COURSE STRUCTURE AND SYLLABUS
for

B.TECH. PETROLEUM ENGINEERING
R19 – Regulation

(Applicable for batches admitted from 2019-2020)

DEPARTMENT OF PETROLEUM ENGINEERING
&
PETROCHEMICAL ENGINEERING,
UNIVERSITY COLLEGE OF ENGINEERING KAKINADA (A),
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA - 533 003, ANDHRA PRADESH, INDIA

I YEAR I SEMESTER							
S. No.	**Course Cod**	**Course Title**	**POs**	**L**	**T**	**P**	**C**
1	BS	Mathematics – I		3	0	0	3
2	BS	Engineering Physics		3	0	0	3
3	PCC	Introduction to Petroleum Engineering		3	0	0	3
4	ES	Programming for Problem Solving		3	0	0	3
5	ES	Engineering Drawing		1	0	3	2.5
6	BS	Engineering Physics Lab		0	0	3	1.5
7	ES	Programming for Problem Solving Lab		0	0	3	1.5
8	HSSMS	English Communication Skills Lab– I		0	0	2	1
9	BS	Physics Virtual Lab		0	0	2	0
10	P	Engineering Exploration Project		0	0	2	1
11	*MC	Constitution of India		3	0	0	0
		Total		16	0	15	**19.5**

I YEAR II SEMESTER							
S. No.	**Course Code**	**Course Title**	**POs**	**L**	**T**	**P**	**C**
1	HSSMS	Communicative English		3	0	0	3
2	BS	Mathematics – II		3	0	0	3
3	BS	Mathematics – III		3	0	0	3
4	BS	Engineering Chemistry		3	0	0	3
5	ES	Engineering Mechanics		3	0	0	3
6	ES	Engineering Workshop & IT Workshop		0	0	3	1.5
7	BS	Engineering Chemistry Lab		0	0	3	1.5
8	HSSMS	English Communication Skills Lab– II		0	0	3	1.5
9	*MC	Environmental Science		3	0	0	0
10	*MC	Physical Fitness Activities		0	0	2	0
11	MOOCS (NPTEL/SWAYAM) for Honors/Minor						
		Total		18	0	11	**19.5**

II YEAR I SEMESTER							
S. No.	Course Code	Course Title	POs	L*	T	P	Credits
1	BS	Mathematics- IV		3	0	0	3
2	HSSMS	Managerial Economics & Financial Accounting		3	0	0	3
3	ES	Basic Electrical & Electronics Engineering		3	0	0	3
4	PCC	Petroleum Geology		3	0	0	3
5	PCC	Chemical Process Principles		3	0	0	3
6	PCC	Momentum Transfer		3	0	0	3
7	PCC	Petroleum Geology Lab		0	0	3	1.5
8	ES	Basic Engineering (Mech. + Elec.) Lab		0	0	3	1.5
9	PCC	Momentum Transfer Lab		0	0	3	1.5
10	*MC	Essence of Indian Traditional Knowledge		3	0	0	0
11	*MC	Physical Fitness Activities		0	0	2	0
12	MOOCS (NPTEL/SWAYAM) for Honors/Minor Degree						
			Total Credits		0		**22.5**

II YEAR II SEMESTER							
S. No.	Course Code	Course Title	POs	L*	T	P	Credits
1	ES	Elements of Mechanical Engineering		3	0	0	2
2	PCC	Process Heat Transfer		3	0	0	3
3	ES	Materials Science & Engineering		3	0	0	3
4	PCC	Petroleum Exploration		3	0	0	3
5	PCC	Thermodynamics for Petroleum Engineers		3	0	0	3
6	PCC	Instrumentation, Process Dynamics & Control		3	0	0	2
7	PCC	Process Heat Transfer Lab		0	0	3	1.5
8	PCC	Instrumentation, Process Dynamics & Control Lab		0	0	3	1.5
9	HSSMS	Socially Relevant Projects		0	0	1	0.5
10	*MC	Physical Fitness Activities		0	0	2	0
12	MOOCS (NPTEL/SWAYAM) for Honors/Minor Degree						
			Total Credits				**19.5**

III YEAR I SEMESTER							
S. No.	Course Code	Course Title	POs	L*	T	P	Credits
1	PCC	Well Logging & Formation Evaluation		3	0	0	3
2	PCC	Drilling & Well Completions		3	0	0	3
3	PCC	Petroleum Reservoir Engineering – I		3	0	0	3
4	PCC	Petroleum Production Engineering		3	0	0	3
5	PEC	PROFESSIONAL ELECTIVE – I i. CBM Reservoir Engineering ii. Equation of State and PVT Analysis		3	0	0	3
6	PCC	Mathematical methods for petroleum engineers - Laboratory		0	0	3	1.5
7	PCC	Drilling Fluids - Laboratory		0	0	3	1.5
8	PCC	Drilling Simulation - Laboratory		0	0	3	1.5
9	PCC	Socially Relevant Project for Petroleum Engineers		0	0	1	0.5
10	*MC	Physical Fitness Activities		0	0	2	0
11	PT	Industrial Visits (Local & Outside)					
12	MOOCS (NPTEL/SWAYAM) for Honors/Minor Degree						
Total Credits							**20**

III YEAR II SEMESTER							
S. No.	Course Code	Course Title	POs	L*	T	P	Credits
1	PCC	Petroleum Refinery & Petrochemical Engineering		3	0	0	3
2	PCC	Petroleum Reservoir Engineering-II		3	0	0	3
3	OEC	OPEN ELECTIVE–I(for other Branches) i. Petroleum Exploration and Engineering ii. Fundamentals of Offshore Operations iii. Fundamentals of Oil and Gas Production.		3	0	0	3
4	PEC	PROFESSIONAL ELECTIVE – II i. Petroleum Asset Management ii. Acidizing Concepts and Design		3	0	0	3
5	PEC	PROFESSIONAL ELECTIVE – III i. Production Optimization using Nodal Analysis ii. Fundamental of Liquefied Natural Gas		3	0	0	3
6	HSS	Universal human values 2: understanding harmony		3	0	0	3
7	PCC	Petroleum Reservoir Engineering - Laboratory		0	0	3	1.5
8	PCC	Petroleum Analysis - Laboratory		0	0	3	1.5
9	*MC	IPR & Patenting		3	0	0	0
10	*MC	Employability Skills – I Python Programming		0	0	2	0
11	PT	Summer Internship (4 or 6 Weeks)					
12	MOOCS (NPTEL/SWAYAM) for Honors/Minor Degree						
		Total Credits					**21**

IV YEAR I SEMESTER							
S. No.	Course Code	Course Title	POs	L*	T	P	Credits
1	PCC	HSE in Petroleum Industry		3	0	0	3
2	PCC	Design and Operation of Surface Facilities		3	0	0	3
3	PEC	PROFESSIONAL ELECTIVE – IV i. Enhanced Oil Recovery Techniques ii. Advanced Well Completion Engineering		3	0	0	3
4	PEE	PROFESSIONAL ELECTIVE – V i. Subsea Engineering ii. Petroleum Economics, Policies and Regulations		3	0	0	3
5	OEC	OPEN ELECTIVE – II (for other branches) i. Corrosion Control in Petroleum Industry ii. Unconventional Hydrocarbon Resources		3	0	0	3
6	PCC	Petroleum Equipment Design & Simulation - Laboratory		0	0	3	1.5
7	PCC	Petroleum Reservoir Simulation - Laboratory		0	0	3	1.5
8	PR	Presentation/Seminar (SIP Report)		0	0	0	1
9	PR	Project work - Phase 1		0	0	0	2
10	*MC	Professional Ethics And Human values		3	0	0	0
11	*MC	Employability Skills – II: Fundamentals of Finance and Accounting		0	0	2	0
12	MOOCS (NPTEL/SWAYAM) for Honors /Minor Degree						
		Total Credits					**21**

IV YEAR II SEMESTER							
S. No.	Course Code	Course Title	*POs*	L*	T	P	Credits
1	PEC	PROFESSIONAL ELECTIVE – VI i. Offshore Deepwater Drilling and Production ii. Pipeline Engineering		3	0	0	3
2	PEC	PROFESSIONAL ELECTIVE – VII i. Applied Mathematics in Reservoir Engineering ii. Advances in Seismic Exploration		3	0	0	3
3	OEC	OPEN ELECTIVE – III (for Petroleum Engineering) i. NPTEL-Data Analysis & Decision making ii. NPTEL- E-Business iii. NPTEL- Innovation, Business Models & Entrepreneurship		3	0	0	3
4	PR	Project Work - Phase 2		3	0	0	8
5	*MC	Physical Fitness Activities		0	0	2	0
6	MOOCS (NPTEL/SWAYAM) for Honors /Minor Degree						
		Total Credits					**17**

TOTAL CREDITS = 39 + 42 + 41 + 38 = 160

I Year- I Semester

L	T	P	C
3	0	0	3

MATHEMATICS-I (Calculus)
(Common to ALL branches of First Year B.Tech.)

Course Objectives:

- This course will illuminate the students in the concepts of calculus.
- To enlighten the learners in the concept of differential equations and multivariable calculus.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

Course Outcomes: At the end of the course, the student will be able to

- utilize mean value theorems to real life problems (L3)
- solve the differential equations related to various engineering fields (L3)
- familiarize with functions of several variables which is useful in optimization (L3)
- Apply double integration techniques in evaluating areas bounded by region (L3)
- students will also learn important tools of calculus in higher dimensions. Students will become familiar with 2- dimensional and 3-dimensional coordinate systems (L5)
- Conclude the use of special function in multiple integrals (L4)

UNIT I: Sequences, Series and Mean value theorems: **(10 hrs)**

Sequences and Series: Convergences and divergence – Ratio test – Comparison tests – Integral test – Cauchy's root test – Alternate series – Leibnitz's rule.

Mean Value Theorems (without proofs): Rolle's Theorem – Lagrange's mean value theorem – Cauchy's mean value theorem – Taylor's and Maclaurin's theorems with remainders.

UNIT II: Differential equations: **(15 hrs)**

Linear differential equations – Bernoulli's equations – Exact equations and equations reducible to exact form – Non-homogeneous equations of higher order with constant coefficients with non-homogeneous term of the type e^{ax}, sin ax, cos ax, polynomials in x^n, e^{ax} V(x) and x^nV(x) – Method of Variation of parameters

Applications: Orthogonal trajectories – Electrical circuits (RL, RC, RLC) – Simple Harmonic motion.

UNIT III: Partial differentiation: **(10 hrs)**

Introduction – Homogeneous function – Euler's theorem – Total derivative – Chain rule – Jacobian – Functional dependence – Taylor's and Mc Laurent's series expansion of functions of two variables.
Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method (with constraints).

UNIT IV: Multiple integrals: **(8 hrs)**

Double and Triple integrals – Change of order of integration – Change of variables.
Applications: Finding Areas and Volumes.

UNIT V: Special functions: **(5 hrs)**

Introduction to Improper Integrals-Beta and Gamma functions- Properties - Relation between Beta and Gamma functions- Evaluation of improper integrals.

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **B. V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. **Joel Hass, Christopher Heil and Maurice D. Weir,** Thomas calculus, 14th Edition, Pearson.
3. **Lawrence Turyn,** Advanced Engineering Mathematics, CRC Press, 2013.
4. **Srimantha Pal, S C Bhunia,** Engineering Mathematics, Oxford University Press.

I Year- I Semester

L	T	P	C
3	0	0	3

ENGINEERING PHYSICS

(for non-circuital branches like ME, CE, Chemical etc)

Course Objectives:

Physics curriculum which is re-oriented to the needs of non-circuital branches of graduate engineering courses offered by JNTUniversity:kakinada that serves as a transit to understand the branch specific advanced topics. The course is designed to:

- *Impart concepts of mechanics required to identify forces and moments in mechanical systems by vector representation-extend Newton's second law for inertial and non-inertial frames of reference- study different types of harmonic oscillatory motions.*
- *Tap the Simple harmonic motion and its adaptability for improved acoustic quality of concert halls- impart concepts of flaw detection techniques using ultrasonics.*
- *Study the structure- property relationship exhibited by solid materials within the elastic limit.*
- *Impart knowledge in basic concepts of LASERs along with its Engineering applications- Familiarize types of sensors for various engineering applications*
- *Explore the knowledge of magnetic and dielectric materials and their utility in appliances.*

UNIT-I **(10hrs)**

MECHANICS: Basic laws of vectors and scalars, rotational frames-conservative and non – conservative forces , F = - grad V, Newton's laws in inertial and linear accelerating non-inertial frames of reference, rotating frame of reference with constant angular velocity, Harmonic oscillator ; damped harmonic motion ; Forced oscillations and resonance.

Outcome:

The students will be able to

- Identify forces and moments in mechanical systems using scalar and vector techniques
- extend Newton's second law for inertial and non-inertial frame of reference
- explain simple harmonic motion and damped harmonic motions

UNIT-II **(10hrs)**

ACOUSTICS & ULTRASONICS: Introduction – Reverberation - Reverberation time - Sabine's formula (Derivation using growth and decay method)–absorption coefficient and its determination- factors affecting acoustics of buildings and their remedies.

Production of ultrasonics by Magnetostriction and piezoelectric methods – Detection of ultrasonics - acoustic grating - Non-Destructive Testing- pulse echo system through transmission and reflection modes - Applications.

Dr.G.Padmaja Rani Dr.P.Dakshina Murthy Dr.V.R.K.Murthy Dr.S.V.S.Ramana Reddy
Dr.R.Padmasuvarna Dr.K.Samatha

Outcome:

The students will be able to

- explain how sound is propagated in buildings
- analyze acoustic properties of typically used materials in buildings
- recognize sound level disruptors and their use in architectural acoustics
- Use of ultrasonics in flaw detection using NDT technique

UNIT-III **(9hrs)**

ELASTICITY:, stress, strain, Hooke's law, stress-strain curve, generalized Hooke's law with and without thermal strains for isotropic materials, different types of moduli and their relations, bending of beams – Bending moment of a beam – Depression of cantilever.

Outcome:

The students will be able to

- Understand the elasticity and plasticity concepts
- Study different types of moduli and their relation
- Analyze the concepts of shearing force and moment of inertia

UNIT-IV **(9hrs)**

LASERS & SENSORS: Characteristics–Spontaneous and Stimulated emission of radiation – population inversion - Einstein's coefficients & Relation between them and their significance - Pumping Mechanisms - Ruby laser – Helium Neon laser – Applications.

