## ANNA UNIVERSITY, CHENNAI
### AFFILIATED INSTITUTIONS
#### R - 2008
#### B.TECH. PETROLEUM ENGINEERING
#### II - VIII SEMESTERS CURRICULA AND SYLLABI

### SEMESTER II
(Common to all B.E. / B.Tech. Degree Programmes except B.E. – Marine Engineering)

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A. CIRCUIT BRANCHES

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

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

B. NON – CIRCUIT BRANCHES

I  Faculty of Civil Engineering
   1. B.E. Civil Engineering

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

III  Faculty of Technology
   1. B.Tech. Chemical Engineering
   2. B.Tech. Biotechnology
   3. B.Tech. Polymer Technology
   4. B.Tech. Textile Technology
   5. B.Tech. Textile Technology (Fashion Technology)
   7. B.Tech. Plastics Technology
SEMESTER-III
(Applicable to the students admitted from the Academic year 2008 – 2009 onwards)

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<td>PE 2039</td>
<td>Principles of Geochemistry</td>
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AIM
To encourage students to actively involve in participative learning of English and to help them acquire Communication Skills.

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

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

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

UNIT II

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

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

Suggested activities:
1. Exercises combining sentences using cause and effect expressions – Gap filling exercises using the appropriate tense forms – Making sentences using different grammatical forms of the same word. (Eg: object –verb / object – noun)
2. Speaking exercises involving the use of stress and intonation – Group discussions– analysis of problems and offering solutions.
3. Reading comprehension exercises with critical questions, Multiple choice question.
UNIT IV
Numerical adjectives – Oral instructions – Descriptive writing – Argumentative paragraphs – Letter of application - content, format (CV / Bio-data) - Instructions, imperative forms - Checklists, Yes/No question form – E-mail communication.

Suggested Activities:
1. Rewriting exercises using numerical adjectives.
2. Reading comprehension exercises with analytical questions on content – Evaluation of content.
3. Listening comprehension – entering information in tabular form, intensive listening exercise and completing the steps of a process.
4. Speaking - Role play – group discussions – Activities giving oral instructions.

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

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

TOTAL: 60 PERIODS

TEXT BOOK

REFERENCES

Extensive Reading:

Note:
The book listed under Extensive Reading is meant for inculcating the reading habit of the students. They need not be used for testing purposes.
UNIT I  ORDINARY DIFFERENTIAL EQUATIONS
Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy’s and Legendre’s linear equations – Simultaneous first order linear equations with constant coefficients.

UNIT II  VECTOR CALCULUS

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

UNIT IV  COMPLEX INTEGRATION

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

TOTAL : 60 PERIODS

TEXT BOOKS

REFERENCES
UNIT I CONDUCTING MATERIALS 9

UNIT II SEMICONDUCTING MATERIALS 9

UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS 9
Superconductivity : properties - Types of super conductors – BCS theory of superconductivity(Qualitative) - High Tc superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

UNIT IV DIELECTRIC MATERIALS 9

UNIT V MODERN ENGINEERING MATERIALS 9
Metallic glasses: preparation, properties and applications.
Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, advantages and disadvantages of SMA

TOTAL : 45 PERIODS

TEXT BOOKS
2. Charles P. Poole and Frank J.Ownen, ‘Introduction to Nanotechnology’, Wiley India(2007) (for Unit V)

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

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

UNIT I  ELECTROCHEMISTRY

UNIT II  CORROSION AND CORROSION CONTROL

UNIT III  FUELS AND COMBUSTION

UNIT IV  PHASE RULE AND ALLOYS

UNIT V  ANALYTICAL TECHNIQUES

TOTAL: 45 PERIODS
TEXT BOOKS

REFERENCES

ME2151 ENGINEERING MECHANICS

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

UNIT I BASICS & STATICS OF PARTICLES

UNIT II EQUILIBRIUM OF RIGID BODIES

UNIT III PROPERTIES OF SURFACES AND SOLIDS

UNIT IV DYNAMICS OF PARTICLES
UNIT V  
FRICITION AND ELEMENTS OF RIGID BODY DYNAMICS  
Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion.

TEXT BOOK

REFERENCES
TEXT BOOKS

REFERENCES

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

UNIT I CIRCUIT ANALYSIS TECHNIQUES 12

UNIT II TRANSIENT RESONANCE IN RLC CIRCUITS 12

UNIT III SEMICONDUCTOR DIODES 12

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

UNIT V SPECIAL SEMICONDUCTOR DEVICES (Qualitative Treatment only) 12

TOTAL : 60 PERIODS
TEXT BOOKS

REFERENCES

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

UNIT I ELECTRICAL CIRCUITS & MEASUREMENTS 12
Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.

UNIT II ELECTRICAL MECHANICS 12

UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS 12

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

UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING 12
Communication Systems: Radio, TV, Fax, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

TOTAL : 60 PERIODS
TEXT BOOKS

REFERENCES

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

A – CIVIL ENGINEERING

UNIT I SURVEYING AND CIVIL ENGINEERING MATERIALS 15
angles – leveling – determination of areas – illustrative examples.


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

Types of Bridges and Dams – Basics of Interior Design and Landscaping.

TOTAL: 30 PERIODS

B – MECHANICAL ENGINEERING

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

UNIT IV I C ENGINES 10
Internal combustion engines as automobile power plant – Working principle of Petrol and
Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two
stroke engines – Boiler as a power plant.
UNIT V  REFRIGERATION AND AIR CONDITIONING SYSTEM


TOTAL : 30 PERIODS

REFERENCES

GE2155  COMPUTER PRACTICE LABORATORY – II

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LIST OF EXPERIMENTS

1. UNIX COMMANDS
   Study of Unix OS - Basic Shell Commands - Unix Editor

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

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

TOTAL: 45 PERIODS

HARDWARE / SOFTWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS

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

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

1. Determination of Young’s modulus of the material – non uniform bending.
2. Determination of Band Gap of a semiconductor material.
3. Determination of specific resistance of a given coil of wire – Carey Foster Bridge.
5. Spectrometer dispersive power of a prism.
6. Determination of Young’s modulus of the material – uniform bending.

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

LIST OF EXPERIMENTS

1. Conduct metric titration (Simple acid base)
2. Conduct metric titration (Mixture of weak and strong acids)
3. Conduct metric titration using BaCl₂ vs Na₂SO₄
4. Potentiometric Titration (Fe²⁺ / KMnO₄ or K₂Cr₂O₇)
5. PH titration (acid & base)
6. Determination of water of crystallization of a crystalline salt (Copper sulphate)
7. Estimation of Ferric iron by spectrophotometry.

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

List of Exercises using software capable of Drafting and Modeling

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using Bspline or cubic spline.

4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.

5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).

6. Drawing of a plan of residential building ( Two bed rooms, kitchen, hall, etc.)

7. Drawing of a simple steel truss.

8. Drawing sectional views of prism, pyramid, cylinder, cone, etc,


10. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.

