.
3. ‘Attruppadai’ in Sanga Tamil Literature.
4. ‘Puranaanuru’ in Sanga Tamil Literature.
5. ‘Pathitrupaththu’ in Sanga Tamil Literature.

UNIT I SANGA TAMIL LITERATURE AN INTRODUCTION 9

UNIT II ‘AGATHINAI’ AND ‘PURATHINAI’ 9

UNIT III ‘ATTRUPPADAI’.
Attruppadai Literature–Attruppadaiin’Puranaanuru’–Attruppadaiin’Pathitrupaththu’–Attruppadai in ‘Paththupaattu’.

UNIT IV ‘PURANAANURU’ 9
Puranaanuru on Good Administration, Ruler and Subjects– Emotion & its Effect in Puranaanuru.

UNIT V ‘PATHITRUPATHTHU’ 9
Pathitrupaththuin’Ettuthogai’–Pathitrupaththu’s Parables– Tamil dynasty: Valor, Administration, Charity in Pathitrupaththu– Message to Society from Pathitrupaththu.

Total (L:45) = 45 PERIODS

COURSE OUTCOMES: Upon completion of this course, the students will be able to:

1. Appreciate and apply the messages in Sanga Tamil Literature in their life.
2. Differentiate ‘Agathinai’ and ‘Purathinai’ in their personal and societal life.
3. Appreciate and apply the messages in ‘Attruppadai’ in their personal and societal life.
4. Appreciate and apply the messages in ‘Puranaanuru’ in their personal and societal life.
5. Appreciate and apply the messages in ‘Pathitrupaththu’ in their personal and societal life.

REFERENCES:


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HSMC– ELECTIVES – HUMANITIES I (ODD SEMESTER)

HU5171 LANGUAGE AND COMMUNICATION LT P C 3 0 0 3

COURSE DESCRIPTION
This course offers an introduction to language and communication. The primary goal of this course is to familiarize students with key ideas related to communication using language as well as non verbal means. Ideas related to the use of language and the underlying power structures are also examined. The course also examines the role of media in communication and in the dissemination of ideas as well as opinions.

Objectives
✓ To familiarize students with the concept of communication using linguistic and non linguistic resources.
✓ To help students ask critical questions regarding facts and opinions.
✓ To provide students with the material to discuss issues such as language and power structures.
✓ To help students think critically about false propaganda and fake news.

Learning Outcomes
➢ Students will be able to use linguistic and non linguistic resources of language in an integrated manner for communication.
➢ Students will be able to analyse communication in terms of facts and opinions.
➢ Students will be able to discuss, analyse and argue about issues related to language and power.

UNIT I  LINGUISTIC AND NON-LINGUISTIC RESOURCE OF COMMUNICATION: 9
a) Writing and Speech
b) Distinction between language structure and language use, form and function, acceptability and grammaticality
c) Gestures and Body language, pictures and symbols, cultural appropriacy
d) Communicative Competency, context and situation, combination of linguistic and non-linguistic elements of communication

UNIT II  STRUCTURE OF WRITING/CONVERSATION: 9
a) Language skills and the communication cycle; speaking and listening, writing and reading
b) Initiating and closing conversations, intervention, turn taking
c) Writing for target reader, rhetorical devices and strategies
d) Coherence and Cohesion in speech and writing

UNIT III POWER STRUCTURE AND LANGUAGE USE: 9
a) Gender and language use
b) Politeness expressions and their use
c) Ethical dimensions of language use
d) Language rights as part of human rights

UNIT IV MEDIA COMMUNICATION: 9
a) Print media, electronic media, social media
b) Power of media
c) Manufacturing of opinion, fake news and hidden agendas

UNIT V PERSUASIVE COMMUNICATION AND MISCOMMUNICATION: 9
a) Fundamentals of persuasive communication
b) Persuasive strategies
c) Communication barriers

TOTAL : 45 PERIODS

TEXT BOOKS:
VALUES AND ETHICS

OBJECTIVES:
- Teach definition and classification of values.
- Explain Purusartha.
- Describe Sarvodaya idea.
- Summarize sustenance of life.
- Conclude views of hierarchy of values.