SENSORS (qualitative description only): Different types of sensors and applications; Strain and Pressure sensors- Piezoelectric, magnetostrictive sensors, Temperature sensor - bimetallic strip, pyroelectric detectors.

Outcome:

The students will be able to

- **Understand** the basic concepts of LASER light Sources
- Study Different types of laser systems
- Identify different types of sensors and their working principles

UNIT-V **(10hrs)**

MAGNETISM & DIELECTRICS: Introduction – Magnetic dipole moment – Magnetization-Magnetic susceptibility and permeability – Origin of permanent magnetic moment – Bohr Magneton - Classification of magnetic materials (Dia, Para and Ferro) – Domain concept of Ferromagnetism - Hysteresis – soft and hard magnetic materials – Applications of Ferromagnetic materials.

Introduction - Dielectric polarization – Dielectric polarizability, Susceptibility and Dielectric constant-types of polarizations: Electronic and Ionic (Quantitative), Orientational polarizations (qualitative)-Lorentz internal field – Claussius_Mossoti equation- Frequency dependence of polarization - Applications of dielectrics.

Outcome:

The students will be able to

- **explain** the concept of dielectric constant and polarization in dielectric materials.
- **summarize** various types of polarization of dielectrics .
- **interpret** Lorentz field and Claussius_Mosotti relation in dielectrics.
- **classify** the magnetic materials based on susceptibility and their temperature dependence.
- **explain** the applications of dielectric and magnetic materials .
- **Apply** the concept of magnetism to magnetic devices.

Dr.G.Padmaja Rani **Dr.P.Dakshina Murthy** **Dr.V.R.K.Murthy** **Dr.S.V.S.Ramana Reddy**

Dr.R.Padmasuvarna **Dr.K.Samatha**

I Year- I Semester

L	T	P	C
3	0	0	3

INTRODUCTION TO PETROLEUM ENGINEERING

Learning Objectives:
The students will be able to learn:

- The basic concepts that will enable the transition from petroleum science to petroleum engineering.
- The role of petroleum engineers in upstream, midstream and downstream sectors.
- The fundamental concepts of upstream, midstream and downstream sectors.
- The transportation of crude oil & its products and natural gas.

UNIT-I

Introduction: What is Petroleum Engineering and its Significance? Introduction to Petroleum Industry- Upstream Sector – Midstream Processing-Downstream Processing- Indian and World Scenario of Petroleum and Natural Gas- Petroleum Trade- Geopolitics.

UNIT II

Upstream Sector-1: Exploration & Production – Indian and World Scenario of Petroleum and Natural Gas Resources.
The Reservoir –Reservoir fluids- Hydrocarbon Phase diagrams- Onshore and Offshore Reservoirs – Reservoir Drives.

UNIT III

Upstream Sector-2: Drilling Rigs- Rig Components-Drill and drill bits- Drilling fluids-Well Completions.
Production System: Sketches of Well - Well head- Christmas tree and Casing and various other parts- Cementing-Safety Systems.
Subsea Wells: Drilling & Completion and Production.
Artificial Lift: Principles and operation of Rod Pumps –Gas Lift –Electrical submersible pumps.
Well Workover and Intervention- Well Stimulation: Basic concepts in Matrix Acidizing and Hydro-fracturing.

UNIT IV

Gathering of Oil & Gas and Storage:
Well Tubing- Separation of Reservoir Fluids- Manifolds and Gathering – Production Separators – Gas Treatment and Compression - Oil & Gas Storage, Metering and Export.

Midstream processing: Transportation of Crude Oil & its Products and Natural Gas - World and Indian pipeline scenario- Design of Oil and Gas pipelines - Safety aspects of pipelines- Environmental issues.

UNIT V

Downstream Processing:

Crude Oil Refining: Classification and Composition – Constituents - Products and their specifications– Pre-treatment of crude oil- Refinery distillation- Safety in refinery operations.

Outcomes:

The students are able to:

- Analyse the role of petroleum engineers in various facets of petroleum exploration, production, transportation, refining and processing.
- Apply the concepts of exploration, drilling, well completions, production system, subsea wells and workover operations.
- Apply the basic concepts of reservoir engineering.
- Apply the basic concepts of tube design, separator design, manifold design for oil & gas gathering and the design for storage system, metering and export.
- Design of transportation pipelines for crude oil & its products and natural gas.
- Apply the concepts of petroleum refining in the design and operation of a refinery.

Text Books:

1. Oil and Gas Production Handbook: An Introduction to Oil & Gas Production, Havard Devold, ABB ATPA Oil and Gas, 2006.
2. Introduction to Petroleum Engineering, John R. Fanchi and Christiansen, R.L., John Wiley & Sons, 2017.

Reference Books:

1. Petroleum engineering handbook: Howard.B. Bradley,SPE,1987
2. Petroleum engineering hand book: Larry .W.lake, SPE, volume II, 2006.
3. Petroleum engineering handbook: Production operations engineering, volume IV, Joe Dunn Clegg, 2009.

I Year- I Semester

L	T	P	C
3	0	0	3

PROGRAMMING FOR PROBLEM SOLVING

Objectives:

The objectives of this course are to make the student familiar with problem solving using computers, development of algorithms, usage of basic flowchart symbols and designing flowcharts.

The students can also understand programming language basic concepts, reading and displaying the data, earn the programming skills using selection, iterative control structures, functions, arrays, pointers and files. After completion of this course the student is expected to analyze the real life problem and write programs in C language to solve the problems.

Course Outcomes:

After completion of this course

- Student will be able to develop efficient algorithm for solving a problem.
- Use various constructs of C programming language efficiently.
- Student will be able to develop programs using modular approach such as functions. And also able to develop programs to perform matrix and mathematical applications.
- Student will be able to understand dynamic memory management and problems using pointers and solving the problems.
- Student will be able to develop programs for real life applications using structures and also learn about handling the files for storing the data permanently.

UNIT I: Problem Solving: Problem solving aspects, Problem solving techniques, Computer as a Problem solving tool, Algorithms-definition, features, criteria. Flowchart-definition, basic symbols, sample flowcharts. Top down design, Implementation of program verification, The efficiency of algorithms, Analysis of algorithms, computational complexity of algorithm, order(O) notation, Worst case & Average case Analysis.

UNIT II: Basics of C programming language: Introduction to C, structure of a C program, basic data types and sizes, constants, variables, unary, binary and ternary operators, expressions, type conversions, conditional expressions, precedence and order of evaluation, Input and Output statements, Sample Programs.

SELECTION-DECISION MAKING CONDITIONAL CONTROL STRUCTURES: simple-if, if-else, nested if-else, if-else ladder and switch-case.

ITERATIVE: while-loop, do-while loop and for loop control structures, goto, break and continue statements. Sample Programs.

28.06.2019

UNIT III: FUNCTIONS-basics, parameter passing, storage classes extern, auto, register, static, scope rules, block structure, user defined functions, standard library functions, recursive functions, Recursive solutions for Fibonacci series, towers of Hanoi, header files, C Preprocessor, example c programs

ARRAYS-concepts, declaration, definition, accessing elements, storing elements, 1-D arrays, 2-D arrays and character arrays, Multidimensional arrays, array applications: Matrix operations, checking the symmetricity of a Matrix, Passing 1-D arrays, 2-D arrays to functions, Strings and String Manipulations

UNIT IV: POINTERS-pointers concepts, initialization of pointer variables, pointers and function arguments, passing by address-dangling memory, address arithmetic, character pointers and functions, pointers to pointers, pointers and multi-dimensional arrays, dynamic memory management functions, command line arguments

UNIT V: ENUMERATED, STRUCTURE AND UNION TYPES: Derived types-structures- declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, typedef, bit-fields, program applications

FILEHANDLING: Concept of a file, text files and binary files, Formatted I/O, File I/O operations

Text Books:

1. How to Solve it by Computer, R. G. Dromey, Pearson Education, 2019
2. Programming in C, Ashok N Kamthane, Amit Ashok Kamthane, 3rd Edition, Pearson Education, 2019

Reference Books:

1. The C programming Language by Dennis Richie and Brian Kernighan
2. Programming in C, Reema Thareja, OXFORD
3. C Programming, A Problem Solving Approach, Forouzan, Gilberg, Prasad, Cengage

M.V. Subbu
L. Suraiah

28.06.2019

I Year- I Semester

L	T	P	C
1	0	3	2.5

ENGINEERING DRAWING

Course Objective: Engineering drawing being the principle method of communication for engineers, the objective is to introduce the students, the techniques of constructing the various types of polygons, curves and scales. The objective is also to visualize and represent the 3D objects in 2D planes with proper dimensioning, scaling etc.

Unit I

Objective: To introduce the students to use drawing instruments and to draw polygons, Engg. Curves. scales

Polygons: Constructing regular polygons by general methods, inscribing and describing polygons on circles.

Curves: Parabola, Ellipse and Hyperbola by general and special methods, cycloids, involutes, tangents & normals for the curves,

Scales: Plain scales, diagonal scales and vernier scales

Unit II

Objective: To introduce the students to use orthographic projections, projections of points & simple lines.

Orthographic Projections: Reference plane, importance of reference lines, projections of points in various quadrants, projections of lines, line parallel to both the planes, line parallel to one plane and inclined to other plane.

Unit III

Objective: The objective is to make the students draw the projections of the lines inclined to both the planes.

Part-A: Projections of straight lines inclined to both the planes.

Part-B: determination of true lengths of a line inclined to both the planes, angle of inclination and traces.

Unit IV

Objective: The objective is to make the students draw the projections of the plane inclined to both the planes and projections of Prism & Cylinder with axis inclined to one plane

Projections of planes: regular planes perpendicular/parallel to one reference plane and inclined to the other reference plane; inclined to both the reference planes.

Projections of Solids – Prisms & Cylinders with the axis inclined to one of the plane.

Unit V

Objective: The objective is to make the students draw the projections of the various types of solids in different positions inclined to one of the plane and 3D views to 2D and vice-versa

Pyramids & Cones with the axis inclined to one of the plane.

Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

24/8/19

HEAD
Mechanical Engineering Department
University College of Engineering
J.N.T. University Kakinada
KAKINADA

TEXT BOOKS:

1. Engineering Drawing by N.D. Butt, Chariot Publications
2. Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers

REFERENCE BOOKS:

1. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers
2. Engineering Graphics for Degree by K.C. John, PHI Publishers
3. Engineering Graphics by PI Varghese, McGrawHill Publishers
4. Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, New Age

Course Outcome: After undergoing this course, the student learnt the scales, various engineering curves and drawing the 2D and 3D objects.

HEAD
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KAKINADA

I Year- I Semester

L	T	P	C
0	0	3	1.5

ENGINEERING PHYSICS LAB
(Any 10 of the following listed 15 experiments)

LIST OF EXPERIMENTS:

1. Determination of Rigidity modulus of a material- Torsional Pendulum.
2. Determination of Young's modulus by method of single cantilever oscillations.
3. Determination of Acceleration due to Gravity and Radius of Gyration - Compound Pendulum.
4. Verification of laws of vibrations in stretched strings – Sonometer.
5. Determenation of spring constant of springs using coupled oscillators.
6. Magnetic field along the axis of a current carrying coil – Stewart and Gee's apparatus
7. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
8. Measurement of magnetic susceptibility by Quincke's method.
9. Determination of ultrasonic velocity in liquid (Acoustic Grating)
10. Determination of dielectric constant by charging and discharging method
11. Determination of wavelength of Laser by diffraction grating
12. Determination of particle size using Laser.
13. Determeination of Pressure variation using strain Gauge sensor.
14. Determination of Moment of Inertia of a Fly Wheel.
15. Determination of Velocity of sound –Volume Resoantor.

1. Dr.G.Padmaja Rani	**Chairman**	
2. Dr.P.Dakshina Murthy	**Member**	
3. Dr.V.R.K.Murthy	**External Member**	
4. Dr.S.V.S.Ramana Reddy	**External Member**	
5. Dr.K.Samatha	**External Member**	
6. Dr.R.Padmasuvarna	**External Member**	

I Year- I Semester

L	T	P	C
0	0	3	1.5

PROGRAMMING FOR PROBLEM SOLVING – LABORATORY

Exercise 1

a) Write a C Program to calculate the area of a triangle.
b) Write a C program to find the largest of three numbers using ternary operator.
c) Write a C Program to swap two numbers without using a temporary variable.

Exercise 2

a) Write a C program to find the 2's complement of a binary number.
b) Write a C program to find the roots of a quadratic equation.
c) Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)

Exercise 3

a) Write a C program to find the sum of individual digits of a positive integer and, also, find the reverse of the given number.
b) Write a C program to generate the first *n* terms of the Fibonacci sequence.
c) Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

Exercise 4

a) Write a C Program to print the multiplication table of a given number.
b) Write a C Program to read a decimal number and find its equivalent binary number.
c) Write a C Program to check whether the given number is Armstrong number or not.

Exercise 5

a) Write a C program to interchange the largest and smallest numbers in the given array.
b) Write a C program to implement a liner search on a given set of values.
c) Write a C program to implement binary search on a given set of values.

Exercise 6

a) Write a C program to implement sorting of an array of elements.
b) Write a C program to input two m x n matrices, check the compatibility and perform addition and multiplication of them.

Exercise 7

Write a C program that uses functions to perform the following operations:

i. To insert a sub-string into given main string at a given position.
ii. To delete n characters from a given position in a given string.
iii. To replace a character of string either from beginning or ending or at a specified location.

Exercise 8

Write a C program that uses functions to perform the following operations using Structure:

i) Reading a complex number
ii) Writing a complex number
iii) Addition of two complex numbers
iv) Multiplication of two complex numbers

M.V. Subba Lakshmi

Exercise 9

Write C Programs for the following string operations without using the built in functions

- to concatenate two strings
- to append a string to another string
- to compare two strings

Exercise 10

a) Write C Program to find the number of characters in a given string including and excluding spaces.

b) Write C Program to copy the contents of one string to another string without using string handling functions.

c) Write C Program to find whether a given string is palindrome or not.

d) Write a C program to find both the largest and smallest number of an array of integers using call by value and call by reference.

Exercise 11

Write a C program using recursion for the following:

a) To display sum of digits of given number

b) To find the factorial of a given integer

c) To find the GCD (greatest common divisor) of two given integers.

d) To find Fibonacci sequence

Exercise 12

a) Write C Program to reverse a string using pointers

b) Write a C Program to compare two 2D arrays using pointers

c) Write a C program consisting of Pointer based function to exchange value of two integers using passing by address.