TOTAL: 45 PERIODS

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

List of Equipments for a batch of 30 students:

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

EE2155 ELECTRICAL CIRCUIT LABORATORY (Common to EEE, EIE and ICE) 0 0 3 2

LIST OF EXPERIMENTS

1. Verification of ohm’s laws and kirchoff’s laws.
2. Verification of Thevenin’s and Norton’s Theorem
3. Verification of superposition Theorem
4. Verification of maximum power transfer theorem.
5. Verification of reciprocity theorem
6. Measurement of self inductance of a coil
7. Verification of mesh and nodal analysis.
8. Transient response of RL and RC circuits for DC input.
10. Frequency response of single tuned coupled circuits.

TOTAL: 45 PERIODS
1. Verification of KVL and KCL
2. Verification of Thevenin and Norton Theorems.
3. Verification of superposition Theorem.
4. Verification of Maximum power transfer and reciprocity theorems.
5. Frequency response of series and parallel resonance circuits.
6. Characteristics of PN and Zener diode
7. Characteristics of CE configuration
8. Characteristics of CB configuration
9. Characteristics of UJT and SCR
10. Characteristics of JFET and MOSFET

TOTAL: 45 PERIODS

ENGLISH LANGUAGE LABORATORY (Optional)

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

2. Speaking:
   - Pronouncing words & sentences correctly – word stress – Conversation practice.

Classroom Session

2. Goal setting – interviews – stress time management – situational reasons

Evaluation

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

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

Note on Evaluation
1. Examples for role play situations:
   a. Marketing engineer convincing a customer to buy his product.
b. Telephone conversation – Fixing an official appointment / Enquiry on availability of flight or train tickets / placing an order. etc.

2. Presentations could be just a Minute (JAM activity) or an Extempore on simple topics or visuals could be provided and students could be asked to talk about it.

REFERENCES

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

MA2211 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C
3 1 0 4
(Common to all branches of B.E. / B.Tech Programmes)

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

UNIT I FOURIER SERIES 9 + 3

UNIT II FOURIER TRANSFORMS 9 + 3

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

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9 + 3
Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) – Fourier series solutions in cartesian coordinates.
UNIT V  
Z-TRANSFORMS AND DIFFERENCE EQUATIONS  
9 + 3
Z-transforms - Elementary properties – Inverse Z-transform – Convolution theorem - Formation  
of difference equations – Solution of difference equations using Z-transform.

TOTAL: 60 PERIODS

TEXT BOOK
(2007)

REFERENCES
Publications(P) Ltd. (2007)
limited, New Delhi (2007).
Education (2007).

PE 2201  
PROCESS ENGINEERING CALCULATIONS  
L T P C
3 1 0 4

AIM
Every Chemical creation involves consumption of materials and energy. The reactions are to 
be balanced with correct quantity of materials and energy to achieve good percentage of 
conversion for products. The aim of course is to give fundamental knowledge on such 
material and energy balances.

OBJECTIVES
To make students understand different types of laws of Chemistry of materials and also 
prepare the students to accurately calculate the stoichiometric relations between the materials 
involved in a physical and chemical reaction.

UNIT I
Methods of expressing compositions of mixture and solutions, wet and dry basis conecpt. 
Ideal and real gas laws – Gas constant – normal molal volume, calculations of pressure, 
volume and temperature using ideal gas law. Gas mixtures – Use of partial pressure and pure 
component volume in gas calculations – Dissociating gases – applications of real gas 
relationships in gas calculation. 
Gas Reservoir calculation of gas in place by volumetric method. Calculation of unit recovery 
from volumetric gas reservoirs. Calculation of unit recovery from Gas Reservoir under water 
drive.

UNIT II
Concept of material balance : Application of material balance to unit operations like distillation, 
evaporation, drying. Material balance involving key components, material balance with 
chemical reaction, - Limiting and excess reactants – Degree of completion. Application of 
material balance to various types of chemical reactions – recycle and by passing operations – 
concept of purge. 
Material balance equations for dry gas reservoirs. Material balance for solution – gas drive 
reservoirs.
UNIT III
Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity – Dew point – Use of humidity in condensation and drying – Wet and dry bulb temperatures, Humidity chart, solving problems using humidity chart.
Calculation of orsat analysis of products of combustion of solid, liquid and gas fuels – Calculation of hydrogen to carbon ratio and percentage excess air from flue gas analysis, calculations of sulphur and sulphur compounds burning operations.

UNIT IV
Heat capacity of solids, liquids, gases – mean heat capacity – calculation of sensible heat using heat capacity, Kopp’s rule, various types of latent heats.

UNIT V
Integrated material and energy balance equation. Concept of unsteady state material and energy balances, problems on unsteady state material and energy balances. Calculations of material balance of gas reservoir in different regions with variation in composition.

TOTAL: 60 PERIODS

TEXT BOOKS

REFERENCES

PE2202 GEOPHYSICS I

AIM
To impart knowledge on the Earth as a planet and its internal structure, geomagnetism, paleomagnetism, geothermal and electrical properties.

OBJECTIVES
Students develop a sound knowledge on Seismology, Seismic survey techniques for oil and gas exploration.

UNIT I
UNIT II

UNIT III

UNIT IV

UNIT V

TEXT BOOKS
1. Principles of applied geophysics by D.S.Parasnis
2. Geophysical methods by Robert E.Sherief

REFERENCE
1. The Blue Planet : An introduction to Earth System Science 2nd Edition by Brain J.Skinner

PE2203 FLUID MECHANICS
L T P C
3 0 0 3

AIM
To have a general idea about the Mechanism of fluid, fluid flow, flow measuring devices through basic concepts and fluid dynamics in Porous Media.

OBJECTIVES
The subject will help the students to have knowledge on the fluid properties, their characteristics while static and during flow through ducts, pipes and porous medium. Knowledge on several machineries used to transport the fluid and their performance are assessed.

UNIT I
The concept of fluid, the fluid as a continuum physical and thermodynamic properties – basic laws – Newtonian and non-newtonian fluids – flow patterns – Velocity field – streamlines and stream tubes – vorticity and irrotationality. The principle of dimensional homogeneity – dimensional analysis, the Pi-theorems. Similitude – use of dimensional analysis for scale up studies.

UNIT II
Pressure and Pressure gradient – equilibrium of fluid element – hydrostatic pressure distributions – application to manometry – mass, energy and momentum balances – continuity equation, equation of motion, Navier – stokes equation and Bernoulli’s theorem.
UNIT III
Reynold’s number regimes, flow through pipes – head loss, friction factor, minor losses in pipe systems and multiple pipe systems – boundary layer concepts, drag forces on solid particles in fluids – flow through fixed and fluidized beds.

UNIT IV

UNIT V

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

PE2204 HEAT AND MASS TRANSFER L T P C
3 0 0 3

AIM
To provide fundamental instruction in various methods of heat transfer through different media. To impart knowledge on how certain substances undergo the change in composition, change in phases and exhibit the properties according to the changed environment.

OBJECTIVES
Students gain knowledge in various heat transfer methodology in chemical process engineering. Also students develop a sound knowledge in Mass Transfer operation.

UNIT I
UNIT II
Concepts of heat transfer by convection – Natural and forced convection, analogies between transfer of momentum and heat transfer. Reynold’s analogy, prandtl and coulburn analogy. Dimensional analysis in heat transfer. Correlations for calculation of heat transfer coefficients, heat transfer co-efficient for flow through a pipe. Heat transfer to fluids with phase change – heat transfer from condensing vapours, dropwise and film wise condensation, Nusselt equation for vertical and horizontal tubes, effect of non-condensable gases on rate of condensation.