UNIT I  DEFINITION AND CLASSIFICATION OF VALUES
Extrinsic values- Universal and Situational values- Physical- Environmental-Sensuous- Economic-Social-
Aesthetic-Moral and Religious values

UNIT II  CONCEPTS RELATED TO VALUES
Purusartha-Virtue- Right- duty- justice- Equality- Love and Good

UNIT III  IDEOLOGY OF SARVODAYA
Egoism- Altruism and universalism- The Ideal of Sarvodaya and Vasudhaiva Kutumbakam

UNIT IV  SUSTENANCE OF LIFE
The Problem of Sustenance of value in the process of Social, Political and Technological Changes

UNIT V  VIEWS ON HIERARCHY OF VALUES
The Problem of hierarchy of values and their choice, The views of Pt. Madan Mohan Malviya and Mahatma Gandhi

TOTAL: 45 PERIODS

OUTCOMES:
- CO1: Able to understand definition and classification of values.
- CO2: Able to understand purusartha.
- CO3: Able to understand sarvodaya idea.
- CO4: Able to understand sustenance of life.
- CO5: Able to understand views of hierarchy of values.

TEXTBOOKS:
2. Little, William, : An Introduction of Ethics (Allied Publisher, Indian Reprint 1955)
OBJECTIVES:
- Illustrate human relations at work its relationship with self.
- Explain the importance of interacting with people at work to develop teamwork.
- Infer the importance of physical health in maintaining human relations at work.
- Describe the importance of staying psychologically healthy.
- Identify the essential qualities for progressing in career.

UNIT I  UNDERSTANDING AND MANAGING YOURSELF  9
Human Relations and You: Self-Esteem and Self-Confidence; Self-Motivation and Goal Setting; Emotional Intelligence, Attitudes, and Happiness; Values and Ethics and Problem Solving and Creativity.

UNIT II  DEALING EFFECTIVELY WITH PEOPLE  9
Communication in the Workplace; Specialized Tactics for Getting Along with Others in the Workplace; Managing Conflict; Becoming an Effective Leader; Motivating Others and Developing Teamwork; Diversity and Cross-Cultural Competence.

UNIT III  STAYING PHYSICALLY HEALTHY  9
Yoga, Pranayam and Exercise: Aerobic and anaerobic.

UNIT IV  STAYING PSYCHOLOGICALLY HEALTHY  9
Managing Stress and Personal Problems, Meditation.

UNIT V  DEVELOPING CAREER THRUST  9

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to
CO1: Understand the importance of self-management.
CO2: Know how to deal with people to develop teamwork.
CO3: Know the importance of staying healthy.
CO4: Know how to manage stress and personal problems.
CO5: Develop the personal qualities essential for career growth.

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TEXT BOOK:

REFERENCES:
COURSE DESCRIPTION
Psychological Processes course is designed for students to be aware of the basic principles of psychology for the better understanding of people’s psyche and behaviour around them. This course enables learners to use the optimal use of different forms of thinking skills and thereby results in effective communication in diverse situations. Every unit of the syllabus highlights the psychological process of people, the most powerful and constructive use of perceptions.

OBJECTIVES
The major objectives of this course is
- To develop students’ awareness – on psychology, learning behavior and usage of perception effectively.
- To learn to use the various kinds of thinking in a formal context.
- To critically evaluate content and comprehend the message on the bases of perception, personality and intelligence.

UNIT 1: INTRODUCTION

UNIT 2: SENSORY & PERCEPTUAL PROCESSES
Some general properties of Senses: Visual system – the eye, colour vision – Auditory system – Hearing, listening, Sounds - Other senses - Selective attention; physiological correlates of attention; Internal influences on perception learning – set - motivation & emotion - cognitive styles; External influences on perception figure and ground separation – movement – organization – illusion; Internal- external interactions: Constancy - Depth Perception- Binocular & Monocular Perception; Perceptual defense & Perceptual vigilance; Sensory deprivation -Sensory bombardment; ESP - Social Perception.