Exercise 13

Examples which explores the use of structures, union and other user defined variables

Exercise 14

a) Write a C program which copies one file to another.

b) Write a C program to count the number of characters and number of lines in a file.

c) Write a C Program to merge two files into a third file. The names of the files must be entered using command line arguments.

L. Suresh

28.06.24

I Year- I Semester

L	T	P	C
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ENGLISH COMMUNICATION SKILLS LABORATORY - 1

Topics:

UNIT I:

Pronunciation: Vowels, Consonants, Phonetic Transcription

UNIT II:

Past tense markers, word stress-di-syllabic words, Poly-Syllabic words

UNIT III:

Rhythm & Intonation

UNIT IV:

Contrastive Stress (Homographs)

UNIT V:

Word Stress: Weak and Strong forms
Stress in compound words

Prescribed text book: "**Infotech English**", Maruthi Publications.

References:

1. Exercises in Spoken English Part 1,2,3,4, OUP and CIEFL.
2. English Pronunciation in use- Mark Hancock, Cambridge University Press.
3. English Phonetics and Phonology-Peter Roach, Cambridge University Press.
4. English Pronunciation in use- Mark Hewings, Cambridge University Press.
5. English Pronunciation Dictionary- Daniel Jones, Cambridge University Press.
6. English Phonetics for Indian Students- P. Bala Subramanian, Mac Millan Publications.

P. Rajendra / Convenor
28/06/2019

28/6/19

28.6.19

I Year- I Semester

L	T	P	C
0	0	2	0

PHYSICS VIRTUAL LAB

LIST OF EXPERIMENTS

1. Hall Effect
2. Crystal Structure
3. Brewster's angle
4. Numerical Aperture of Optical fiber
5. Photoelectric Effect
6. LASER – Beam Divergence and Spot size
7. Michelson's interferometer
8. Black body radiation
9. Flywheel – moment of inertia
10. AC Sonometer
11. Resistivity by four probe method
12. Newton's rings –Refractive index of liquid

URL: ***www.vlab.co.in***

1. Dr.G.Padmaja Rani	**Chairman**	
2. Dr.P.Dakshina Murthy	**Member**	
3. Dr.V.R.K.Murthy	**External Member**	
4. Dr.S.V.S.Ramana Reddy	**External Member**	
5. Dr.K.Samatha	**External Member**	
6. Dr.R.Padmasuvarna	**External Member**	

I Year- I Semester

L	T	P	C
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ENGINEERING EXPLORATION PROJECT

Learning Objectives:

- To get in-depth understanding of role of chemical engineering in a process industry.
- To get familiarity with organizational structure, work environment & culture, anatomy of chemical processes and equipment involved in a process industry.
- To interact with the teams of engineers and operating personnel in a process industry.
- To know the challenges in design, operation and production of a process industry.

Methodology:

The total students of a class are divided into small groups. Each group would be sent to a process industry for 7 days. Preferably on each Saturday in a week of 6-8 students along with a Faculty member. The host process industry provides a mentor (an experienced engineer). The students are expected to study all aspects of the industry under the guidance of the mentors (Faculty and Industry). At the end of the 7 day program each student should submit a report, which will be evaluated by a two-member team of faculty nominated by the Head of the Department.

Outcomes:

The students will be able:

- To understand the professional activities in process industry.
- To judge the importance and relevance of various subjects in curriculum.
- To know the possible career options in a process industry.

I Year- I Semester

L	T	P	C
3	0	0	0

CONSTITUTION OF INDIA
(MC)

Learning Objectives:

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution

UNIT – I:

History of Making of the Indian Constitution: History, Drafting Committee, (Composition& Working), **Philosophy of the Indian Constitution:** Preamble, Salient, Features.

UNIT – II:

Contours of Constitutional Rights &Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT – III:

Election Commission: Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

UNIT – IV:

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 – 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: ZilaPachayat.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.

Course Outcomes:

After the completion of the course, student will be able to

- **CO1** Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- **CO2** Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- **CO3** Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- **CO4** Discuss the passage of the Hindu Code Bill of1956.

Text Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication
2. Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, Dr. S. N. Busi, 2015

References:

1. Indian Constitution Law, 7th Edn. M. P. Jain, Lexis Nexis, 2014.
2. Introduction to the Constitution of India, Lexis Nexis, D.D. Basu, 2015.

I Year- II Semester

L	T	P	C
3	0	0	3

COMMUNICATE ENGLISH

Introduction

The course is designed to train students in receptive (listening and reading) as well as productive and interactive (speaking and writing) skills by incorporating a comprehensive, coherent and integrated approach that improves the learners' ability to effectively use English language in academic/ workplace contexts. The shift is from *learning about the language* to *using the language*. On successful completion of the compulsory English language course/s in B.Tech., learners would be confident of appearing for international language qualification/proficiency tests such as IELTS, TOEFL, or BEC, besides being able to express themselves clearly in speech and competently handle the writing tasks and verbal ability component of campus placement tests. Activity based teaching-learning methods would be adopted to ensure that learners would engage in actual use of language both in the classroom and laboratory sessions.

Course Objectives

- Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers
- Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials
- Help improve speaking skills through participation in activities such as role plays, discussions and structured talks/oral presentations
- Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information
- Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

Learning Outcomes

At the end of the module, the learners will be able to

- understand social or transactional dialogues spoken by native speakers of English and identify the context, topic, and pieces of specific information
- ask and answer general questions on familiar topics and introduce oneself/others
- employ suitable strategies for skimming and scanning to get the general idea of a text and locate specific information
- recognize paragraph structure and be able to match beginnings/endings/headings with paragraphs
- form sentences using proper grammatical structures and correct word forms

P. Rajendra Kumara 28/06/19 (28/6/19) 28/6/19

Unit 1:

Lesson-1: A Drawer full of happiness from **"Infotech English"**, Maruthi Publications

Lesson-2: Deliverance by Premchand from **"The Individual Society"**, Pearson Publications. (Non-detailed)

Listening: Listening to short audio texts and identifying the topic. Listening to short audio texts and identifying the context and specific pieces of information to answer a series of questions both in speaking and writing.

Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests. Self introductions and introducing others.

Reading: Skimming text to get the main idea. Scanning to look for specific pieces of information.

Reading for Writing: Paragraph writing (specific topics) using suitable cohesive devices; linkers, sign posts and transition signals; mechanics of writing - punctuation, capital letters.

Vocabulary: Technical vocabulary from across technical branches (20) GRE Vocabulary (20) (Antonyms and Synonyms, Word applications) Verbal reasoning and sequencing of words.

Grammar: Content words and function words; word forms: verbs, nouns, adjectives and adverbs; nouns: countables and uncountables; singular and plural basic sentence structures; simple question form - wh-questions; word order in sentences.

Pronunciation: Vowels, Consonants, Plural markers and their realizations

Unit 2:

Lesson-1: Nehru's letter to his daughter Indira on her birthday from "**Infotech English**", Maruthi Publications

Lesson-2: Bosom Friend by Hira Bansode from **"The Individual Society"**, Pearson Publications. (Non-detailed)

Listening: Answering a series of questions about main idea and supporting ideas after listening to audio texts, both in speaking and writing.

P. Rajendra Karmarkar
28/06/19

(28/6/19)

28/6/19

Speaking: Discussion in pairs/ small groups on specific topics followed by short structured talks. Functional English: Greetings and leave takings.

Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

Reading for Writing: Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions.

Vocabulary: Technical vocabulary from across technical branches (20 words) GRE Vocabulary Analogies (20 words) (Antonyms and Synonyms, Word applications)

Grammar: Use of articles and zero article; prepositions.

Pronunciation: Past tense markers, word stress-di-syllabic words

Unit 3:

Lesson-1: Stephen Hawking-Positivity 'Benchmark' from "**Infotech English**", Maruthi Publications

Lesson-2: Shakespeare's Sister by Virginia Woolf from "**The Individual Society**", Pearson Publications. (Non-detailed)

Listening: Listening for global comprehension and summarizing what is listened to, both in speaking and writing.

Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed. Functional English: Complaining and Apologizing.

Reading: Reading a text in detail by making basic inferences - recognizing and interpreting specific context clues; strategies to use text clues for comprehension. Critical reading.

Reading for Writing: Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions. Letter writing-types, format and principles of letter writing. E-mail etiquette, Writing CV's.

Vocabulary: Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Association, sequencing of words

Grammar: Verbs - tenses; subject-verb agreement; direct and indirect speech, reporting verbs for academic purposes.

P. Raghavendra Karmakar 28/06/19

(28/6/19)

Pronunciation: word stress-poly-syllabic words

Unit 4:

Lesson-1: Liking a Tree, Unbowed: Wangari Maathai-biography from "**Infotech English**", Maruthi Publications

Lesson-2: Telephone Conversation-Wole Soyinka from "**The Individual Society**", Pearson Publications. (Non-detailed)

Listening: Making predictions while listening to conversations/ transactional dialogues without video (only audio); listening to audio-visual texts.

Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions. Functional English: Permissions, Requesting, Inviting.

Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicative process or display complicated data.

Reading for Writing: Information transfer; describe, compare, contrast, identify significance/trends based on information provided in figures/charts/graphs/tables. Writing SOP, writing for media.

Vocabulary: Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Cloze Encounters.

Grammar: Quantifying expressions - adjectives and adverbs; comparing and contrasting; degrees of comparison; use of antonyms

Pronunciation: Contrastive Stress

Unit 5:

Lesson-1: Stay Hungry-Stay foolish from "**Infotech English**", Maruthi Publications

Lesson-2: Still I Rise by Maya Angelou from "**The Individual Society**", Pearson Publications. (Non-detailed)

P. Rajendra Kumar 28/06/19

(28/6/19)

28/6/19

Listening: Identifying key terms, understanding concepts and interpreting the concepts both in speaking and writing.

Speaking: Formal oral presentations on topics from academic contexts - without the use of PPT slides. Functional English: Suggesting/Opinion giving.

Reading: Reading for comprehension. RAP Strategy Intensive reading and Extensive reading techniques.

Reading for Writing: Writing academic proposals- writing research articles: format and style.

Vocabulary: Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Coherence, matching emotions.

Grammar: Editing short texts – identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)

Pronunciation: Stress in compound words

Prescribed text books for theory for Semester-I:
1. **"Infotech English"**, Maruthi Publications. (Detailed)
2. **"The Individual Society"**, Pearson Publications. (Non-detailed)

Prescribed text book for Laboratory for Semesters-I & II:
1. **"Infotech English"**, Maruthi Publications. (with Compact Disc)

Reference Books

- Bailey, Stephen. *Academic writing: A handbook for international students.* Routledge, 2014.
- Chase, Becky Tarver. *Pathways: Listening, Speaking and Critical Thinking.* Heinley ELT; 2nd Edition, 2018.
- Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
- Hewings, Martin. *Cambridge Academic English (B2).* CUP, 2012.

P. Rajendra Karmarkar 28/6/19

(28/6/19)

28/6/19

I Year- II Semester

L	T	P	C
3	0	0	3

MATHEMATICS – II
(Linear Algebra and Numerical Methods)

Course Objectives:

- Singular values of a matrix, singular value decomposition (Ref. Book – 1).

UNIT III: Iterative methods: **(8 hrs)**

Introduction – Bisection method – Secant method – Method of false position – Iteration method – Newton-Raphson method (One variable and simultaneous Equations) – Jacobi and Gauss-Seidel methods for solving system of equations – Power Method for finding Largest Eigenvalue –Eigenvector.

UNIT IV: Interpolation: **(10 hrs)**

Introduction – Errors in polynomial interpolation – Finite differences – Forward differences – Backward differences – Central differences – Relations between operators – Newton's forward and backward formulae for interpolation – Interpolation with unequal intervals – Lagrange's interpolation formula – Newton's divide difference formula.

UNIT V: Numerical integration and solution of ordinary differential equations: **(10 hrs)**

Trapezoidal rule – Simpson's $1/3^{rd}$ and $3/8^{th}$ rule – Solution of ordinary differential equations by Taylor's series – Picard's method of successive approximations – Euler's method – Runge-Kutta method (second and fourth order) – Milne's Predictor and Corrector Method.

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 43^{rd} Edition, Khanna Publishers.
2. **B. V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. **David Poole,** Linear Algebra- A modern introduction, 4^{th} Edition, Cengage.
2. **Steven C. Chapra,** Applied Numerical Methods with MATLAB for Engineering and Science, Tata Mc. Graw Hill Education.
3. **M. K. Jain, S. R. K. Iyengar and R. K. Jain,** Numerical Methods for Scientific and Engineering Computation, New Age International Publications.
4. **Lawrence Turyn,** Advanced Engineering Mathematics, CRC Press.

I Year- II Semester

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MATHEMATICS-III (Vector Calculus, Transforms and PDE)
(Common to ALL branches of First Year B.Tech.)

Course Objectives:

- To familiarize the techniques in partial differential equations
- To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real world applications.

Course Outcomes: At the end of the course, the student will be able to

- interpret the physical meaning of different operators such as gradient, curl and divergence (L5)
- estimate the work done against a field, circulation and flux using vector calculus (L5)
- apply the Laplace transform for solving differential equations (L3)
- find or compute the Fourier series of periodic signals (L3)
- know and be able to apply integral expressions for the forwards and inverse Fourier transform to a range of non-periodic waveforms (L3)
- identify solution methods for partial differential equations that model physical processes (L3)

Unit –I: Vector calculus: **(10 hrs)**

Vector Differentiation: Gradient – Directional derivative – Divergence – Curl – Scalar Potential.

Vector Integration: Line integral – Work done – Area – Surface and volume integrals – Vector integral theorems: Greens, Stokes and Gauss Divergence theorems (without proof).

Unit –II: Laplace Transforms: **(10 hrs)**

Laplace transforms of standard functions – Shifting theorems – Transforms of derivatives and integrals – Unit step function – Dirac's delta function – Inverse Laplace transforms – Convolution theorem (with out proof).

Applications: Solving ordinary differential equations (initial value problems) and integro differential equations using Laplace transforms.

Unit –III: Fourier series and Fourier Transforms: **(10 hrs)**

Fourier Series: Introduction – Periodic functions – Fourier series of periodic function – Dirichlet's conditions – Even and odd functions – Change of interval – Half-range sine and cosine series.

Fourier Transforms: Fourier integral theorem (without proof) – Fourier sine and cosine integrals – Sine and cosine transforms – Properties – inverse transforms – Finite Fourier transforms.