UNIT III
Paraplel and Counterflow heat exchangers – Log mean temperature difference – single pass and multipass heat exchangers, plate heat exchangers. Fouling factors design of various types of heat exchangers.

UNIT IV

UNIT V

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
PE 2205  INTRODUCTION TO PETROLEUM ENGINEERING  L T P C  3 0 0 3

AIM
To impart knowledge on worldwide Petroleum and Natural Gas Exploration and Production Industries.

OBJECTIVE
To provide an overview of Petroleum Engineering Industry including oil and gas reserves, petroleum industry, including oil and natural gas reserves, petroleum exploration and exploitation.

UNIT I

UNIT II
Drilling – Introduction to drilling of oil and gas wells. Drilling Rigs and equipments. Drilling fluids.

UNIT III

UNIT IV
Petroleum Exploitation – Well testing and completion, Production potential and well performances. Material balance, Artificial lift, Improved recovery methods.

UNIT V

TOTAL : 45 PERIODS

TEXT BOOKS / REFERENCES
1. Geology of Petroleum by Levenson A.L.
2. Principles of oil production by T.E.W Nind
3. Introduction to Petroleum Engineering by Geltin

PE 2207  FLUID MECHANICS LABORATORY  L T P C  0 0 3 2

AIM
To determine experimentally the flow characteristics of fluids and also to determine the efficiency of the flow measuring devices and fluid transport machineries.

OBJECTIVES
To give the exposure of all the fluid mechanics equipments and also to visualize the Fundamental concept of fluid mechanics.
LIST OF EXPERIMENTS
1. Calibration of constant and variable head meters
2. Calibration of weirs and notches
3. Determination of drag coefficient
4. Flow through straight pipe
5. Flow through annular pipe
6. Pressure drop studies in packed column
7. Minimum fluidization velocity in gas-solid and liquid-solid fluidization column
8. Open drum orifice and draining time
9. Flow through helical coil and spiral coil
10. Characteristic curves of pumps
11. Losses in pipe fittings and valves
12. Viscosity measurement of non Newtonian fluids.

TOTAL: 45 PERIODS

PE 2208 HEAT AMD MASS TRANSFER LABORATORY – I

AIM
To impart knowledge on how substances undergo the change in composition and change in phases during changes in temperatures.

OBJECTIVE
Students develop sound knowledge on heat and mass transfer operations

LIST OF EXPERIMENTS-HEAT TRANSFER LABORATORY
1. Determination of conduction parameters
2. To relate Heat transfer co-efficient with Reynolds number
3. To determine heat transfer coefficient in condenser.
4. To study the effect of stirring on heat transfer co-efficient
5. To study the effect of coil diameter on heat transfer coefficient
6. To determine the overall heat transfer coefficient

LIST OF EXPERIMENTS -MASS TRANSFER LABORATORY
7. To determine the critical moisture content and drying rate
8. To determine the critical moisture content and drying rate under vacuum
9. To verify Rayleigh equation
10. To determine the efficiency of steam distillation
11. To determine diffusion coefficient
12. To relate mass transfer coefficient with Reynolds number

TOTAL: 45 PERIODS
OBJECTIVES
At the end of the course, the students would

- Acquire skills in handling situations involving more than one random variable and functions of random variables.
- Be introduced to the notion of sampling distributions and have acquired knowledge of statistical techniques useful in making rational decision in management problems.
- Be exposed to statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation.

UNIT I  RANDOM VARIABLES  9 + 3
Discrete and continuous random variables - Properties- Moments - Moment generating functions and their properties. Binomial, Poisson ,Geometric, Negative binomial, Uniform, Exponential, Gamma, and Weibull distributions.

UNIT II  TWO DIMENSIONAL RANDOM VARIABLES  9 + 3
Joint distributions - Marginal and conditional distributions – Covariance - Correlation and Regression – function of a random variable-Transformation of random variables - Central limit theorem.

UNIT III  TESTING OF HYPOTHESIS  9 + 3
Sampling distributions – Testing of hypothesis for mean, variance, proportions and differences using Normal, t, Chi-square and F distributions - Tests for independence of attributes and Goodness of fit.

UNIT IV  DESIGN OF EXPERIMENTS  9 + 3

UNIT V  RELIABILITY AND QUALITY CONTROL  9 + 3
Concepts of reliability-hazard functions-Reliability of series and parallel systems- control charts for measurements (x and R charts) – control charts for attributes (p, c and np charts)

Note : Use of approved statistical table is permitted in the examination.

TOTAL : 60 PERIODS

TEXT BOOKS

REFERENCES
AIM
To provide an awareness to Petroleum Refining and Petrochemicals

OBJECTIVES
- To enable the students to learn various topics related to distillation, estimation of vapour liquid equilibria, types of distillation equipments and design of distillation columns.
- Students are expected to have sound knowledge on manufacturing process of petrochemicals

UNIT I

UNIT II
Lube oil and wax processing, solvent extraction, dewaxing desilting, deasphalting, clay contacting, principles operating parameters, feed and product equalities and yields. Types and functions of secondary processing, cracking, thermal cracking and visbreaking, different feed stocks, products, yields and qualities.

UNIT III
Fluid catalytic feed stocks and product yields and qualities. Catalyst and operating parameters. Steam Reforming, Hydrogen, Synthesis gas, cracking of gaseous and liquid feed stocks, olefins, Diolofins, Acetylene and Aromatics and their separation.

UNIT IV
Alkylation, oxidation, dehydrogenation, nitration, chlorination, sulphonation and isomerisation.

UNIT V
Models and Techniquies, production of polyethylene, PVC, Polypropylene, SAN, ABS, SBR, Polyacrylonitrile, Polycarbonates, Polyurethanes, Nylon, PET

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
AIM
To impart knowledge on the fluid content of sub-surface rocks, salinity, permeability, fluid saturations, Darcy’s law, the permeability co-efficient. The measurement of permeability. The permeability of dirty sands. Electrical and acoustic properties of reservoir rocks. Composition and phase diagrams of natural gases and pseudocritical properties of hydrocarbons.

OBJECTIVES
At the end of the courses students will be in a position to have a knowledge on interpretation of fluid content data, fundamentals of the behaviour of hydro-carbon fluids and properties of water, brines and PVT properties of oil gas systems.

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE
AIM
To develop a sound knowledge on nature and properties of rocks and minerals, sedimentation and sedimentary environments, geological and geophysical methods in petroleum exploration and development.

OBJECTIVES
At the end of the course students will be in a position to have knowledge on nature and geological properties of petroleum, petroleum generation, migration, entrapment and degradation, sedimentology of petroleum bearing sequences, primary and secondary porosity, structural and stratigraphic traps, formation of water, oil shale and other non-conventional petroleum sources.
Note: One day field excursion is a compulsory part of the course.

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V
Non conventional petroleum resources and reserve estimation. – Plastic and solid hydrocarbons. Tar sands. Oil and gas shales. Coal bed methane. Assessment of reserves.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
AIM
To impart knowledge in the application of geophysics in 3D mapping of geological structures, interpretation of 2D and 3D seismic reflection data.