UNIT 3: COGNITION & AFFECT

UNIT 4: THINKING, PROBLEM-SOLVING & DECISION MAKING

UNIT 5: PERSONALITY & INTELLIGENCE
Psychological phenomena & Attributes of humans - cognition, motivation, and behavior - thoughts, feelings, perceptions, and actions – personality dimensions, traits, patterns - Specialized knowledge, performance accomplishments, automaticity or ease of functioning, skilled performance under challenge - generative flexibility, and speed of learning or behavior change.

References
COURSE DESCRIPTION
This course introduces students to multidisciplinary studies in Education, Technology and Society. Students will get an understanding of the relationship between education, technology and society. They will also learn about the long lasting impact of good education in a technologically advanced society.

COURSE OBJECTIVES:
The course aims
- To help learners understand the basics of different types of technology utilised in the field of education
- To make them realize the impact of education in society
- To make them evolve as responsible citizen in a technologically advanced society

LEARNING OUTCOMES
By the end of the course, learners will be able to
- Understand the various apps of technology apps and use them to access, generate and present information effectively.
- Apply technology based resources and other media formats equitably, ethically and legally.
- Integrate their technical education for betterment of society as well as their personal life.

UNIT I             INDIAN EDUCATION SYSTEM
Gurukul to ICT education – Teacher as facilitator – Macaulay’s Minutes – English medium vs Regional medium – Importance of Education in Modern India - Challenges in Education

UNIT II               LEARNING THEORIES

UNIT III  TECHNOLOGICAL ADVANCEMENTS
Web tools – Social media in education – elearning – MOOCs – Mobile assisted learning – Learning Apps – Blended learning - Self-directed learning

UNIT IV  EDUCATIONAL TECHNOLOGY
Technological implications on Education – Teaching, Learning & Testing with Technology - Advantages and drawbacks – Critical analysis on the use of technology

UNIT V              ETHICAL IMPLICATIONS
Plagiarism – Online Copyright issues – Ethical and value implications of education and technology on individual and society.

TOTAL:45 PERIODS

TEACHING METHODS
Teaching modes include guest lectures, discussion groups, presentations, visual media, and a practicum style of learning.

EVALUATION
As this is course is not a content based course, it focuses more on the ethical use of technology in education and society, and so, evaluation can be based on assignments and discussions. So there is no need for an end semester examination. Internals marks can be taken for the total marks.

INTERNAL (100 % WEIGHTAGE)
(a) Written Test (40 marks)
(b) Assignment: Write a real time report of the technology use in any school / college (15 marks)
(c) Presentation: Students choose any one of the technological tools and present its relevance to education and society (15 marks)
(d) Group discussion: Students discuss in groups on case studies relating to various challenges in education and technology use in society (20 marks)
(e) Blog entry: Making weekly blog posts in Class Blog on the topics related to the course posted by the instructor and commenting on others’ posts. (10 marks)

REFERENCES
1) Education and Social order by Bertrand Russel
2) Theories of learning by Bower and Hilgard
3) Technology and Society by Jan L Harrington
OBJECTIVES

- To create a new understanding by teaching philosophy through a comparison of Indian and Western traditions.
- To foster critical thinking and imagination by dealing with inter-related concepts in literature and science.
- To bridge the gap between the sciences and humanities through introspective analyses.
- To nurture an understanding of the self and elucidates ways to progress towards a higher understanding of one’s self and others.

UNIT I KNOWLEDGE

UNIT II ORIGIN

UNIT III WORD

UNIT IV KNOWLEDGE AS POWER/OPPRESSION

UNIT V SELF KNOWLEDGE/BRAHMAN

TOTAL : 45 PERIODS

OUTCOMES:
On completion of the course, the students will be able to:
1. Think sceptically, ask questions and to arrive at deductions.
2. Connect and relate different branches of thought.
3. Comprehends the relation between language, thought and action.
4. Arrive at a better understanding of self and others and forms a new outlook.