Unit –IV: PDE of first order: **(8 hrs)**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations.

UNIT V: Second order PDE and Applications: **(10 hrs)**

Second order PDE: Solutions of linear partial differential equations with constant coefficients – RHS term of the type $e^{ax+by}, \sin(ax+by), \cos(ax+by), x^m y^n$.

Applications of PDE: Method of separation of Variables – Solution of One dimensional Wave, Heat and two-dimensional Laplace equation.

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **B. V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. **Dean. G. Duffy,** Advanced Engineering Mathematics with MATLAB, 3rd Edition, CRC Press.
3. **Peter O' Neil,** Advanced Engineering Mathematics, Cengage.
4. **Srimantha Pal, S C Bhunia,** Engineering Mathematics, Oxford University Press.

ANNEXURE-II

UNIVERSITY COLLEGE OF ENGINEERING
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

I B. Tech. ENGINEERING CHEMISTRY (Non-circuit branches)

Knowledge of basic concepts of Chemistry for Engineering students will help them as professional engineers later in design and material selection, as well as utilizing the available resources.

Learning Objectives:

- ***Importance*** of usage of plastics in household appliances and composites (FRP) in aerospace and automotive industries.
- ***Outline*** the basics for the construction of electrochemical cells, batteries and fuel cells. Understand the mechanism of corrosion and how it can be prevented.
  Express the increase in demand as wide variety of advanced materials are introduced; which have excellent engineering properties.
  Classify and discuss the materials used in major industries like steel industry, metallurgical industries and construction industries and electrical equipment manufacturing industries. Lubrication is also ***summarized***.
- ***Relate*** the need of fuels as a source of energy to any industry, particularly industries like thermal power stations, steel industry, fertilizer industry etc., and hence introduced.
- ***Explain*** the importance and usage of water as basic material in almost all the industries; ***interpret*** drawbacks of steam boilers and also how portable water is supplied for drinking purposes.

UNIT I: POLYMER TECHNOLOGY

Polymerisation:- Introduction-methods of polymerization (emulsion and suspension)-physical and mechanical properties.

Plastics: Compounding-fabrication (compression, injection, blown film, extrusion) - preparation, properties and applications of PVC, polycarbonates and Bakelite-mention some examples of plastic materials used in electronic gadgets, recycling of e-plastic waste.

Elastomers:- Natural rubber-drawbacks-vulcanization-preparation, properties and applications of synthetic rubbers (Buna S, thiokol and polyurethanes).

Composite materials: Fiber reinforced plastics-conducting polymers-biodegradable polymers-biopolymers-biomedical polymers.

Learning Outcomes: ***At the end of this unit, the students will be able to***

- ***Outline*** the properties of polymers and various additives added and different methods of forming plastic materials.
- ***Explain*** the preparation, properties and applications of some plastic materials.
- ***Interpret*** the mechanism of conduction in conducting polymers .
- ***Discuss*** natural and synthetic rubbers and their applications.

UNIT II: ELECTROCHEMICAL CELLS AND CORROSION

Single electrode potential-Electrochemical series and uses of series-standard hydrogen electrode, calomel electrode-concentration cell-construction of glass electrode-Batteries: Dry cell, Ni-Cd cells, Ni-Metal hydride cells, Li ion battery, zinc air cells-Fuel cells: H_2-O_2, CH_3OH-O_2, phosphoric acid, molten carbonate.

Corrosion:-Definition-theories of corrosion (chemical and electrochemical)-galvanic corrosion, differential aeration corrosion, stress corrosion, waterline corrosion-passivity of metals-galvanic series-factors influencing rate of corrosion-corrosion control (proper designing, cathodic protection)-Protective coatings: Surface preparation, cathodic and anodic coatings, electroplating, electroless plating (nickel). Paints (constituents, functions, special paints).

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Learning Outcomes: ***At the end of this unit, the students will be able to***

- ***Explain*** the theory of construction of battery and fuel cells.
- ***Categorize*** the reasons for corrosion and study some methods of corrosion control.

UNIT III: CHEMISTRY OF MATERIALS

Part- A:

Nano materials:- Introduction-sol-gel method-characterization by BET, SEM and TEM methods-applications of graphene-carbon nanotubes and fullerenes:Types, preparation and applications

Thermal analysis techniques: Instrumentation and applications of thermogravimetric analysis (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC).

Part-B:

Refractories: - Definition, classification, properties (refractoriness, refractoriness under load, porosity and thermal spalling), failure of refractories.

Lubricants: - Definition, mechanism of lubricants and properties (definition and importance).

Cement: - Constituents, manufacturing, parameters to characterize the clinker formation: lime saturation factor (LSF), silica ratio (SR) and alumina ratio (AR), chemistry of setting and hardening, deterioration of cement.

Learning Outcomes: ***At the end of this unit, the students will be able to***

- ***Outline*** the awareness of materials like nanomaterials and fullerenes and their uses.
- ***Explain*** the techniques that detect and measure changes of state of reaction.
- ***Illustrate*** the commonly used industrial materials.

UNIT IV: FUELS

Introduction-calorific value-HCV and LCV-problems using Dulong's formula-proximate and ultimate analysis of coal sample-significance of these analyses-problems-Petroleum (refining-cracking)-Synthetic petrol (Fischer Tropsch and Bergius)-petrol knocking-diesel knocking-octane and cetane ratings-anti-knock agents-Introduction to alternative fuels (Bio-diesel, ethanol, methanol, Natural gas, LPG, CNG)-Flue gas analysis by Orsat apparatus-Rocket fuels.

Learning Outcomes: ***At the end of this unit, the students will be able to***

- ***Differentiate*** petroleum, petrol, synthetic petrol and have knowledge how they are produced.
- ***Study*** alternate fuels.
- ***Analyse*** flue gases.

UNIT V: WATER TECHNOLOGY

Hardness of water-determination of hardness by complexometric method-boiler troubles (priming and foaming, scale formation, boiler corrosion, caustic embrittlement)-internal treatments-softening of hard water (zeolite processs and related sums, ion exchange process)-treatment of industrial waste water Portable water and its specifications-steps involved in purification of water-chlorination, break point chlorination-reverse osmosis and electro dialysis.

Learning Outcomes: ***At the end of this unit, the students will be able to***

- ***Explain*** the impurities present in raw water, problems associated with them and how to avoid them are understood.

Text Books:

1. Engineering Chemistry by Jain and Jain; Dhanpat Rai Publicating Co. Latest edition
2. Engineering Chemistry by Shikha Agarwal; Cambridge University Press, 2019 edition.

Reference Books:

1. A text book of engineering Chemistry by S. S. Dara: S. Chand & Co Ltd., Latest Edition
2. Engineering Chemistry by Shashi Chawla: Dhanpat Rai Publicating Co. Latest edition

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28.06.2019

I Year- II Semester

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ENIGINEERING MECHANICS

Objectives: The students completing this course are expected to understand the concepts of forces and its resolution in different planes, resultant of force system, Forces acting on a body, their free body diagrams using graphical methods. They are required to understand the concepts of centre of gravity and moments of inertia and their application, Analysis of frames and trusses, different types of motion, friction and application of work - energy method.

UNIT – I

Objectives: The students are to be exposed to the concepts of force and friction, direction and its application.

Introduction to Engg. Mechanics – Basic Concepts.

Systems of Forces: Coplanar Concurrent Forces – Components in Space – Resultant – Moment of Force and its Application – Couples and Resultant of Force Systems.

Friction: Introduction, limiting friction and impending motion, coulomb's laws of dry friction, coefficient of friction, cone of friction

UNIT II

Objectives: The students are to be exposed to application of free body diagrams. Solution to problems using graphical methods and law of triangle of forces.

Equilibrium of Systems of Forces: Free Body Diagrams, , Lami's Theorm, Equations of Equilibrium of Coplanar Systems, Graphical method for the equilibrium, Triangle law of forces, converse of the law of polygon of forces condition of equilibrium, Equations of Equilibrium for Spatial System of forces, Numerical examples on spatial system of forces using vector approach, Analysis of plane trusses.

UNIT – III

Objectives : The students are to be exposed to concepts of centre of gravity. The students are to be exposed to concepts of moment of inertia and polar moment of inertia including transfer methods and their applications.

Centroid: Centroids of simple figures (from basic principles) – Centroids of Composite Figures

Centre of Gravity: Centre of gravity of simple body (from basic principles), centre of gravity of composite bodies, Pappus theorems.

Area moments of Inertia: Definition – Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia. **Mass Moment of Inertia:** Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, mass moment of inertia of composite bodies.

UNIT – IV

Objectives: The students are to be exposed to motion in straight line and in curvilinear paths, its velocity and acceleration computation and methods of representing plane motion.

Rectilinear and Curvilinear motion of a particle: Kinematics and Kinetics- D'Alembert's Principle, Work Energy method and applications to particle motion- Impulse momentum method.

UNIT – V

Objectives: The students are to be exposed to rigid motion kinematics and kinetics

Rigid body Motion: Kinematics and kinetics of translation, Rotation about fixed axis and plane motion, Work Energy method and Impulse momentum method.

Dr. K. Meera Saheb Dr. B. Balakrishna Dr. A. Gopala Krishna Dr.A.SwarnaKumari

Dr. N. Mohan Rao Dr. K. Mallikarjuna Rao Dr.A.V.Sitarama Raju Dr. P. Ramesh Babu

Dr. K. Ramanaiah Dr.G.Madhusudan Reddy Dr.Ch. Rajesh

TEXT BOOK:

1. Engg. Mechanics - S.Timoshenko & D.H.Young., 4th Edn - , Mc Graw Hill publications.

REFERENCES:

1. Engineering Mechanics statics and dynamics – R.C.Hibbeler, 11th Edn – Pearson Publ.
2. Engineering Mechanics , statics – J.L.Meriam, 6th Edn – Wiley India Pvt Ltd.
3. Engineering Mechanics , dynamics – J.L.Meriam, 6th Edn – Wiley India Pvt Ltd.
4. Engineering Mechanics , statics and dynamics – I.H.Shames, – Pearson Publ.
5. Mechanics For Engineers , statics - F.P.Beer & E.R.Johnston – 5th Edn Mc Graw Hill Publ.
6. Mechanics For Engineers, dynamics - F.P.Beer & E.R.Johnston –5th Edn Mc Graw Hill Publ.
7. Theory & Problems of engineering mechanics, statics & dynamics – E.W.Nelson, C.L.Best & W.G. McLean, 5th Edn – Schaum's outline series - Mc Graw Hill Publ.
8. Engineering Mechanics , Fedinand . L. Singer , Harper – Collins.
9. Engineering Mechanics statics and dynamics , A Nelson , Mc Graw Hill publications
10. Engineering Mechanics, Tayal. Umesh Publ.

Course outcomes:

CO1. To Learn the principles (Axioms) of statics, able to find resultant & resolution of system of forces and resultant force.
CO2. Explore the concepts of constraints, free body diagram and action-reaction.
CO3. Estimate the geometric parameters like centroid, center of gravity and moment of inertia and identify their application.
CO4. Learn the analysis of frames and trusses and know the importance of friction.
CO5. Able to determine solution to dynamic problems through D'Alembert equilibrium equations, Impulse-Momentum and work– energy method

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Dr. N. Mohan Rao	Dr. K. Mallikarjuna Rao	Dr.A.V.Sitarama Raju	Dr. P. Ramesh Babu
Dr. N. Ramanaiah	Dr.G.Madhusudan Reddy	Dr.Ch. Rajesh	

I Year- II Semester

L	T	P	C
0	0	3	1.5

ENGINEERING WORKSHOP & IT WORKSHOP

ENGINEERING WORKSHOP:

Learning Objectives: To impart hands-on practice on basic engineering trades and skills.

Note: At least two exercises to be done from each trade.

Trade:

1.Carpentry
1. T-Lap Joint
2. Cross Lap Joint
3. Dovetail Joint
4. Mortise and Tenon Joint

2.Fitting
1. Vee Fit
2. Square Fit
3. Half Round Fit
4. Dovetail Fit

3.Black Smithy
1. Round rod to Square
2. S-Hook
3. Round Rod to Flat Ring
4. Round Rod to Square headed bolt

4.House Wiring
1. Parallel / Series Connection of three bulbs
2. Stair Case wiring
3. Florescent Lamp Fitting
4. Measurement of Earth Resistance

5.Tin Smithy
1. Taper Tray
2. Square Box without lid
3. Open Scoop
4. Funnel

IT WORKSHOP

Objectives:

- **PC Hardware:** Identification of basic peripherals, Assembling a PC, Installation of system software like MS Windows, device drivers, etc. Troubleshooting of PC Hardware and Software issues.
- **Internet & World Wide Web:** Different ways of hooking the PC on to the internet from home and workplace and effectively usage of the internet, web browsers, email, newsgroups and discussion forums. Awareness of cyber hygiene (protecting the personal computer from getting infected with the viruses), worms and other cyber attacks.
- **Productivity Tools:** Understanding and practical approach of professional word documents, excel spread sheets, power point presentations and personal web sites using the Microsoft suite office tools.

Course Outcomes:

List of Exercises:

(Faculty to consolidate the workshop manuals using the textbook and references)

Task 1: Identification of the peripherals of a computer - Prepare a report containing the block diagram of the computer along with the configuration of each component and its functionality. Describe about various I/O Devices and its usage.

Task 2: Practicing disassembling and assembling components of a PC

Task 3: Installation of Device Drivers, MS windows, Linux Operating systems and Disk Partitioning

Task 4: Introduction to Memory and Storage Devices, I/O Port, Assemblers, Compilers, Interpreters, Linkers and Loaders.

Task 5: Demonstration of Hardware and Software Troubleshooting

Task 6: Demonstrating Importance of Networking, Transmission Media, Networking Devices- Gateway, Routers, Hub, Bridge, NIC, Bluetooth Technology, Wireless Technology, Modem, DSL, and Dialup Connection.