OBJECTIVES
Students will be able to understand mapping, structural interpretation, reservoir evaluation, inversion of seismic reflection data to determine petrophysical properties

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V
Reservoir evolution – Reservoir management. Process model. Effect of rock and fluid properties. Flow surveillance and porosity calculations. 4D seismic. Inversion of seismic reflection data applications. 4D reservoir characterization.

TOTAL : 45 PERIODS

TEXT BOOKS
AIM
To introduce the basic concept of Reservoir Engineering, estimation of hydrocarbon volume in place and recovery calculations.

OBJECTIVES
Students will be able to gain knowledge of Petroleum Reservoir, fundamentals of petrophysics, interrelation between petrophysical parameters capillary gravity equilibrium and initial fluid distribution.
At the end of the course students will also be in a position to have knowledge on relative permeability, capillary pressure, rock microstructure, multiphase flow, oil gas phase behaviour, material balance equations and calculations of water influx from material balance.

UNIT I
Introduction to Reservoir Engineering, Basic principles, definitions and data – Reservoir fluids, oil, gas, Gas formation volume factor, oil formation, volume factor, water formation volume factor – oil, gas, water, rock compressibility – Resistivity index, wettability and contact angle, effective permeability characteristics, capillary pressure curves – Resistivity factors and saturation exponents. Fluid PVT analysis and oil gas phase behaviour.

UNIT II

UNIT III

UNIT IV

UNIT V
Well inflow equations for stabilized flow conditions. Constant terminal rate solution of the radial diffusivity equation and its application to oil well testing.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
1. Dake, L.P. Practice of Reservoir Engineering Elsevier 2001
AIM
To introduce various methods of analysis by using sophisticated instruments and analytical equipments to determine various physical properties of crude, natural gas, petroleum products and petro-chemicals

OBJECTIVES
On completion of the course, the students should be conversant with the theoretical principles and experimental procedures for quantitative estimation.

List of Experiments:
1. Aromatic content Determination
2. Carbon residue determination
3. Karl-Fisher Conductometer Apparatus for water estimation
4. Foaming characteristics of lube oil
5. Mercaptan as sulphur estimation
6. Copper Corrosion test of petroleum oil
7. Freezing point of Aqueous Engine coolant solution
8. Automatic Vacuum Distillation
9. Characteristics of Hydrocarbon in Petroleum products
10. Coking tendency of oil
11. Testing of Petroleum products using Saybolt

List of Equipments
1. Conradson Apparatus 2
2. Karl–Fisher 2
3. Dr. Test Apparatus 2
4. Bomb Calorimeter 2
5. API Distillation Apparatus 2
6. Junkers Gas Calorimeter 2
7. Abbey Refractometer 2
8. Mercaptan as sulphur Estimation Apparatus 2

TOTAL: 45 PERIODS

AIM
To provide practical knowledge on various types of heat and mass transfer equipments.

OBJECTIVES
Students gain practical knowledge in various distillation columns, extraction columns and chemical reactors.
Students develop a sound knowledge on collection of data by experiments which can be used for the design of heat and mass transfer equipments
List of Experiments:
1. Determination of Bubble Point and Dew Point
2. Study of X-Y data in multicomponent system and determination of number of trays.
3. Extraction in Binary Systems
4. Extraction in Multicomponent systems
5. Steam distillation using Benzene - Toluene system
6. Study of Reaction Kinetics in CSTR
7. Study of Reaction Kinetics in Plug Flow reactors
8. Study of Reaction Kinetics in mixed reactors
9. Fluidized bed reactors
10. Study of Filtration characteristics

TOTAL : 45 PERIODS

List of Equipments
1. Packed Distillation Column 2
2. Bubble Cap Distillation Column 2
3. Tray Type Distillation Column 2
4. Spray Column 1
5. Rotary Disc Contractor 1
6. Steam Distillation 2
7. Vapour –Liquid Equilibrium 3
8. Filter Press 1
9. CSTR 1
10. Plug Flow Reactor 1
11. Mixed Reactors 1
12. Fluidized Bed Reactor 1

AIM
The Main aim is to understand the Well Drilling Equipments

OBJECTIVES
The objective of learning this subject is the students will understand the Drilling Process and Drilling Equipments.

UNIT I

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

TEXT BOOKS
2. D.P Helander ‘Fundamentals Of Formation Evaluation’

REFERENCE

PE2302 WELL LOGGING L T P C
3 0 0 3

AIM
The main aim of learning this subject is that student will be able to understand the well logging theory and practicing methods.

OBJECTIVES
The objective of this course is to have in-depth knowledge is GR logging, SP logging, NMR logging and will be able to interpret different cross plots.

UNIT I
Aims and objectives of well logging, Reservoir formations, Borehole conditions. Fundamental concepts in borehole geophysics physical properties of reservoir rocks, Formation parameters and their relationships: formation factor, porosity, permeability, resistivity, water and hydrocarbon saturations, and movable oil. Archie’s and Humbles equations.

UNIT II
Principles, instrumentation, operational procedures and applications of different geophysical logs: S.P., electrical, induction, nuclear, sonic, caliper, temperature, dip and direction. Natural gamma ray spectrometry log, nuclear magnetic log, litho density log, neutron activation technique, thermal neutron decay time log, chlorine and oxygen logs.
UNIT III
Recording, transmission and processing of log data, Formation evaluation for hydrocarbons, Qualitative and quantitative interpretations of well log data, Overlays and cross-plots, Determination of reservoir parameters – porosity, resistivity, permeability, water and hydrocarbon saturation, movable oil. Lithology determination by neutron, density and sonic cross-plots, dual mineral method, triporosity method, litho porosity cross-plot (M-N plot), clean sand and shaly sand interpretations.

UNIT IV

UNIT V
Theoretical computations of normal and lateral log responses, Identification and delineation of sub-surface formations from well log data, Calculation of reservoir parameters: formation factor, porosity, permeability, resistivity, water and hydrocarbon saturations, and movable oil. Sub-surface correlation of formations and interpretation of field data.

TOTAL : 45 PERIODS

TEXT BOOKS
2. D.P Helander ‘Fundamentals Of Formation Evaluation’

REFERENCE

PE2303 DRILLING FLUIDS AND CEMENTING TECHNIQUES

AIM
The main aim is to understand the fundamentals of drilling fluids and cementing technology.

OBJECTIVES
The objective is that students will be able to understand the different types of drilling fluids used in the drilling process and different stages of cementing techniques.

UNIT I
Introduction to the basic functions and properties of drilling fluids and cement slurries, Compositions and related properties of drilling fluids and cement slurries.
UNIT II

UNIT III
Types of equipment and methods used in cementing operations, Drilling fluid and cement slurry hydraulics.

UNIT IV
Determination of torque and drag, Calculation of cutting transport efficiency, Placement technique of cements. Gas migration through cement columns.

UNIT V

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

PE2304 FIELD DEVELOPMENT GEOLOGY

AIM
The main aim is to understand the fundamental filed Geology for interpretation.

OBJECTIVES
The objective is that students will be able to understand the different types filed recognition geological structure and tools and use the same for the various applications.

UNIT I
Structural Elements: Dip and Strata – True dip, Apparent dip, Strike, Measurement of dip and strikes, important for Dip and Strike, Out crops, Outcrops pattern, topography and Geological Structures, Brunton compass, Clinometer, Global Positioning systems.