REFERENCES:
7. Bacon, Francis: Power as Knowledge
UNITI INTRODUCTION
Nature and fields.

UNITII PSYCHOLOGY IN INDUSTRIES AND ORGANIZATIONS
Job analysis; fatigue and accidents; consumer behavior.

UNITIII PSYCHOLOGY AND MENTAL HEALTH
Abnormality, symptoms and causes psychological disorders

UNITIV PSYCHOLOGY AND COUNSELING
Need of Counseling, Counsel or and the Counselee, Counseling Process, Areas of Counseling.

UNITV PSYCHOLOGY AND SOCIAL BEHAVIOUR
Group, group dynamics, team building, Prejudice and stereotypes; Effective Communication, conflict and negotiation.

TOTAL: 45 PERIODS

TEXTBOOKS
COURSE DESCRIPTION

This course offers an introduction to Gender Studies that asks critical questions about the meanings of sex and gender in Indian society. The primary goal of this course is to familiarize students with key issues, questions and debates in Gender Studies, both historical and contemporary drawing from Indian literature and media studies, to examine cultural assumptions about sex, gender, and sexuality. This course integrates analysis of current events through student presentations, aiming to increase awareness of contemporary and historical experiences of women, and of the multiple ways that sex and gender interact with class, caste and other social identities. This course also seeks to build an understanding of the concepts of gender, gender-based violence, sexuality, and rights and their impact on development through a number of discussions, exercises and reflective activities.

Objectives

- To familiarize students with the concepts of sex and gender through literary and media texts.
- To help students ask critical questions regarding gender roles in society.
- To provide students with the material to discuss gender issues such as gender based discrimination, violence and development.
- To help students think critically about gender based problems and solutions.

Learning Outcomes

- Students will be able to critically read literary and media texts and understand the underlying gender perspectives in them.
- Students will be able to analyse current social events in the light of gender perspectives.
- Students will be able to discuss, analyse and argue about issues related to gender and their impact on society, culture and development.

UNIT I: Introduction to Gender

- Definition of Gender
- Basic Gender Concepts and Terminology
- Exploring Attitudes towards Gender
- Social Construction of Gender

Texts:
1. Sukhu and Dukhu (Amar Chitra Katha)
2. The Cat who Became a Queen (Folk tale, J. Hinton Knowles, Folk-Tales of Kashmir. London: Kegan Paul, Trench, Trübner, and Company, 1893, pp. 8-10.)

UNIT II: Gender Roles and Relations

- Types of Gender Roles
- Gender Roles and Relationships Matrix
- Gender-based Division and Valuation of Labour

Texts:
1. Muniyakka (Short Story, Lakshmi Kannan, Nandanvan and Other Stories, Hyderabad: Orient Blackswan, 2011)

UNIT III: Gender Development Issues

- Identifying Gender Issues
- Gender Sensitive Language
- Gender, Governance and Sustainable Development
- Gender and Human Rights
- Gender and Mainstreaming

Texts:
2. Tell Us Marx (Poem, Mallika Sengupta, Translated by Sanjukta Dasgupta)

UNIT IV: Gender-based Violence

- The concept of violence
- Types of Gender-based violence
- The relationship between gender, development and violence
• Gender-based violence from a human rights perspective

Texts:
1. Lights Out (Play, Manjula Padmanabhan)
2. Lights Out (Video of play enacted)

UNIT V: Gender and Culture
• Gender and Film
• Gender, Media and Advertisement

Texts:
1. Mahanagar (Movie: Satyajit Ray)
2. Beti Bachao Beti Padhao Advertisements

READINGS: Relevant additional texts for readings will be announced in the class. Classes will consist of a combination of activities: dialogue-based lectures, discussions, collaborative learning activities, group work and in-class assignments.