Task 7: Awareness of various threats on the Internet and its solutions

Task 8: Demonstration and Practice on Microsoft Word

Task 9: Demonstration and Practice on Microsoft Excel

TEXT BOOK:

1 Computer Fundamentals, Anita Goel, Pearson India Education, 2017
2 PC Hardware Trouble Shooting Made Easy, TMH

REFERENCE BOOK:

1. Scott Mueller's Upgrading and Repairing PCs, 18/e, Scott. Mueller, QUE, Pearson,2008
2. Comdex Information Technology, Vikas Gupta, Dreamtech.
3. Essential Computer and IT Fundamentals for Engineering and Science Students, Dr. N.B. Venkateswarlu
4. Information Technology Workshop, 3e, G Praveen Babu, M V Narayana BS Publications

28.06.2019

I Year- II Semester

L	T	P	C
0	0	3	1.5

ENGLISH COMMUNICATION SKILLS LABORATORY - II

UNIT I:
Oral Activity: JAM, Hypothetical Situations, Self/Peer Profile
Common Errors in Pronunciation, Neutralising Accent

UNIT II:
Oral Activity: Telephonic Etiquette, Role Plays
Poster Presentations

UNIT III:
Oral Activity: Oral Presentation skills, Public speaking
Data Interpretation

UNIT IV:
Oral Activity: Group Discussions: Do's and Don'ts- Types, Modalities

UNIT V:
Oral Activity: Interview Skills: Preparatory Techniques, Frequently asked questions, Mock Interviews.
Pronunciation: Connected speech (Pausing, Tempo, Tone, Fluency etc.,)

References:

1. Exercises in Spoken English Part 1,2,3,4, OUP and CIEFL.
2. English Pronunciation in use- Mark Hancock, Cambridge University Press.
3. English Phonetics and Phonology-Peter Roach, Cambridge University Press.
4. English Pronunciation in use- Mark Hewings, Cambridge University Press.
5. English Pronunciation Dictionary- Daniel Jones, Cambridge University Press.
6. English Phonetics for Indian Students- P. Bala Subramanian, Mac Millan Publications.
7. Technical Communication- Meenakshi Raman, Sangeeta Sharma, Oxford University Press.
8. Technical Communication- Gajendrea Singh Chauhan, Smita Kashiramka, Cengage Publications.

P. Rajendra Karmarkar 28/06/19

28/6/19

28/6/19

I Year- II Semester

L	T	P	C
3	0	0	0

ENVIRONMENTAL SCIENCE
(MC)

Learning Objectives:

The objectives of the course are to impart:

- Overall understanding of the natural resources.
- Basic understanding of the ecosystem and its diversity.
- Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities.
- An understanding of the environmental impact of developmental activities.
- Awareness on the social issues, environmental legislation and global treaties.

UNIT-I:

Multidisciplinary nature of Environmental Studies: Definition, Scope and Importance –Sustainability: Stockholm and Rio Summit–Global Environmental Challenges: Global warming and climate change, acid rains, ozone layer depletion, population growth and explosion, effects;. Role of information technology in environment and human health.

Ecosystems: 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 Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems.

UNIT-II:

Natural Resources: Natural resources and associated problems.

Forest resources: Use and over – exploitation, deforestation – Timber extraction – Mining, dams and other effects on forest 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.

Food resources: World food problems, changes caused by non-agriculture activities-effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.

Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources.

Land resources: Land as a resource, land degradation, Wasteland reclamation, man induced landslides, soil erosion and desertification; Role of an individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

UNIT-III:

Biodiversity and its conservation: Definition: genetic, species and ecosystem diversity-classification - Value of biodiversity: consumptive use, productive use, social-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, man-wildlife conflicts. - Endangered and endemic species of India – Conservation of biodiversity: conservation of biodiversity.

UNIT – IV Environmental Pollution: Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, Nuclear hazards. Role of an individual in prevention of pollution. - Pollution case studies, Sustainable Life Studies. Impact of Fire Crackers on Men and his well being.

Solid Waste Management: Sources, Classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products, Biomedical, Hazardous and e – waste management.

UNIT – V Social Issues and Environmental Management: Urban problems related to energy - Water conservation, rain water harvesting-Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Environmental Protection Act -Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act-Issues involved in enforcement of environmental legislation. -Public awareness.Impact Assessment and its significance various stages of EIA, preparation of EMP and EIS, Environmental audit. Ecotourism, Green Campus – Green business and Green politics.

The student should Visit an Industry / Ecosystem and submit a report individually on any issues related to Environmental Studies course and make a power point presentation.

Text Books:

1. Environmental Studies, K. V. S. G. Murali Krishna, VGS Publishers, Vijayawada
2. Environmental Studies, R. Rajagopalan, 2nd Edition, 2011, Oxford University Press.
3. Environmental Studies, P. N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani; Pearson Education, Chennai

Reference:

1. Text Book of Environmental Studies, Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.
2. A Textbook of Environmental Studies, Shaashi Chawla, TMH, New Delhi
3. Environmental Studies, Benny Joseph, Tata McGraw Hill Co, New Delhi
4. Perspectives in Environment Studies, Anubha Kaushik, C P Kaushik, New Age International Publishers, 2014

I Year- II Semester

L	T	P	C
0	0	2	0

PHYSICAL FITNESS ACTIVITIES
(MC)

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I Year- II Semester

L	T	P	C
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MOOCS (NPTEL/ SWAYAM) FOR HONORS/MINORS DEGREE

Learning Objectives:

The students will be able to:

- Avail the expertise in a specific subject from nation-wide reputed faculty, through MOOC (Massive Open Online Course)
- Develop the ability for self-actualization and in getting opportunity for life-long learning

There shall be a Discipline Centric Elective Course through Massive Open Online Course (MOOC) as Program Elective course. The student shall register for the course (Minimum of 12 weeks) offered by SWAYAM/NPTEL through online with the approval of Head of the Department. The Head of the Department shall appoint one mentor for each of the MOOC subjects offered. The student needs to register the course in the SWAYAM/NPTEL portal. During the course, the mentor monitors the student's assignment submissions given by SWAYAM/NPTEL.

The student needs to submit all the assignments given and needs to take final exam at the center. The student has to earn a certificate by passing the exam. The student will be awarded the credits given in curriculum only by submission of the certificate. In case if student does not pass subjects registered through SWAYAM/NPTEL, the same or alternative equivalent subject may be registered again through SWAYAM/NPTEL in the next semester with the recommendation of Head of the Department and shall be passed in the examination.

The list of MOOCS courses is given in the appendix (to do honors in chemical engineering, the eligible student has to choose the subjects in chemical engineering from the list to fulfill the criteria of 20 credits). In order to get minor degree, a student has to select and do the courses in any one discipline other than chemical engineering to fulfil the criteria of 20 credits.

The total 20 credits for honors or minor degree should be obtained from the second semester to the end of eighth semester. A candidate can take a 3-credit course in each semester during the above mentioned period.

It may be noted that, each student is to get minimum 8.0 SGPA without any backlogs in each semester to do honors and minors degree.

Outcomes:

The students are able to:

- Overcome the digital divide in acquiring fast developing technologies / knowledge and be part of digital revolution.
- Acquire subject specific expert knowledge from National Resource Pool.
- Understand his /her academic / professional priorities for future development.

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II Year- I Semester

L	T	P	C
3	0	0	3

MATHEMATICS – IV

Course Objectives:

- To familiarize the complex variables.
- To familiarize the students with the foundations of probability and statistical methods.
- To equip the students to solve application problems in their disciplines.

Course Outcomes: At the end of the course students will be able to

- apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic (L3)
- find the differentiation and integration of complex functions used in engineering problems (L5)
- make use of the Cauchy residue theorem to evaluate certain integrals (L3)
- apply discrete and continuous probability distributions (L3)
- design the components of a classical hypothesis test (L6)
- infer the statistical inferential methods based on small and large sampling tests (L4)

UNIT-I: Functions of a complex variable and Complex integration: **(10 hrs)**

Introduction – Continuity – Differentiability – Analyticity – Properties – Cauchy-Riemann equations in Cartesian and polar coordinates – Harmonic and conjugate harmonic functions – Milne – Thompson method.
Complex integration: Line integral – Cauchy's integral theorem – Cauchy's integral formula – Generalized integral formula (all without proofs).

UNIT-II: Series expansions and Residue Theorem: **(10 hrs)**

Radius of convergence – Expansion in Taylor's series, Maclaurin's series and Laurent series.
Types of Singularities: Isolated – pole of order m – Essential – Residues – Residue theorem (without proof) – Evaluation of real integral of the type $\int_{-\infty}^{\infty} f(x)dx$

UNIT – III: Probability and Distributions: **(10 hrs)**

Review of probability and Baye's theorem – Random variables – Discrete and Continuous random variables – Distribution function – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

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Member

Shri A. Doraiah
Member

Shri S. Swarna Raju
Member

UNIT – IV: Sampling Theory: **(8 hrs)**

Introduction – Population and samples – Sampling distribution of Means and Variance (definition only) – Central limit theorem (without proof) – Introduction to t, χ^2 and F-distributions – Point and Interval estimations – Maximum error of estimate.

UNIT – V: Tests of Hypothesis: **(10 hrs)**

Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance – One tail and two-tail tests – Tests concerning one mean and two means (Large and Small samples) – Tests on proportions.

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **Miller and Freund's,** Probability and Statistics for Engineers, 7/e, Pearson, 2008.

Reference Books:

1. **S. C. Gupta and V. K. Kapoor**, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.
2. **Jay l. Devore,** Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage.
3. **Shron L. Myers, Keying Ye, Ronald E Walpole,** Probability and Statistics Engineers and the Scientists, 8th Edition, Pearson 2007.
4. **Sheldon, M. Ross**, Introduction to probability and statistics Engineers and the Scientists, 4th Edition, Academic Foundation, 2011

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B. TECH. PETROLEUM ENGINEERING

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L	T	P	C
3	0	0	3

MANAGERIAL ECONOMICS & FINANCIAL ACCOUNTING

Learning Objectives:

 The Learning objectives of this paper is to understand the concept and nature of Managerial Economics and its relationship with other disciplines and also to understand the Concept of Demand and Demand forecasting, Production function, Input Output relationship, Cost-Output relationship and Cost-Volume- Profit Analysis.

 To understand the nature of markets, Methods of Pricing in the different market structures and to know the different forms of Business organization and the concept of Business Cycles.

 To learn different Accounting Systems, preparation of Financial Statement and uses of different tools for performance evaluation. Finally, it is also to understand the concept of Capital, Capital Budgeting and the techniques used to evaluate Capital Budgeting proposals.

UNIT-I

Introduction to Managerial Economics and demand Analysis:

Definition of Managerial Economics –Scope of Managerial Economics and its relationship with other subjects

–Concept of Demand, Types of Demand, Determinants of Demand- Demand schedule, Demand curve, Law of Demand and its limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement- Demand forecasting and Methods of forecasting, Concept of Supply and Law of Supply.

UNIT – II:

Theories of Production and Cost Analyses:

Theories of Production function- Law of Variable proportions-Isoquants and Isocosts and choice of least cost factor combination-Concepts of Returns to scale and Economies of scale-Different cost concepts: opportunity costs, explicit and implicit costs- Fixed costs, Variable Costs and Total costs – Cost –Volume-Profit analysis- Determination of Breakeven point(problems)-Managerial significance and limitations of Breakeven point.

UNIT – III:

Introduction to Markets, Theories of the Firm & Pricing Policies:

Market Structures: Perfect Competition, Monopoly, Monopolistic competition and Oligopoly – Features – Price and Output Determination – Managerial Theories of firm: Marris and Williamson's models – other Methods of Pricing: Average cost pricing, Limit Pricing, Market Skimming Pricing, Internet Pricing: (Flat Rate Pricing, Usage sensitive pricing) and Priority Pricing, Business Cycles : Meaning and Features – Phases of a Business Cycle. Features and Evaluation of Sole Trader, Partnership, Joint Stock Company – State/Public Enterprises and their forms.

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UNIT – IV:

Introduction to Accounting & Financing Analysis:

Introduction to Double Entry System, Journal, Ledger, Trail Balance and Preparation of Final Accounts with adjustments – Preparation of Financial Statements-Analysis and Interpretation of Financial Statements-Ratio Analysis – Preparation of Funds flow and cash flow analysis (Problems)

UNIT – V:

Capital and Capital Budgeting: Capital Budgeting: Meaning of Capital-Capitalization-Meaning of Capital Budgeting-Time value of money- Methods of appraising Project profitability: Traditional Methods (pay back period, accounting rate of return) and modern methods (Discounted cash flow method, Net Present Value method, Internal Rate of Return Method and Profitability Index)

Course Outcome:

 The Learner is equipped with the knowledge of estimating the Demand and demand elasticities for a product and the knowledge of understanding of the Input-Output-Cost relationships and estimation of the least cost combination of inputs.

 One is also ready to understand the nature of different markets and Price Output determination under various market conditions and also to have the knowledge of different Business Units.

 The Learner is able to prepare Financial Statements and the usage of various Accounting tools for Analysis and to evaluate various investment project proposals with the help of capital budgeting techniques for decision making.

References:

1. Varshney R.L, K.L Maheswari, Managerial Economics, S. Chand & Company Ltd,
2. JL Pappas and EF Brigham, Managerial Economics, Holt, R & W; New edition edition
3. N.P Srinivasn and M. Sakthivel Murugan, Accounting for Management, S. Chand & Company Ltd,
4. Maheswari S.N, AnIntroduction to Accountancy, Vikas Publishing House Pvt Ltd
5. I.M Pandey, Financial Management , Vikas Publishing House Pvt Ltd
6. V. Maheswari, Managerial Economics, S. Chand & Company Ltd,

BASIC ELECTRICAL & ELECTRONICS ENGINEERING

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II Year- I Semester

L	T	P	C
3	0	0	3

Preamble:
This course covers the topics related to analysis of various electrical circuits, operation of various electrical machines and electronic components to perform well in their respective fields.

Course objectives:

- To learn the basic principles of electrical circuital law's and analysis of networks.
- To understand principle of operation and construction details of DC machines & Transformers.
- To understand principle of operation and construction details of alternator and 3-Phase induction motor.
- To study operation of PN junction diode, half wave, full wave rectifiers and OP-AMPs.
- To learn operation of PNP and NPN transistors and feedback amplifier.

Unit - I
Electrical Circuits
Basic definitions – types of network elements – Ohm's Law – Kirchhoff's Laws – inductive networks – capacitive networks – series – parallel circuits – Mesh and Node Analysis -star-delta and delta-star transformations- simple Numerical Problems.

Unit - II
DC Machines
Principle of operation of DC generator – EMF equation – open circuit characteristics of separately excited DC shunt Generator - types of DC machines – Principle of operation of DC Motor - torque equation – three point starter – speed control methods of DC motor – Swinburne's Test- simple Numerical Problems.

Unit - III
AC Machines:
Transformers
Principle of operation and construction of single phase transformers – EMF equation – Losses – OC & SC tests w.r.t. efficiency and regulation only - simple Numerical Problems.