UNIT II
UNIT III

UNIT IV
Introduction to micro fossils – types of fossils – Importance of Micro fossils – Applications of Micro fossils in Hydrocarbon explorations.

UNIT V

TOTAL: 45 PERIODS

TEXT BOOKS

PE2305 RESERVOIR ENGINEERING - II L T P C
3 0 0 3

AIM
The aim of this learning this subject is that student will able to follow and understand. The reservoir concepts such as reservoir simulation, rock characteristics and reservoir management.

OBJECTIVES
The main of objective is that after learning student will able to interpret cross plots, well characteristics, simulation and gas condensate reservoirs.

UNIT I

UNIT II

UNIT III
Well testing – Basic well testing theory – oil well testing: gas well testing – Practical well testing – Gas field reservoir engineering – Fluid phase behavior – Gas in place volumes and recovery estimations. Reservoir testing and performance analysis: well test – drillstem tests (DST); production tests, pressure tests on gas wells; formation interval testing and other well testing techniques. Coning of water and gas; effects of partial penetration.

UNIT IV
Material balance techniques: Production forecasting – Gas condensate reservoir engineering Fluid phase behavior development – options.
UNIT V

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE

PE2306 WATER FLOODING AND ENHANCED OIL RECOVERY

AIM
The main of the learning the subject is that student will be able to understand. The basic of oil recovery methods in oil & gas Industry.

OBJECTIVES
Students will be able to get the clear idea, better understanding and can get introduced with Different types of recovery methods which are employed in the oil and gas Engineering.

UNIT I

UNIT II
Chemical oil recovery methods – Polymer, surfactant/polymer and alkaline flooding – Carbon dioxide (CO₂) flooding.

UNIT III

UNIT IV

UNIT V
Laboratory design for EOR – Preliminary test – Water analysis – Oil analysis – Core testing – Viscosity testing.

TOTAL: 45 PERIODS
TEXT BOOKS
   Well publishing co., Tulsa (1980).

REFERENCE
   C.Lyons & Gary J.Plisga -Gulf professional publishing comp (Elsevier).

GE2321 COMMUNICATION SKILLS LABORATORY
(Fifth / Sixth Semester) L T P C 0 0 4 2

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

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

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

A. ENGLISH LANGUAGE LAB (18 Periods)

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

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

3. SPEAKING: (6)
   Phonetics: Intonation – Ear training - Correct Pronunciation – Sound recognition exercises –
   Common Errors in English.
   Conversations: Face to Face Conversation – Telephone conversation – Role play activities
   (Students take on roles and engage in conversation)
B. DISCUSSION OF AUDIO-VISUAL MATERIALS (6 PERIODS)

(Samples are available to learn and practice)

1. RESUME / REPORT PREPARATION / LETTER WRITING (1)
   Structuring the resume / report - Letter writing / Email Communication - Samples.

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

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

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

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

II. Practice Session (Weightage – 60%) 24 periods

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

REFERENCES

LAB REQUIREMENT
1. Teacher console and systems for students.
2. English Language Lab Software
3. Career Lab Software
Guidelines for the course

GE2321  COMMUNICATION SKILLS LABORATORY

A batch of 60 / 120 students is divided into two groups – one group for the PC- based session and the other group for the Class room session.

The English Lab (2 Periods) will be handled by a faculty member of the English Department. The Career Lab (2 Periods) may be handled by any competent teacher, not necessarily from English Department.

Record Notebook: At the end of each session of English Lab, review exercises are given for the students to answer and the computer evaluated sheets are to be compiled as record notebook. Similar exercises for the career lab are to be compiled in the record notebook.

Internal Assessment: The 15 marks (the other 5 marks for attendance) allotted for the internal assessment will be based on the record notebook compiled by the candidate. 10 marks may be allotted for English Lab component and 5 marks for the Career Lab component.

End semester Examination: The end-semester examination carries 40% weightage for English Lab and 60% weightage for Career Lab.

Each candidate will have separate sets of questions assigned by the teacher using the teacher-console enabling PC–based evaluation for the 40% of marks allotted.

The Career Lab component will be evaluated for a maximum of 60% by a local examiner & an external examiner drafted from other Institutions, similar to any other lab examination conducted by Anna University.

Requirement for a batch of 60 students

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<tr>
<th>Sl.No.</th>
<th>Description of Equipment</th>
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<td>o OS: Win 2000 server</td>
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<td>o 256 or 512 MB RAM / 40 GB HDD</td>
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<td>Handicam Video Camera (with video lights and mic input)</td>
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<td>6.</td>
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<td>7.</td>
<td>Audio Mixer</td>
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<td>8.</td>
<td>DVD Recorder / Player</td>
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**AIM**

The main aim of this laboratory is to understand the drilling fluid equipment, Principles and operation and oil well cement properties.

**OBJECTIVES**

The objectives of this laboratory are to demonstrate the processes involved in drilling and cementing operations, introduce laboratory techniques which are used to select and optimize drilling fluids and cement slurry and to develop interest in experimentation.

1. Drilling Fluid properties measurements using: Mud balance – Determination on density or weight of a drilling mud.
2. Determination of thickening time of cement slurries using Fann consistometer.
3. Determination and measurement of fluid loss and mud cake properties of a drilling fluid using a low pressure – Low temperature and High temperature filter and Filter press.
4. Picnometer and F.G.T. meter
5. pH and resistivity emulsion.
6. Test cell meters.
7. Oil well cement properties; measurement of the compressive strength or tensile strength of the cement at pressure up to 21000 Kpa and maximum temperature of 260°C.
8. Measurement and control of the basic properties of drilling fluids (density, viscosity, filtration, lubricity and electrochemical properties) and cement slurries (density, viscosity, filtration, thickening time and mechanical properties).

**LIST OF EQUIPMENT**

1. Mud balance
2. Picnometer and F.G.T meter
3. Filter press, low pressure – Low temperature and high temperature filters
4. pH meter
5. Test cell meters
6. Fann consistometers
7. Compact Curing chamber
8. Thickening time tester

**TOTAL: 45 PERIODS**
AIM
The main aim of this laboratory is to understand the preparation of Geological maps and identify the rock specimens by Megascopic and Microscopic, Identify the Depositional environment and Sediment types.

OBJECTIVE
The objectives of this laboratory are to demonstrate the various methods involved in the preparation of structural maps and interpretation and calculation the thickness of the beds, studying depositional environment using grain size analysis and find out sediment types using Sand – Silt – Clay ratio.
1) Calculation of True and Apparent Dip.
2) Estimation of Thickness, Distance and Depth of the ore body.
3) Estimation of Throw and Nature of the fault.
4) Interpretation of surface Geology using contour maps.
5) Sand – Silt – Clay ratio estimation.
6) Grain – Size analysis.
7) Identification of important sedimentary rocks in hand specimen.
8) Identification of important sedimentary rocks in microscopic level

EQUIPMENT
1) Sieve Shakers
2) Sieves set.
3) Petrological Microscopes
4) Hot even
5) 1000 ml and 50 ml beakers

TOTAL: 45 PERIODS

AIM
The main of learning this subject is that student will be able understand the Basic reservoir characterization, modeling and simulation methods used in oil industry.