ASSESSMENT AND GRADING:
Discussion & Classroom Participation: 20%
Project/Assignment: 30%
End Term Exam: 50%

HU5272 ETHICS AND HOLISTIC LIFE

OBJECTIVES:
• To emphasize the meaning and nature of ethics, human values and holistic life for leading a good, successful and happy life through continuous examination of thoughts and conduct in day to day life.
• To understand the status and responsible role of individual in abatement of value crisis in contemporary world in order to develop a civilized and human society. Understanding the process of ethical decision making through critical assessment of incidents/cases of ethical dilemmas in personal, professional and social life.
• To view the place of Ethics and Human Values in the development of individual and society through identification and cross examination of life values and world view of his/her role models in society.

UNIT I       HUMAN LIFE, ITS AIM AND SIGNIFICANCE
The concept of a successful life, happy life and a meaningful life, Ethical and decision making capability and its development: Meaning of Ethical dilemma, sharing real life experiences.

UNIT II       CREATIVE AND LEADERSHIP ABILITY AND THEIR DEVELOPMENT
Intellectual, Emotional, Creative, Ethico - spiritual development, Aesthetic sense, Self-dependency, Activeness, Development of positive attitude.

UNIT III      HARMONY IN PERSONAL AND SOCIAL LIFE:
Concept of personal and group Ethics; Balance between - rights and duties-welfare of self and welfare of all, Creating a value based work culture in hostel, classroom and other places in the campus and society.

UNIT IV       CHARACTER, RIGHTEOUSNESS AND VIRTUES FOR A MEANINGFUL LIFE
Egolessness, Humility, Righteousness, Purity, Truthfulness, Integrity, Self-restraint, Self-control, Sense of responsibility, Empathy, Love, Compassion, Maitri / Comradeship, Cooperation, Tolerance.

UNIT V DILEMMA BETWEEN MATERIALISTIC DEVELOPMENT AND HUMAN WELFARE

TOTAL:45 PERIODS

OUTCOMES:
On completion of the course, the students will be able to:
1. Enable students to understand the concept of contemporary ethics at different levels: Individual, local and Global and enable them to cross examine the ethical and social consequences of the decisions of their life-view and world view.
2. Develop the ability of students to create a balance between their individual freedom and social responsibilities and enable them to identify the personal, professional and social values and
integrate them in their personality after cross examination.
3. Enable students to cross examine their earlier decisions taken in life and understand the meaning of ethical dilemma to overcome the ethical dilemmas and engage in critical reflection.
4. Develop positive habits of thought and conduct and work cohesively with fellow beings who have variety of strengths, experiences, shortcomings and challenges, hence to enable them to handle diverse type of personalities.
5. Enable students to develop a method for making ethically sound decisions for themselves, within hostels, classrooms, university campus and society.
UNIT II EVOLUTION OF FILM

UNIT III FILMS ACROSS THE WORLD

UNIT IV INDIAN FILMS

UNIT V INTERPRETING FILMS
Film Criticism & Appreciation – Censorship in Movies – Cultural Representation in Movies – Television – New Media & Online Media – Films Beyond Entertainment.

TOTAL: 45 PERIODS

OUTCOMES
On completion of the course, the students will be able to:
- Recognize types of films, their impact on society and their roles in our lives.
- Have an understanding of the concepts of storytelling, Mise en Scene, and other elements of film making.
- Interpret the underlying messages in the movies.

Teaching Methods
- Each unit consists of reading materials, learning activities videos, websites. Students are expected to watch movies sometimes in class and at times at home and discuss in class.

Evaluation
- As this is a course of critical appreciation on films, there is no written end semester examination. The course is more on learning how to critically analyse a movie and appreciate its finer elements. Therefore evaluation can be based on assignments and discussions. Internals marks can be taken for the total marks.