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r.K.Ramasudha (Member)	Dr.D.Suryanarayana (Member)	Dr.D.M.Vinod Kumar (Member)	Sri K.Praveen Kumar (Member)	Dr.M.Siva Kumar (Member)	Dr.K.Sri Kumar (Chairman)

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Member

AC Rotating Machines

Principle of operation and construction of alternators – types of alternators –Regulation of alternator by synchronous impedance method- principle of operation of 3-Phase induction motor – slip-torque characteristics – efficiency. simple Numerical Problems.

Unit IV

Rectifiers and Linear ICs

PN junction diodes and their characteristics – Rectifiers- half wave and bridge rectifiers - simple Numerical Problems. Characteristics of operation amplifiers (OP-AMP) – application of OP-AMPs (inverting, non-inverting, integrator and differentiator)

Unit V

Transistors

Operation of PNP and NPN junction transistors, transistor as an amplifier – single stage and frequency response of CE amplifier – concepts of feedback amplifier..

Course Outcomes:

The student should be able to:

- Analyse various electrical networks.
- Understand operation of DC generators,3-point starter and DC machine testing by Swinburne's Test.
- Analyse performance of single-phase transformer.
- Explain operation of 3-phase alternator and 3-phase induction motors.
- Analyse operation of half wave, full wave bridge rectifiers and OP-AMPs and Explain single stage CE amplifier and concept of feedback amplifier.

Text Books:

1. Electrical Technology by Surinder Pal Bali, Pearson Publications.
2. Electronic Devices and Circuits by R.L. Boylestad and Louis Nashelsky, 9th edition, PEI/PHI 2006.

Reference Books:

1. Electrical Circuit Theory and Technology by John Bird, Routledge Taylor &Francis Group
2. Basic Electrical Engineering by M.S.Naidu and S.Kamakshiah, TMH Publications
3. Fundamentals of Electrical Engineering by Rajendra Prasad, PHI Publications,2nd edition
4. Basic Electrical Engineering by Nagsarkar, Sukhija, Oxford Publications,2nd edition
5. Industrial Electronics by G.K. Mittal, PHI

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Dr.K.Ramasudha (Member)	**Dr.D.Suryanarayana (Member)**	**Dr.D.M.Vinod Kumar (Member)**	**Sri K.Praveen Kumar (Member)**	**Dr.M.Siva Kumar (Member)**	**Dr.K.Sri Kumar (Chairman)**

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Shri C. V. G. Krishna
Member

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3	0	0	3

PETROLEUM GEOLOGY

Learning Objectives:

- This basic course in geology is designed to train the students to understand the basic of geology, viz: formation of earth, layers of earth, different types of rocks, formation of sedimentary basins to oil and gas accumulation.
- It exposes the students to different geological environments relates to petroleum industry.
- This is a basic course in petroleum geology. The students will be exposed to different source, reservoir and cap-rocks, characterization of reservoir rocks, classification of reservoir pore space, permeability, migration and entrapment, temperature-pressure conditions for the generation of oil and gas from sediments.

UNIT-I:
Origin of the Earth- envelops of the Earth- Crust, mantle, core. Internal dynamics process- Plate tectonics- Continental drift, External dynamic process- Weathering, erosion and deposition. Identification of different structural features encountered in oil exploration Viz: Joints, faults, folds, Unconformities. Origin of igneous, sedimentary and metamorphic rocks. Structures and textures- Petrographic character of conglomerate, sandstone, shale, limestone and dolomite.

UNIT-II:
Introduction to sedimentary basins and deltaic systems. Source rocks: Definition of source rocks. Organic source rocks, nature and types of source rocks- shale.
The process of diagenesis, catagenesis and metagenesis in the formation of source rocks, Kerogen- types, thermal maturation, Subsurface pressure temperature conditions for the generation of oil and gas from the source sediments, Oil window.

UNIT-III:
Characteristics of Reservoir rocks: Classification and nomenclature: Clastic Reservoir Rocks, Carbonate Reservoir Rocks, Unconventional, Fractured and Miscellaneous reservoir rocks, Marine and non-marine reservoir rocks, Concept of Shale oil.
Reservoir Properties and Cap Rocks: Reservoir pore space, porosity- primary and secondary porosity, effective porosity, fracture porosity – permeability, saturation- effective and relative permeability relationship between porosity, permeability. Cap rocks: Definition and characteristics of cap rocks.

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UNIT-IV:

Hydrocarbon migration: Geological framework of migration and accumulation, the concept of hydrocarbon migration from source beds to the carrier beds, Carrier beds to the reservoir,
Free path ways for migration: Short distance and long distance migration, Evidence for migration, Oil and gas seepages.

UNIT-V:

Entrapment and accumulation of hydrocarbons: Classification and types of traps, Structural, stratigraphic and combination type of traps, Traps associated with salt domes.
Sedimentary Basins: Sedimentary basins -origin and classification, Types of basins and their relationship to hydrocarbon prospects,
Tectonic classification, stratigraphic evolution and hydrocarbon accumulations of the following basins: Krishna-Godavari basin, Assam Arakan basin, Cambay basin and Mumbai off-shore.

Outcomes:

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

- Discern the dimension of the earth structure, composition, origin of the earth. It deals essence of scientific studies dealing with the origin, age, structure of the earth and with the evolution, modification, and extinction of various surface and subsurface physical features.
- Be impressed by the fact that the subject is not static and will more likely keep his/her mind open to new ideas.
- Understand the origin of different kinds of igneous, sedimentary, metamorphic rocks that can be understood in terms of their tectonic setting.
- Gain the knowledge on fundamentals of sedimentary basins.
- Identify different source rocks from which hydrocarbons are generated.
- Discern about origin of source rocks, formation of good source rocks, different characterization of reservoir rocks, classification, nomenclature and different source of reservoir rocks, pore space, porosity and its types
- Gain knowledge of how and why fluid hydrocarbons migrate from a source rock to reservoir rock, entrapment and accumulation of hydrocarbons.
- Do tectonic classification, stratigraphy evaluation and hydrocarbon accumulation of KG basin, Cambay basin and Mumbai off-shore.
- Gain knowledge on to evaluate and solve technical problems related to the exploration and production of hydrocarbon reservoirs, from regional to reservoir scale, by interpreting and integrating different types of geological, geophysical data..

Text Book:

1. Geology of Petroleum, A.I. Levorsen, 2nd Edition. CBS, Publishers, 2006.

Reference Books:

1. Elements of Petroleum Geology, Richard, C. Selley, Elsevier, 1997.
2. Sedimentary basins of India- ONGC bulletin.
3. Unconventional Petroleum Geology, Caineng Zou et al., Elsevier, 2013.

University College of Engineering Kakinada (A)
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R19 Course Structure
B. TECH. PETROLEUM ENGINEERING

II Year- I Semester

L	T	P	C
3	0	0	3

CHEMICAL PROCESS PRINCIPLES

Learning Objectives:
The subject of chemical process calculations is intended to make the students understand mainly the calculations involved in material and energy balances across process units. The students will be trained to:

- Understand and correctly implement unit conversions in process calculations.
- Understand and apply theoretical knowledge towards problem solving in chemical processes.
- Analyze and solve elementary material balances in physical and chemical processes.
- Analyze and solve elementary energy balances in reactive and non-reactive processes.
- Formulate and solve combined material and energy balances.
- Realize the relevance of thermodynamics in process calculations.
- Carry out complex process calculations using MS Excel.

UNIT-I
Stoichiometric relations: Basis of calculations, Methods of expressing compositions of mixtures and solutions, density and specific gravity, Baume and API gravity scales, Units and inter conversions
Behavior of Ideal gases: Kinetic theory of gases, Application of ideal gas law, Gaseous mixtures, Gases in chemical reactions.

UNIT-II
Material balances: Tie components, Yield, Material Balance with and without reaction, Conversion. Material balance calculations in simple drying, dissolution and crystallization processes. Processes involving chemical reactions. Processes involving recycles, bypass, purge and other complexities.

UNIT-III
Energy Balances: Energy, energy balances, Heat capacity of gases, liquid and mixture solutions. Kopp's rule, Latent heats, Heat of fusion and Heat of vaporization, Trouton's rule, Kistyakowsky equation for nonpolar liquids enthalpy and its evaluation.
Calculation and applications of heat of reaction, combustion, formation and neutralization, Kirchoff's equation, enthalpy concentration change, calculation of theoretical and actual flame temperatures.

UNIT-IV
VLE: Liquefaction and liquid state, vaporization, boiling point, Effect of temperature on vapor pressure, Antoine equation, Vapor pressure plots (ternary), Estimation of critical properties, Vapor pressure of immiscible liquids and ideal solutions, Raoult's law, Non-volatile solutes.

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Humidity and Saturation: Relative and percentage saturation or dew point, wet bulb and dry bulb temperature, Use of humidity charts for engineering calculations

UNIT-V

Combustion Calculations: Introduction to fuels, Calorific value of fuels, coal, liquid fuels, Gaseous fuels, air requirement and flue gases, Combustion calculations, incomplete combustion, Material and energy balances, Thermal efficiency calculations.

Outcomes:

A student who successfully completes this course will be able to:

- Learn all background information/charts/datasheets required to carry out process calculations. Some of these are vapor pressure correlations, latent heat correlation, steam tables, psychrometric charts, enthalpy-concentration diagrams etc.,
- Formulate and solve simple and moderately complex process calculations associated to industrially prominent chemical processes and technologies.
- Conceptualize an integrated methodology that encompasses the knowledge in other subjects (Physical Chemistry, Thermodynamics and Mathematics) and MS Excel for a systematic and structured approach towards chemical process calculations.
- Analyze chemical processes through the power of modeling and computation. These include back-calculation methods, inventory losses and revenue related assessment etc.

Text Books:

1. Chemical Process Principles, Part -I, Material and Energy Balances, Hougen O A, Watson K. M. and Ragatz R.A., 2nd Edition, CBS Publishers & distributors, New Delhi, 2010.
2. Basic Principles and Calculations in Chemical Engineering, D.H. Himmelblau, 7th Edition. PHI, New Delhi, 2009.

Reference Books:

1. Elementary Principles of Chemical Processes, R. M. Felder and R. W. Rousseau, 3rd Ed., Wiley, 1999.
2. Handbook Chemical Engineering Calculations, N. Chopey, 3rd Edition, Mc-Graw Hill, 2004.
3. Stoichiometry, Bhatt, B. I., Thakore S. B., 5th Ed., Tata Mc-Graw Hill Education 2010.

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B. TECH. PETROLEUM ENGINEERING

II Year- I Semester

L	T	P	C
3	0	0	3

MOMENTUM TRANSFER

Learning Objectives:

This course involves the fundamentals of fluid flow by including both theory and the applications of fluid flow in chemical engineering. Basic concepts of fluid mechanics will be taught to make the students to

- Understand basic concepts associated with fluid flow such as viscosity, shear, Newtonian and non-Newtonian fluids etc.
- Learn and apply Continuity and Navier Stokes equations as fundamental equations for the analysis of chemical processes.
- Learn and apply the concept of Boundary Layer Theory and governing mathematical equations for Newtonian and non-Newtonian fluid flows.
- Learn and apply Bernoulli's equation for various simple and complex cases of fluid flow.
- Understand the basic differences between compressible and incompressible fluid flows and suitably adapt, modify and apply suitable correlations for compressible fluid flows.
- Have sound knowledge with respect to various important fluid flows related machinery and equipment. Emphasis shall be towards flow like including various types of pumps, compressors and blowers, Venturimeter transportation and metering methods, Orifice Meters
- Master the relevant theory for the application of fluid flow past solid surfaces. Emphasis is towards drag and pressure drop correlations for packed and fluidized beds.
- Understand various accessories required for fluid flow in pipelines such as fittings and valves and their relevance towards variation in pressure drop correlations in pipes
- Understand the knowledge related to various fluid flow measuring devices (Venturi, Orifice, Rotameter, hot wire anemometer and Pitot Tube).

UNIT-I

Basic concepts of Dimensional analysis, Nature of fluids, Hydrostatic equilibrium, Applications of fluid statics.

Fluid flow Phenomena-Laminar flow, Shear rate, Shear stress, Rheological properties of fluids, Turbulence, Boundary layers.

UNIT-II

Basic equation of fluid flow –Mass balance in a flowing fluid; continuity, differential momentum balance; Equations of motion, Macroscopic momentum balances, Mechanical energy equations.

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Shri A. Doraiah, Member
Shri S. Swarna Raju, Member

Incompressible Newtonian/Non-Newtonian flow in pipes and channels- shear stress and skin friction in pipes, laminar flow in pipes and channels, Turbulent flow in pipes and channels, friction from changes in velocity or direction, Losses in pipes.

UNIT-III

Flow past immersed bodies, Drag and Drag coefficient, Flow through beds of solids, Motion of particles through fluids.

Fluidization, Conditions for fluidization, Minimum fluidization velocity, Types of fluidization, Expansion of fluidized bed, Applications of fluidization, Continuous fluidization, slurry and pneumatic transport.

UNIT-IV

Transportation and Metering of fluids- Pipes, fittings and valves, Pumps: positive displacement and centrifugal pumps.

Measurement of flowing fluids: full bore meters, insertion meters; Venturi meter, Rotameter, Orifice meter, Hot wire anemometer, Pitot tube, and Other flow metering devices.

UNIT-V

Flow of compressible fluids- Definitions and basic equations, Processes of compressible flow, Isentropic flow through nozzles, Adiabatic frictional flow, and Isothermal frictional flow.

Compressors, fans, blowers, steam ejectors and jets

Outcomes:

By mastering the fluid mechanics course, the students shall be able to:

- Analyze fluid flow in circular and non-circular conduits.
- Do calculations associate to the estimation of friction factor and pressure drop in circular conduits.
- Do calculations involving Bernoulli's equation for the transport of acidic, alkaline, hydrocarbon and miscellaneous incompressible fluids in pipelines.
- Calculate the pressure drops and energy requirements associated to compressible fluid flow in circular and rectangular ducts.
- Estimate pressure drop in packed and fluidized beds.
- Rigorously carry out various calculations associated to fluid flow in various types of pumps, fans and blowers.
- Calculate, analyze and calibrate various flow measuring devices.

Text Books:

1. Unit Operations of Chemical Engineering, McCabe,W.L., J.C.Smith & Peter Harriot McGraw-Hill, 7th Edition, 2001.
2. Transport Processes and Unit Operations, Christie J. Geankoplis, PHI, 2003.