OBJECTIVE
The objective of this subject is that student will be able to follow and utilize the different concepts of reservoir modeling and characteristics and their usage.

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

UNIT II
UNIT III 9

UNIT IV 9
Reservoir simulation – Investigation of petroleum reservoir characteristics and behavior, including: pore volume, fluid distribution and movement, and recovery. The result of simulation studies include optimized field development and management plans which maximize the value and/or reserves of producing properties. Finite difference approximations to the diffusivity equation and the application of those approximations for reservoir simulations. Practical use of reservoir simulation.

UNIT V 9

TEXT BOOKS
1. Petroleum Exploration Hand Book by Moody, G.B.
2. Wellsite Geological Techniques for petroleum Exploration by Shay’s et al.

REFERENCE

PE2352 PETROLEUM PRODUCTION ENGINEERING

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AIM
The main of learning this subject is that student will be able to understand the basics of oil and gas production engineering techniques.

OBJECTIVE
The objective of studying this subject is that student will be able practice both theory and practical of different production operations in the oil and gas wells such as artificial lifts and subsurface equipments.

UNIT I 9

UNIT II 9
UNIT III
Surface equipment and operations. Flow control and well heads. Gathering systems; service and cleaning systems; design and testing of flow lines. Separation and separators; separator components, stage separation; design and construction of separators. Meeting - Oil and gas metering techniques.

UNIT IV

UNIT V
Well completion techniques and equipment, drill stem test (DST) flowing well performance, vertical lift performance, optimum size tubing and chokes, production forecast for a pool. Design and analysis of artificial methods of petroleum production. Work over and sand exclusion technique.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE

PE2353 WELL COMPLETION TESTING AND WORK OVER

AIM
The main of learning this subject is that student will be able to understand the basics of Well Completion techniques.

OBJECTIVE
The objective of studying this subject is that student will be able to complete the Well Operation during the hydrocarbon Explorations.

UNIT I

UNIT II
Design of drill string including bottom hole (BHA) assembly. 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 downhole equipment, tubing accessories and wellhead equipment.

UNIT V

TEXT BOOKS
1. Wellsite Geological Techniques for Petroleum exploration by Sahay B. et al
2. Petroleum Exploration Hand Book by Moody, G.B.

REFERENCE

GE 2021 ENVIRONMENTAL SCIENCE AND ENGINEERING
L T P C 3 0 0 3

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

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

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

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

UNIT III NATURAL RESOURCES 10
Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.
Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

TEXT BOOKS:

TOTAL: 45 PERIODS
REFERENCES BOOKS:

PE2355 PETROLEUM ECONOMICS L T P C
3 0 0 3

AIM
To introduce the students concept and fundamentals of engineering economics of energy industry.

OBJECTIVES
To make the students understand the basic quantitative theories and methodologist in oil sector.

UNIT I
Supplies 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

TEXT BOOKS

REFERENCES

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PE2356 NATURAL GAS ENGINEERING L T P C
3 0 0 3

AIM
The main of learning this subject is that student will be able to understand the basics of Natural Gas engineering techniques.

OBJECTIVE
The objective of studying this subject is that student will be understanding the basic concept and applications of Natural Gas Engineering.

UNIT I

UNIT II
Properties of Natural Gases: typical compositions. Equations of state: general cubic equations, specific high accuracy equations. Use of equation of state to find residual energy properties, gas measurement gas hydrates, condensate stabilization, acid gas treating, gas dehydrations, compressors, process control deliverability test, gathering and transmission, and natural gas liquefaction.

UNIT III

UNIT IV
UNIT V


TOTAL : 45 PERIODS

TEXT BOOK

REFERENCE

PE 2357   PETROLEUM TRANSPORTATION DESIGN   L T P C
           0 0 3 3

1. Introduction to sketching lettering and lines.
2. Drafting Equipment and Media.
5. CADD Design of any one tool used in Petroleum.
7. Design of Piping.
10. Design of De-gasifier.
12. Demonstration of Rotary equipment.
13. Demonstration of Mud pumps.

TOTAL : 45 PERIODS

PE2358    PROCESS CONTROL AND INSTRUMENTATION LABORATORY   L T P C
          0 0 3 3

PROCESS CONTROL LAB:
  o Operation of interacting and non-interacting systems.
  o Closed loop response of Flow control loop.
  o Closed loop response of Level control loop.
  o Closed loop response of Temperature control loop.
  o Closed loop response of Pressure control loop.
  o Study of complex control system (ratio/cascade/ feed forward)
INSTRUMENTATION LAB:

b. Viscosity measurement.
c. pH meter standardization and measurement of pH values of solution.
d. Calibration of pressure gauge.
e. Conductivity meter calibration and measurement of conductivity test solution.
f. IR spectrophotometer.

TOTAL : 45 PERIODS

EQUIPMENT REQUIRED.

i. Rota meter.
ii. Say bolt viscometer.
iii. Redwood viscometer.
iv. Engler viscometer.
v. U tube viscometer.
vi. ph meter.
vii. Dead weight tester.
viii. Pressure Gange.
ix. Conductivity meter.
x. IR spectro photometer.

TOTAL : 45 PERIODS
TEXT BOOKS

REFERENCE
1. Petroleum Exploration Hand Book by Moody, G.B.

PE2402 INTEGRATED OIL / GAS FIELD EVALUATION

AIM
To impart knowledge in the different analysis of oil/gas field evaluation in order to maximize the production and improvement of facilities.

OBJECTIVE
Students will be able to understand the different evaluation methods of oil/gas fields and reserves.

UNIT I

UNIT II
Petroleum project evaluation-mineral project evaluation case studies. The design and evaluation of well drilling systems-Economic appraisal methods for oil field developmental project evaluation including risk analysis, probability and statistics in decision-making and evaluations. case studies.

UNIT III
An integrated reservoir description in petroleum engineering-usage of geophysical, geological, petrophysical and engineering data-emphasis on reservoir and well data analysis and interpretation, reservoir modeling (simulation), reservoir management (production optimization of oil and gas fields) and economic analysis (property evaluation)

UNIT IV
An integrated reservoir development in petroleum engineering-reservoir and well evaluation-production optimization-nodal analysis, stimulation, artificial lift facilities-surveillance.

UNIT V

TOTAL: 45 PERIODS

TEXT BOOKS
AIM
To understand the concept of designing Equipments for Petroleum Exploration

OBJECTIVE
To study and analyse the suitable equipment for particular reservoir conditions.

UNIT I
Casing program, casing and tubing design, principles of cementing, completion added skin, well perforating, hydraulic fracturing. DRILL BIT DESIGN, ROLLER CONE BITS, PDC DRILL BITS. NOMENCLATURE AND IADC CODES for drill bits. BHA (Bottom hole assembly). ESP (Electrical submersible pumps). SRP (Sucker rod pumping) unit design.

UNIT II
Design of Surface Facilities - Design of production and processing equipment, including deparation problems, treating, and transmission systems.

UNIT III
Capstone design Student teams apply knowledge in the areas of geology, reservoir engineering, production, drilling and well completions to practical design problems based on real field data with all of the associated shortcomings and uncertainties. Use of commercial software.

UNIT IV

UNIT V
Refinery Equipment Design - atmospheric distillation column Design and construction of on/offshore pipelines, Fields Problems in pipeline, Hydrates, scaling & wax etc and their mitigation.