Internal (100 % weightage)
- Assignment 1: Write a movie review with critical analysis (20 marks).
- Assignment 2 : Write a script for a scene taken from a short story / novella (20 marks).
- Presentation: Students choose any one topic related to films and present it to the audience. (25 marks)
- Group discussion : Students discuss in groups on the various aspects of movies and its impact on society. (25 marks)
- Blog entry: Making weekly blog posts in Class Blog on the topics related to the course posted by the instructor and commenting on others’ posts. (10 marks)

REFERENCES
1. A Biographical Dictionary of Film by David Thomson, Secker & Warburg, 1975
2. Signs and Meaning in the Cinema by Peter Wollen, Secker & Warburg, 1969
3. The World Viewed by Stanley Cavell 1971
4. Film Style and Technology: History and Analysis by Barry Salt, Starword, 1983

HU5275 FUNDAMENTALS OF LANGUAGE AND LINGUISTICS

OBJECTIVES
- To broadly introduce students to the formal and theoretical aspects of linguistics.
- To enable learners to understand the various practical applications of language and recent findings in the field of applied linguistics.
CONTENTS:

UNIT I LANGUAGE AND LINGUISTICS: AN OVERVIEW

UNIT II MORPHOLOGY - WORDS OF LANGUAGE

UNIT III SYNTAX- THE SENTENCE PATTERNS OF LANGUAGE AND SEMANTICS-THE MEANING OF LANGUAGE

UNIT IV PHONETICS – THE SOUNDS OF LANGUAGE

UNIT V APPLIED LINGUISTICS - THE PRACTICAL APPLICATIONS OF LANGUAGE
Language learning and teaching (ELT)- lexicography-translation studies-computational linguistics-neurolinguistics (speech pathology and language disorders)- forensic linguistics – sociolinguistics.

TOTAL : 45 PERIODS

Teaching Methods :
Lectures, discussion.

Evaluation Internal and External :
Internal: 2 written tests + assignments, seminars, project (50+15+15+20).
External: A 3 hour written exam (50 marks)

REFERENCES :

HU5276 UNDERSTANDING SOCIETY AND CULTURE THROUGH LITERATURE
OBJECTIVES
- To internalize the importance of language by understanding its role in the transformation of man.
- To look at language, literature and culture as locus of identity and change.
- To extract meaning from existing literatures and cultures.
- To identify meanings in modern life by reconnecting with lost cultures.

Unit 1 Introduction
Why study literature? Tracing the origin – pictures. Tokens as precursors of writing. Movement from three dimensions to two dimensions- Pictography. From visual to oral -Logography. Reading out literature to young children- Edmund J Farrell.

Unit 2. Reading Culture
Reading culture through language, signs and consumables- Roland Barthes. Culture through poems- Nissim Ezekiel’s ‘ The night of the Scorpion’. ‘Nothing’s Changed’- Tatamkhulu Afrika- Apartheid. Ruskin Bond- ‘Night train at Deoli’- How real life is different from movies.
Unit 3. Identifying Meaning
Searching and locating meaning through literature. Looking for order in a chaotic world. The Myth of Sisyphus (Albert Camus) and Adi Shankar’s ‘Jagat Mithya’- the world as an illusion. The Indian version as ‘meaningless meaning’.

Unit 4. Post Modernism
‘If on a winter’s night a traveler’- Italo Calvino. The book about the reader- the experience of reading as reading. Metafiction. Selfie Culture. Visual Culture as purpose of modern life.

Unit 5. Returning to Pictures

Reading list
1. Bond, Ruskin: ‘Night train at Deoli’
2. Ezekiel, Nissim: ‘The Night of the Scorpion’
3. Afrika,Tatamkhulu: ‘Nothing’s Changed’
4. Barthes, Roland: Mythologies
5. Shankaracharya: Viveka Chudamani
6. Camus, Albert- The Myth of Sisyphus
7. Calvino, Italo: If on a winter’s night a traveler

Outcome
• Can identify the connections among language, literature and culture.
• Is able to relate between seemingly different aspects of life.
• Understands the fractions in modern life and can assimilate meanings.