Reference Books:

1. Introduction to Fluid Mechanics, Fox, R.W. and A. T. McDonald, 5th Edition, John Wiley& Sons, 1998.
2. Chemical Engineering, Vol-1: Fluid flow, Heat Transfer and Mass Transfer, J. M. Coulson and J. F. Richardson, Pergamon Press, 4th Edition, 1990.
3. Fluid Mechanics for Chemical Engineers, Noel De Nevers, Tata McGraw-Hill, 2011.
4. Fluid Flow for Chemical and Process Engineers, Bragg R and F. A. Holland, 2nd Edition, Hodder Stoughton Educational, 1995.
5. Fluid Flow for the Practicing Chemical Engineer, Patrick Abulencia, J and Louis Theodore, John wiley and Sons, 2009.

II Year- I Semester

L	T	P	C
0	0	3	1.5

PETROLEUM GEOLOGY LAB

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Chairman

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Member

Shri S. K. S. Charyulu
Member

Shri C. V. G. Krishna
Member

Dr. V.S. R. K. Prasad
Member

Shri A. Doraiah
Member

Shri S. Swarna Raju
Member

Learning Objectives:

- To import fundamental understanding on sedimentary reservoirs associated with oil and gas reservoirs also to impart a sound understanding on distinction between source rocks and the reservoir rocks that includes both conventional and unconventional hydrocarbon reservoirs.
- To identify location of outcrop on the toposheet, geological mapping.
- To measure strike and dip, to learn representation of strike and dip in different locations such as hills beach etc.
- To find importance of litho stratigraphic columns, plotting geological cross sections.
- To determine the location of oil-water contact in the reservoir.

List of Experiments:

1. Identifying the distinction between sedimentary and carbonate reservoir rocks.
2. Location of observed outcrop on the Toposheet. Geological mapping and traversing.
3. Measurement of the strike, dip and apparent and true thickness of the outcrops.
4. Preparation of litho stratigraphic columns correlation, geological cross section.
5. Preparation of structural contour map and location of Oil Water Contact (OWC)
6. Recognizing various hydrocarbon traps.
7. Contour lines/ Isolines, Different maps – (Basin map, structure map)
8. Well correlation (SP and ɣ- ray) (Used for transforming known stratigraphic position in a (key) well to other wells in similar geological setting.
9. Petroleum system – Source rock, migration path, reservoir path, cap rock.
10. Identifying source rock parameters

Outcomes:

- Understand the basics of sedimentary and carbonate reservoir rock.
- Plotting litho stratigraphic column and geological cross-section
- Understand the basics of well correlation used SP and Gamma ray mapping.
- Student can be in a position to plot contour lines and litho stratigraphic column.
- Identifying and understanding source rock parameters.
- Student can understand to confirmation of the height of the oil bearing sand.
- Student can understand how to use the maps to estimate reservoir area and thickness.

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II Year- I Semester

L	T	P	C
0	0	3	1.5

BASIC ENGINEERING (MECH. + ELEC.) LABORATORY

Any SIX experiments from each section

Section A: Mechanical Engineering Laboratory:

Learning Objectives:

 To impart practical exposure on the performance evaluation methods of various mechanical components like, I. C. Engine, Hydraulic turbine, hydraulic pump, Air compressor etc. and also understand the various processes that can be performed on a lathe machine.

List of Experiments:

1. Draw the valve timing diagram of a 4-stroke diesel engine and port timing diagram of a 2-stroke petrol engine.
2. Perform load test on a 4-stroke C.I. Engine and draw the performance curves.
3. Pattern design and making – for one casting drawing.
4. Taper turning and thread cutting on a Lathe machine.
5. Performance on an Impulse/Reaction Hydraulic Turbine.
6. Performance of Centrifugal/Reciprocating Pump.
7. Find the volumetric efficiency, isothermal efficiency of an Air compressor.

Outcomes:

 The student will be able to predict the performance of several mechanical components and operate a lathe machine to produce the required job work.

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B. TECH. PETROLEUM ENGINEERING

Course Objectives:

- To obtain Open Circuit Characteristics of DC shunt generator.
- To predetermine the efficiency of dc shunt machine using Swinburne's test.
- To control speed of dc shunt motor using Armature voltage and Field control methods.
- To predetermine the efficiency and regulation of single-phase transformer with O.C and S.C tests.
- To obtain performance characteristics of a 3-phase induction motor.
- To find out regulation of an alternator by synchronous impedance method.

The following experiments are required to be conducted as compulsory experiments:

1. Open Circuit Characteristics of separately excited DC Shunt Generator
2. Swinburne's test on D.C. Shunt machine (predetermination of efficiency of a given D.C. shunt machine working as motor and generator).
3. Speed control of D.C. Shunt motor by Armature Voltage control and Field control methods
4. OC and SC tests on single phase transformer (predetermination of efficiency and regulation at given power factors).
5. Brake test on 3-phase Induction motor (determination of performance characteristics)
6. Regulation of alternator by Synchronous impedance method.

Dr.Ch.Saibabu (Member)	Dr.S.SivanagaRaju (Member)	Dr.R.SrinivasaRao (Member)	Dr.V.V.N.Murthy (Member)	Dr.B.Sarvesh (Member)	Dr.K.S.Rama Rao (Member)
Dr.K.Ramasudha (Member)	**Dr.D.Suryanarayana (Member)**	**Dr.D.M.Vinod Kumar (Member)**	**Sri K.Praveen Kumar (Member)**	**Dr.M.Siva Kumar (Member)**	**Dr.K.Sri Kumar (Chairman)**

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Member

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Member

Shri C. V. G. Krishna
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Dr. D. Lingaraju
Chairman

Dr. V.S. R. K. Prasad
Member

Shri A. Doraiah
Member

Shri S. Swarna Raju
Member

University College of Engineering Kakinada (A)
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B. TECH. PETROLEUM ENGINEERING

Course Outcomes:

The students should be able to

- Determine the Open Circuit Characteristics of a DC shunt generator.
- Predetermine the efficiency of a DC shunt machine
- Control the speed of dc shunt motor using Armature voltage and Field control methods.
- Estimate the efficiency and regulation for different load conditions and power factors of single phase transformer with OC and SC test.
- Analyze the performance characteristics of a three-phase induction motor.
- Determine the regulation of an alternator by synchronous impedance method.

Dr.Ch.Saibabu (Member)	Dr.S.SivanagaRaju (Member)	Dr.R.SrinivasaRao (Member)	Dr.V.V.N.Murthy (Member)	Dr.B.Sarvesh (Member)	Dr.K.S.Rama Rao (Member)
Dr.K.Ramasudha (Member)	Dr.D.Suryanarayana (Member)	Dr.D.M.Vinod Kumar (Member)	Sri K.Praveen Kumar (Member)	Dr.M.Siva Kumar (Member)	Dr.K.Sri Kumar (Chairman)

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University College of Engineering Kakinada (A)
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B. TECH. PETROLEUM ENGINEERING

II Year- I Semester

L	T	P	C
0	0	3	1.5

MOMENTUM TRANSFER LAB

Learning Objectives:

- Fundamentals of momentum transfer will be demonstrated in a series of laboratory exercises like determination of discharge coefficient of orifice, venturi, notches, friction factors in pipes, pressure drop in packed and fluidized beds, fluid viscosity, characteristics of centrifugal pump, characterization of fluid flow, verification of Bernoulli's theorem, and measurement of point velocities. Hands-on experience and communication skills will be achieved.

List of Experiments:

1. Identification of laminar and turbulent flows
2. Measurement of point velocities
3. Verification of Bernoulli's equation
4. Variation of Orifice coefficient with Reynolds Number
5. Determination of Venturi coefficient
6. Friction losses in Fluid flow in pipes
7. Pressure drop in a packed bed for different fluid velocities
8. Pressure drop and void fraction in a fluidized bed
9. Studying the coefficient of contraction for a given open orifice
10. Studying the coefficient of discharge in notches
11. Studying the Characteristics of a centrifugal pump
12. Viscosity determination using Stoke's law
13. Viscosity determination using Canon-Fenske viscometer

Outcomes:

After completion of the course**,** students will be able to do the following:

- Operate fluid flow equipment and instrumentation.
- Collect and analyze data using momentum transfer principles and experimentation methods.
- Prepare reports following accepted writing and graphical techniques.
- Perform exercises in small teams.
- Demonstrate principles discussed in momentum transfer lecture course.
- Demonstrate appropriate work habits consistent with industry standards.

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University College of Engineering Kakinada (A)
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II Year- I Semester

L	T	P	C
3	0	0	0

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE
(MC)

Learning Objectives:

To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.

- The course aim of the importing basic principle of third process reasoning and inference sustainability is at the course of Indian traditional knowledge system
- To understand the legal framework and traditional knowledge and biological diversity act 2002 and geographical indication act 2003.
- The courses focus on traditional knowledge and intellectual property mechanism of traditional knowledge and protection.
- To know the student traditional knowledge in different sector.

UNIT-I: Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge

Learning Outcomes:

At the end of the unit, the student will able to:

- Understand the traditional knowledge.
- Contrast and compare characteristics importance kinds of traditional knowledge.
- Analyze physical and social contexts of traditional knowledge.
- Evaluate social change on traditional knowledge.

UNIT-II:

Protection of traditional knowledge: the need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

Learning Outcomes:

At the end of the unit, the student will able to:

- Know the need of protecting traditional knowledge.
- Apply significance of tk protection.
- Analyze the value of tk in global economy.

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- Evaluate role of government

UNIT-III:

Legal framework and TK: A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmers Rights Act, 2001 (PPVFR Act); B:The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indications act 2003.

Learning Outcomes:

At the end of the unit the student will able to:

- Understand legal framework of TK.
- Contrast and compare the ST and other traditional forest dwellers
- Analyze plant variant protections
- Evaluate farmers right act

UNIT-IV:

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

Learning Outcomes:

At the end of the unit, the student will able to:

- Understand TK and IPR
- Apply systems of TK protection.
- Analyze legal concepts for the protection of TK.
- Evaluate strategies to increase the protection of TK.

UNIT-V:

Traditional knowledge in different sectors: Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

Learning Outcomes:

At the end of the unit, the student will able to:

- Know TK in different sectors.
- Apply TK in engineering.
- Analyze TK in various sectors.
- Evaluate food security and protection of TK in the country.

Course Outcomes: After completion of the course, students will be able to:

1. Understand the concept of Traditional knowledge and its importance
2. Know the need and importance of protecting traditional knowledge

3. Know the various enactments related to the protection of traditional knowledge.
4. Understand the concepts of Intellectual property to protect the traditional knowledge

Reference Books:

1. Traditional Knowledge System in India, by Amit Jha, 2009.
2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, Pratibha Prakashan 2012.
3. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002
4. "Knowledge Traditions and Practices of India" Kapil Kapoor, Michel Danino

E-Resources:

1. https://www.youtube.com/watch?v=LZP1StpYEPM
2. https://nptel.ac.in/courses/121106003/

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B. TECH. PETROLEUM ENGINEERING

II Year- I Semester

L	T	P	C
0	0	2	0

PHYSICAL FITNESS ACTIVITIES
(MC)

MOOCS (NPTEL/ SWAYAM) FOR HONORS/MINORS DEGREE

Learning Objectives:

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The students will be able to:

- Avail the expertise in a specific subject from nation-wide reputed faculty, through MOOC (Massive Open Online Course)
- Develop the ability for self-actualization and in getting opportunity for life-long learning

There shall be a Discipline Centric Elective Course through Massive Open Online Course (MOOC) as Program Elective course. The student shall register for the course (Minimum of 12 weeks) offered by SWAYAM/NPTEL through online with the approval of Head of the Department. The Head of the Department shall appoint one mentor for each of the MOOC subjects offered. The student needs to register the course in the SWAYAM/NPTEL portal. During the course, the mentor monitors the student's assignment submissions given by SWAYAM/NPTEL.
The student needs to submit all the assignments given and needs to take final exam at the center. The student has to earn a certificate by passing the exam. The student will be awarded the credits given in curriculum only by submission of the certificate.
In case if student does not pass subjects registered through SWAYAM/NPTEL, the same or alternative equivalent subject may be registered again through SWAYAM/NPTEL in the next semester with the recommendation of Head of the Department and shall be passed in the examination.
The list of MOOCS courses is given in the appendix (to do honors in chemical engineering, the eligible student has to choose the subjects in chemical engineering from the list to fulfill the criteria of 20 credits). In order to get minor degree, a student has to select and do the courses in any one discipline other than chemical engineering to fulfil the criteria of 20 credits.
The total 20 credits for honors or minor degree should be obtained from the second semester to the end of eighth semester. A candidate can take a 3-credit course in each semester during the above mentioned period.
It may be noted that, each student is to get minimum 8.0 SGPA without any backlogs in each semester to do honors and minors degree.

Outcomes:

The students are able to:

- Overcome the digital divide in acquiring fast developing technologies / knowledge and be part of digital revolution.
- Acquire subject specific expert knowledge from National Resource Pool.
- Understand his /her academic / professional priorities for future development.

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University College of Engineering Kakinada (A)
Department of Petroleum Engineering & Petrochemical Engineering
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II Year- II Semester

L	T	P	C
3	0	0	3

ELEMENTS OF MECHANICAL ENGINEERING

Learning Objectives:

 The content of this course shall provide the student the basic concepts of various mechanical systems and exposes the student to a wide range of equipment and their utility in a practical situation. It shall provide the fundamental principles of materials, fuels, Steam, I.C. Engines, compressors, hydraulic machines and transmission systems that usually exist in any process plant.

UNIT –I:

Stresses and strains: kinds of – stress-strains, elasticity and plasticity, Hooks law, stress – strain diagrams, modules of elasticity, Poisson's ratio, linear and volumetric strain, relation between E, N, and K, bars of uniform strength, compound bars and temperature stresses.

UNIT–II:

Types of supports – loads – Shear force and bending moment for cantilever and simply supported beams without overhanging for all types of loads.

UNIT-III:

Thin cylindrical shells: stress in cylindrical shells due to internal pressures, circumferential stress, longitudinal stress, design of thin cylindrical shells, spherical shells, change in dimension of the shell due to internal pressure, change in volume of the shell due to internal pressure.

Thick Cylinders: Lame's equation- cylinders subjected to inside and outside pressures columns and Struts.

UNIT-IV:

Steam boilers: Classification of boilers, essentialities of boilers, selection of different types of boilers, study of boilers, boiler mountings and accessories.