TOTAL : 45 PERIODS

TEXT BOOKS
1. Petroleum Exploration Hand Book by Moody, G.B.
2. Wellsite Geological Techniques for petroleum Exploration by Sahay.B et al

REFERENCE
AIM
The main of learning this subject is that student will be able to understand the basics of Mathematics in Reservoir applications.

OBJECTIVE
The objective of studying this subject is that student will be understanding the basic concept and applications of Numerical Methods in Reservoirs.

UNIT I
Introduction, fracturing, Stress Distribution, Vertical Versus Horizontal Fractures, Pressure Related to Fracturing, Closure Pressure, Fracturing Pressure –Decline analysis, Pressure Interpretation After Closure, Properties of Fracturing Fluids.

UNIT II

UNIT III
Acid Fracturing, Acid Systems and Placement Techniques, Fracturing of Deviated and Horizontal Wells, Matrix Stimulations, Matrix Acidizing Design, Rate and Pressure Limits for Matrix Treatment, Fluid Volume Requirements,

UNIT IV
Design and implementation of a multiphase flow reservoir simulator, including interphase mass transfer and variable fluid saturation pressure. Design of compositional reservoir simulators using generalized equation of state. Recent advances in reservoir simulation.

UNIT V

TOTAL : 45 PERIODS

TEXTBOOK

REFERENCE
1. Petroleum Exploration Hand Book by Moody, G.B.
PE2407  OIL FIELD EQUIPMENT DESIGN DRAWING  

AIM
Design of the following equipments as per IADC, API, ISME, TEMA, ISI codes and drawing according to scale

OBJECTIVE
Students able to draw
1. Drawing and design of Offshore platform TLP (TENSION LEG PLATFORM) - Fixed platform design,
2. Drawing and design of offshore Jack ups
3. Drawing and design of well equipments
4. Drawing and design of ROV (remotely operated vehicle)
5. Drawing and design of natural gas storage tank (Horton sphere)
6. Drawing and Designing of Mud tank
7. Drawing and design of on/offshore pipeline.
8. Drawing and design of rotary system in drilling

TOTAL : 45 PERIODS

PE2408  PETROLEUM EQUIPMENT DESIGN LABORATORY  

Design of the following equipments as per IADC, API, ISME, TEMA, ISI codes and drawing according to scale:
1. STORAGE VESSELS-VOLATILE AND NON-VOLATILE LIQUIDS CRUDE OIL STORAGE TANKS
2. HEAT EXCHANGERS
3. Drawing and design of double pipe, single pass and multi pass heat exchangers shell and tube heat exchangers.
4. DRILL BITS
5. Drawing and design of drill bits-conical PDC (Poly-diamond-crystalline) bits and its components.
6. BOP
7. Drawing and design of Blow out presenter (BOP).
8. BHA
9. Drawing and design of Bottom-hole-assembly. (BHA) components and assemblies
10. ARTIFICIAL LIFT
11. Drawing and design of sucker rod pumping (SRP) unit.
12. WELL BORE DIAGRAM
13. Drawing and design of well bore
14. OIL RIG
15. Drawing and design of land and marine and work-over rig.
16. OFFSHORE PLATFORM
17. Drawing and design of typical Offshore platform
18. PRIME MOVERS
   Drawing and design of oil pumps compressors and turbines.

TOTAL : 45 PERIODS
UNIT I  ENGINEERING ETHICS

UNIT II  ENGINEERING AS SOCIAL EXPERIMENTATION
Engineers as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study

UNIT III  ENGINEER’S RESPONSIBILITY FOR SAFETY

UNIT IV  RESPONSIBILITIES AND RIGHTS

UNIT V  GLOBAL ISSUES

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
UNIT I  INTRODUCTION

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

UNIT III  TQM TOOLS & TECHNIQUES I

UNIT IV  TQM TOOLS & TECHNIQUES II

UNIT V  QUALITY SYSTEMS

TOTAL: 45 PERIODS

TEXT BOOK

REFERENCES
OBJECTIVE

- To understand the various processes involved in Marketing and its Philosophy.
- To learn the Psychology of consumers.
- To formulate strategies for advertising, pricing and selling

UNIT I MARKETING PROCESS
Definition, Marketing process, dynamics, needs, wants and demands, marketing concepts, environment, mix, types. Philosophies, selling versus marketing, organizations, industrial versus consumer marketing, consumer goods, industrial goods, product hierarchy

UNIT II BUYING BEHAVIOUR AND MARKET SEGMENTATION
Cultural, demographic factors, motives, types, buying decisions, segmentation factors demographic -Psycho graphic and geographic segmentation, process, patterns.

UNIT III PRODUCT PRICING AND MARKETING RESEARCH
Objectives, pricing, decisions and pricing methods, pricing management. Introduction, uses, process of marketing research.

UNIT IV MARKETING PLANNING AND STRATEGY FORMULATION
Components of marketing plan-strategy formulations and the marketing process, implementations, portfolio analysis, BCG, GEC grids.

UNIT V ADVERTISING, SALES PROMOTION AND DISTRIBUTION
Characteristics, impact, goals, types, and sales promotions- point of purchase- unique selling proposition. Characteristics, wholesaling, retailing, channel design, logistics, and modern trends in retailing.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
UNIT I
Heating of crude oil through exchangers, pipe still heaters, their type and constructional features. Estimation of heat duty, combustion calculation and heat transfer area in different parts in pipe still heater. Calculation of pressure drop and stack height.

UNIT II

UNIT III
Vacuum distillation Column internals and operational aspects for lubes and asphalt’s Cracking feed stocks.

UNIT IV
Pressure distillation and gas fractionating units. Difference between various types of distillation Regaining of products of pressure distillations.

UNIT V
Lubrication oils, Specifications, characteristics, Production lube specialties, additives, Refining of lubrication oil-solvent chemical and hydrogenation method dew axing, deasphalting etc. Asphalt and asphalt specialties. Air blowing and emulsification techniques.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

UNIT I
MODES OF CRUDE OIL, PRODUCT AND GAS TRANSPORTATION AND PIPELINE TRANSPORTATION

UNIT II
LIQUID TRANSPORT & GAS TRANSPORTATION
UNIT III  BRANCHING AND LOOPING IN PIPELINES AND MULTIPHASE FLOW  9

UNIT IV  PIPELINE PRACTICE AND EQUIPMENT AND SURFACE PROTECTION  9

UNIT V  AUXILIARY EQUIPMENT/ FACILITIES AND PUMPS & COMPRESSOR STATION  9

TOTAL : 45 PERIODS

TEXT BOOKS
2. Introduction to the Oil Pipeline Industry (Oil Pipeline Transportation Practices), he University of Texas at Austin - Petroleum Extension Service; 3rd edition 1984.

PE2025  MAJOR HAZARDS MANAGEMENT  L T P C
3 0 0 3

UNIT I  Geology and its perspectives. Formation of core, mantle, crust, hydrosphere, atmosphere and biosphere - Elementary ideas of continental drift and plate tectonics - Evolution of ocean and continental basins.

UNIT II  Ecology, ecosystem and biotic communities, human impact on air, land, soil, water, climate and forest resources - conservation of resources, coping with natural hazards.

UNIT III  Natural Environmental Hazards: Various domains and classes of natural hazards- tropical cyclones, floods, landslides and earthquakes - Prediction control and awareness of earthquakes- volcanic types, distribution and causes - coastal erosion.

UNIT IV  Introduction to Environmental Hazards Management - Global Climate Change: Causes, trends, consequences, and management challenges- Mitigation measures of volcanoes, prevention and controls of landslides.
UNIT V
Environmental degradation and pollution - Air pollution - Water pollution and Soil pollution. Cyclones- types and effects - Droughts- types and factors contribution for drought - Floods-causes and forecast.

TEXT BOOKS

REFERENCE

PE2026 PETROLEUM CORROSION TECHNOLOGY

AIM
The main of learning corrosion technology is that student will be able to be introduced and understand the basic corrosion problems in oil and gas industry.

OBJECTIVE
• The objective is that student can be able to analyse the current corrosion problems and control methods in the petroleum industry.

UNIT I

UNIT II
Forms of corrosion-uniform-pitting-Galvanic erosion-Intergranualar and weld corrosion, selective Leaching, stress corrosion. Hydrogen embitterment-Fatigue. Role of oxygen in oil filed corrosion-downhole and surface equipment-water flood Removal of oxygen, analysis and criteria for control.

UNIT III
Role of carbon dioxide (CO₂) in corrosion-Effect of temperature and pressure Corrosion of well tubing and other equipments. Role of hydrogen sulphide (H₂S)-Corrosion in downhole, surface, storage and pipelines.

UNIT IV
UNIT V
Oil treatment corrosion-crude oil properties-desalting-distillation and other processing case histories, sweetening processes-subsea systems corrosion. Inspection and corrosion monitoring case history-oil storage tank corrosion-Oilfield and oil treating facilities-offshore platforms-down hole equipments.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE

PE2030 ADVANCED TOPICS IN GEOPHYSICS

UNIT I
Physical Basis of Geophysical exploration – Various surface and sub surface methods and their classifications – Physical Properties of rocks and minerals exploited in exploration and factors that control them Geophysical anomalies

UNIT II

UNIT III

UNIT IV
Seismic methods, fundamentals of elasticity – bulk modulus – Poisson’s ratio – Elastic Seismic wave theory – Body and surface waves – Primary and Secondary waves – Seismic Instruments - Seismic channels – Applications of Seismic data – Interpretation of field data

UNIT V
Introduction to Well logging techniques – Well conditions – SP and Resistibility logging – Qualitative interpretation of SP and resistibility logs – applications.

TOTAL: 45 PERIODS

TEXT BOOKS
1. Introduction to Geophysics by Dobrin.

REFERENCE
1. Principles of applied Geophysics by D.S. Paranis

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UNIT I

UNIT II
Hoisting Systems - Design – Rating and Testing – Inspections – Supplementary and Requirements – Manufacture and Tolerances

UNIT III
Rotary Equipments - Swivel and Rotary Hose – Rotary Table and Bushing - Bits and Down hole tools.

UNIT IV
Mud Pumps – Pump installations – Pump operations – Drilling Muds and Completion fluids – Suspended solids and Transport Cuttings – Nonaqueous fluids – Oil base and synthetic – Base muds – Drilling fluids activities – Clay chemistry

UNIT V

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCE

UNIT I

UNIT II
Design of drill string including bottom hole (BHA) assembly. 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 Stimulation: Well completion design, types of completion, completion selection and design criteria. Interval selection and productivity Considerations: effects of producing mechanisms. Inflows performance and multiple tubing performance analyses using commercial software.
UNIT IV
Well stimulation and work over planning. Tubing-packer movement and forces. Tubing design: graphical tubing design and simplified tensional strength design. Selection of downhole equipment, tubing accessories and wellhead equipment.

UNIT V

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCE
1. Petroleum Exploration Hand Book by Moody, G.B.

PE2034 RISK ASSESSMENT AND SAFETY ENGINEERING L T P C 3 0 0 3

UNIT I

UNIT II

UNIT III

UNIT IV
UNIT V

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

PE 2035 STORAGE AND TRANSPORTATION OF CRUDE OIL AND NATURAL GAS

UNIT I INTRODUCTION
Crude oil Trade, Selection of Port Location, Ship Building/Shipyards.

UNIT II NATURAL GAS REGASIFICATION TECHNOLOGY
Commercial Sourcing of Natural Gas, Different Kinds of Regasification Techniques, Regasification Process & Cold Utilization, Synchronization of Degasified gas and Pipelines, Current Status in India

UNIT III CRUDE OIL TRANSPORTATION
Transportation techniques of crude oil, Pipeline specification, Corrosion Prevention techniques, Pressure drop, Pumps and Booster station, Wax deposition and prevention, Chemical treatment

UNIT IV DESIGN
Basic Engineering Aspects of Terminal Design, Design of Liquefaction Train, Ship Building/Shipyards, Storage Facilities

UNIT V CHARTERTICS OF STORAGE

TOTAL : 45 PERIODS

TEXT BOOKS

PE2036 COMPUTER AIDED PROCESS PLANT DESIGN

UNIT I

UNIT II
Basic Model Development For Preliminary Systems: Methods of calculating vapor liquid equilibrium data for ideal and non-ideal mixtures - Bubble point and Dew point - Flash and distillation calculations - Equipment design - Development of software programmes for the following systems - Piping system, single phase & two phase.

UNIT III
Cad Model For Fluid Moving Machinery & Storage Design: Separator system - Two phase and three phase - Storage system - Atmospheric, pressurized & cryogenic.

UNIT IV

UNIT V

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
UNIT I

UNIT II
Life processes, unit of living system, microbiology, reaction in living systems, biocatalysts, model reactions. Fermentation mechanisms and kinetics: Kinetic models of microbial growth and product formation. Fermenter types.

UNIT III
Modeling of batch and continuous fermentor. Bioreactor design, mixing phenomena in bioreactors. Sterilization of media and air, sterilization equipment, batch and continuous sterilize design.

UNIT IV
Biochemical product recovery and separation. Membrane separation process: reserve osmosis, dialysis, ultra filtration; Chromatographic methods: adsorption chromatography, gel filtration affinity chromatography etc.

UNIT V

TOTAL: 45 PERIODS

TEXT BOOKS
UNIT IV  
Reaction kinetics, accounting porous nature of catalyst: Heterogeneous catalytic reactions - effectiveness factor, internal and external transport processes, non-isothermal reacting systems, uniqueness and multiplicity of steady states, stability analysis.

UNIT V  
Modeling of chemical reactors: Modeling of multiphase reactors - Fixed, fluidized, trickle bed, and slurry reactors.

TOTAL : 45 PERIODS

TEXT BOOKS  

REFERENCES  

PE2039  
PRINCIPLES OF GEOCHEMISTRY  
L T P C  
3 0 0 3  

UNIT I  

UNIT II  

UNIT III  

UNIT IV  
Anomalies in Natural waters : Mode of occurrence of elements – persistence of anomaly – contrast at source – Decay by dilution – Decay on precipitation – ground water, seawater and lake water anomalies
UNIT V

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
1. Hoefs, J., 1980, Stable Isotope Geochemistry., Springer Verlag