Internal combustion engines: classification of IC engines, basic engine components and nomenclature, working principle of engines, Four strokes and two stroke petrol and diesel engines, comparison of CI and SI engines, comparison of four stroke and two stroke engines, simple problems such as indicated power, brake power, friction power, specific fuel consumption, brake thermal efficiency, indicated thermal efficiency and mechanical efficiency.

UNIT-V:

Transmission systems: Belts –Ropes and chain: belt and rope drives, velocity ratio, slip, length of belt , open belt and cross belt drives, ratio of friction tensions, centrifugal tension in a belt, power transmitted by belts and ropes, initial tensions in the belt, simple problems.

Outcomes:

After completing the course, the student shall be able to determine:

 The stress/strain of a mechanical component subjected to loading.

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 The performance of components like Boiler, I.C. Engine, Compressor, Steam/Hydraulic turbine, Belt, Rope and Gear.
 The type of mechanical component suitable for the required power transmission.

Text Books:

1. Strength of Materials and Mechanics of Structures, B.C.Punmia, Standard Publications and distributions, 9 th Edition, 1991.
2. Thermal Engineering, Ballaney,P.L., Khanna Publishers, 2003.
3. Elements of Mechanical Engineering, A.R.Asrani, S.M.Bhatt and P.K.Shah, B.S. Publs**.**
4. Elements of Mechanical Engineering, M.L.Mathur, F.S.Metha&R.P.Tiwari Jain Brothers Publs., 2009**.**

Reference Book:

1. Theory of Machines, S.S. Rattan, Tata McGraw Hil., 2004 & 2009.

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L	T	P	C
3	0	0	3

PROCESS HEAT TRANSFER

Learning Objectives:

- This course is designed to introduce of the phenomena of heat transfer to carry out thermal design/ heat transfer process design for heat exchange systems such as process heat exchangers, reboilers, air/utility coolers/condensers, furnaces, boilers, super-heaters, evaporators, driers, cooling towers etc. The principles involve the estimation of overall heat transfer coefficients, heat transfer surface area, pressure drop involved in single-phase and multi-phase flow regimes.
- Further the students will be trained to acquire skills to carry out the detailed process design of shell and tube heat exchangers such as number tubes, selection of shell and tube material, estimate number of baffles and also provide necessary information regarding TEMA classification. Design of double pipe heat exchangers, both counter current and co-current

UNIT-I

Introduction & Conduction: Nature of heat flow, conduction, convection, natural and forced convection, and radiation. Steady state: Heat transfer by conduction in Solids, Fourier's law, thermal conductivity, steady state conduction in plane wall & composite walls, compound resistances in series.

Heat flow through a cylinder, conduction in spheres, thermal contact resistance, plane wall: variable conductivity. Unsteady state heat conduction, equation for one-dimensional conduction, Semi-infinite solid.

UNIT-II

Principles of heat flow in fluids: Typical heat exchange equipment, countercurrent and parallel current flows, energy balances, rate of heat transfer, overall heat transfer coefficient, electrical analogy, critical radius of insulation, logarithmic mean temperature difference.

Variable overall coefficient, multi-pass in exchangers, individual heat transfer coefficients, resistance form of overall coefficient, fouling factors, classification of individual heat transfer coefficients, magnitudes of heat transfer coefficients, effective coefficients for unsteady-state heat transfer.

UNIT-III

Heat Transfer to Fluids without Phase change: Regimes of heat transfer in fluids, thermal boundary layer, heat transfer by forced convection in laminar flow, heat transfer by forced convection in turbulent flow, the transfer of heat by turbulent eddies. Analogy between transfer of momentum and heat, heat transfer to liquid metals, heating and cooling of fluids in forced convection outside tubes.

Natural convection: Natural convection to air from vertical shapes and horizontal planes, effect of natural convection in laminar flow heat transfer.

UNIT-IV

Heat transfer to fluids with phase change: Heat transfer from condensing vapors, heat transfer to boiling liquids.

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Dr. D. Lingaraju, Chairman

Dr. V.S. R. K. Prasad, Member — Shri A. Doraiah, Member — Shri S. Swarna Raju, Member

Radiation: Properties and definitions, black body radiation, real surfaces, and the grey body. Absorption of radiation by opaque solids, radiation between surfaces, radiation and shielding, combined heat transfer by conduction, convection and radiation.

UNIT-V

Heat Exchange Equipment: General design of heat exchange equipment, heat exchangers, condensers, boilers and calendrias, extended surface equipment, heat transfer in agitated vessels, scraped surface heat exchangers, heat transfer in packed beds, heat exchanger effectiveness (NTU method).

Evaporators: Types of Evaporators, performance of tubular evaporator. Capacity and economy, methods of feeding, multiple effect evaporators, vapor recompression.

Outcomes:

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

- Understand the basic laws of heat transfer.
- Account for the consequence of heat transfer in thermal analyses of engineering systems.
- Analyze problems involving steady state heat conduction in simple geometries.
- Develop solutions for transient heat conduction in simple geometries.
- Obtain numerical solutions for conduction and radiation heat transfer problems.
- Understand the fundamentals of convective heat transfer process.
- Evaluate heat transfer coefficients for natural convection.
- Evaluate heat transfer coefficients for forced convection inside ducts.
- Evaluate heat transfer coefficients for forced convection over exterior surfaces.
- Analyze heat exchanger performance by using the method of log mean temperature difference.
- Analyze heat exchanger performance by using the method of heat exchanger effectiveness.
- Calculate radiation heat transfer between black body surfaces as well as grey body surfaces.

Text Books:

1. Unit Operations of Chemical Engineering, McCabe, W.L., J.C Smith and Peter Harriott, 7th Edition, McGraw-Hill, 2005.
2. Heat Transfer, Y.V.C. Rao, Universities Press (India) Pvt. Ltd., 2001.
3. Heat Transfer, Holman, J.P., 9th Edition, Tata McGraw-Hill, 2008

Reference Books:

1. Process Heat Transfer, D.Q. Kern, Tata- McGraw-Hill, 1997.
2. Schaum's Outline of Heat Transfer, Donald Pitts and L. E. Sisson, 2nd Edition, McGraw-Hill, 1998.
3. A Text Book on Heat Transfer, Sukhatme, P., 5th Edition, Universities Press (India) Pvt. Ltd., 2005.
4. Heat Transfer: Principles and Applications, Binay Dutta, K., PHI Learning, 2009.
5. Chemical Engineering: Fluid Flow, Heat Transfer and Mass Transfer, Coulson, J.M.; Richardson, J.F.; Backhurst, J.R.; Harker, J.H., Vol.1, 6th Edition, Reed Elsevier India, 2006.

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B. TECH. PETROLEUM ENGINEERING

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L	T	P	C
3	0	0	3

MATERIALS SCIENCE & ENGINEERING

Learning objectives:
This subject is intended to:

- Provide all the technical/engineering inputs to the learner to choose or select suitable materials of construction of chemical/petrochemical process equipment, piping and internals.
- Impart expertise to the material so that it meets the specific life expectancy, by reducing the shutdown frequency.
- Learn the techniques in minimizing equipment breakdown and increasing the on-stream factor.
- Gain knowledge in choosing/selecting the material such that it withstands the severe process operating conditions such as cryogenic, high temperature, high pressure, acidic, basic, stress induced chemical/petrochemical environments keeping view the reliability and safety of the process equipment.

UNIT- I
Introduction: Engineering Materials – Classification – levels of structure.Crystal Geometry and Structure Determination: Space lattice and Unit cell. Bravais lattices, crystal systems with examples. Lattice coordinates, Miller indices, Bravais indices for directions and places: crystalline and non-crystalline solids; ionic, covalent and metallic solids; packing efficiency, coordination number; structure determination by Bragg's X-ray diffraction and powder methods.

UNIT -II
Crystal Imperfection: Point defects, line defects-edge and screw dislocation, Berger's circuit and Berger's vectors, dislocation reaction, dislocation motion, multiplication of dislocations during deformation.
Role of dislocation on crystal properties; surface defects, dislocation density and stress required to move dislocations.

UNIT -III
Basic thermodynamic functions: phase diagrams and phase transformation: Primary and binary systems-general types with examples; tie line& lever rule, non- equilibrium cooling: phase diagrams of Fe-Fe3-C, Pb-Sn, Cu-Ni systems.

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Shri C. V. G. Krishna, Member
Dr. D. Lingaraju, Chairman
Dr. V.S. R. K. Prasad, Member
Shri A. Doraiah, Member
Shri S. Swarna Raju, Member

Phase transformations in Fe-Fe3-C steels, Time-Temperature-Transformation (TTT) curves for eutectoid steels and plain carbon steels; effect of alloying elements on properties of steels; types of steels, alloys and other metals used in chemical industry.

UNIT -IV

Elastic, an elastic and plastic deformations in solid materials; rubber like elasticity, visco elastic behavior (models); shear strength of real and perfect crystals, work hardening mechanisms, cold working, hot working; dynamic recovery, recrystallization, grain growth, grain size and yield stress, Brief description of heat treatment in steels.

Magnetic materials: Terminology and classification, magnetic moments due to electron spin, ferro-magnetism and related phenomena, domain structure, hysteresis loop, soft and hard magnetic materials.

UNIT- V

Fracture in ductile and brittle materials, creep: mechanism of creep and methods to reduce creeping in materials, creep rates and relations. Fatigue-mechanisms and methods to improve fatigue resistance in materials. Composite materials: types; stress-strain relations in composite materials, applications.
Oxidation and Corrosion: Mechanisms of oxidation, oxidation resistant materials, principles and types of corrosion, protection against corrosion.

Outcomes:

After the course, the students will be able to:

- Equipped with knowledge to understand material selection diagram, evaluation of equipment life and prediction of life of the equipment.
- Acquiring the abilities to carryout reliability studies.
- Ready to carryout equipment failure analysis and propose the remedial measures

Text books:

1. Materials Science and Engineering, Raghavan, V., 5th Edition, PHI, New Delhi, 2009.
2. Material Science and Engineering, Ravi Prakash, William F. Smith and Javed Hashemi, 4th Edition, Tata-McGraw Hill, 2008.

Reference Books:

1. Elements of Materials Science, L.R. Van Vlack,
2. Science of Engineering Materials, vols. 1&2, ManasChanda, McMillan Company of India Ltd.
3. Materials Science and Engineering, Bala Subramaniam, R., Callister's, Wiley, 2010

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B. TECH. PETROLEUM ENGINEERING

II Year- II Semester

L	T	P	C
3	0	0	3

PETROLEUM EXPLORATION.

Learning Objectives:

- The syllabus for petroleum exploration should be aimed at the students to have a broad knowledge of exploration history in India. The students should know what are the basic methods; which are used in petroleum exploration with special emphasis on gravity/magnetic and more importantly the students should understand in detail about the Seismic methods which are the back bone of the whole gamut of oil exploration,
- At the same time sedimentology and biostratigraphy are also important to understand the sedimentary sequences holding hydrocarbons as the knowledge of these will help in the log interpretation also.

UNIT-I:
Introduction: Overview of petroleum exploration in India, Introduction to Geophysical/Geological methods used in petroleum exploration.
Sedimentological methods in hydrocarbon exploration biostratigraphic methods in hydrocarbon exploration.

UNIT-II:
Basic concepts of Gravity/Magnetic methods: Newton's gravitational law- Units of gravity- Gravity measuring instruments- Gravity survey- Gravity anomalies- Gravity data reduction- Drift- latitude- Elevation and free air correction- Free air & bouguer anomalies- Gravity response of simple shapes- Interpretation of gravity anomalies- Application of gravity methods.

UNIT-III:
The geomagnetic field- Magnetic anomalies- Magnetic survey-instruments- Field method of magnetic surveys- Reduction of magnetic data - Diurnal correction and geomagnetic correction- Interpretation of magnetic anomaly- Response of magnetic method for different type of bodies and geological structure- Application of magnetic surveys both overland and from air.

UNIT-IV:
Basic Concepts of seismic methods: Seismic refraction surveys- Geometry of refracted path, planar interface – Two-layer case with horizontal interface- Methodology of refraction profiling- Recording instruments & energy sources- Corrections applied to refraction data, Interpretation of refraction data - Application of seismic refraction method.

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UNIT-V:

Geometry of reflected ray path: Single horizontal reflector- The reflection seismograph and seismogram (Seismic traces)- Importance of seismic reflection survey over seismic refraction survey technique- Common depth point (CDP) profiling and stacking- 2D, 3D, & 4D seismic surveys - Field procedures and principles - Time corrections applied to seismic data- Data processing - Introduction to 2D, 3D & 4D data acquisition, interpretation of reflection data for identification of drillable structures.

Outcomes:

- It gives insight to the students to have a broad based understanding of the seismic exploration, viz. its acquisition methods, processing and interpretation, as they have already had geology in IInd year course. The knowledge of these methods will go a long way along with the other subject i. e., well completion, reservoir engineering so that they can opt for upstream industry jobs.
- Students should be able to interpret GM & Seismic data for identification of oil bearing structures.

Text Books:

1. Introduction to Geophysical Prospecting, Milton B. Dobrin, and Carl H. Savit, 4th Edition, McGraw Hill, 1988.
2. Outlines of Geophysical Prospecting: A Manual for Geologists, M.B. Ramachandra Rao,
3. EBD Educational Pvt. Ltd., 1993.
4. Field Geophysics, John Milsom and Asger Eriksen, 4th Edition, John Wiley, 2011.

Reference Books:

1. Elements of Geology: Oil and Gas Exploration Techniques, J. Guillemot, Technip 1991.
2. Hydrocarbon Well Logging Recommended Practice, Society of Professional Well Log Analysts.
3. Open – Hole Log Analysis and Formation Evaluation, Richard M. Batemons, International Human Resources Development Corporation, Bostan, 1985.
4. Well Logging for Earth Scientists, Darwin V. Ellis, Julian M. Singer, Springer, 2007.
5. Fundamentals of Well Log Interpretation: The Acquisition of Data, Oberto Serra, Elsevier, 1984.
6. Well Logging Handbook, Oberto Serra, Editions Technip, 2008.

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II Year- II Semester

L	T	P	C
3	0	0	3

THERMODYNAMICS FOR PETROLEUM ENGINEERS

Learning Objectives:

- This course is designed to make the students:
- Understand zeroth, first, second and third laws of thermodynamics.
- Discern various thermodynamic properties such as internal energy, specific volume, enthalpy, entropy, specific heat etc. from fundamental correlations.
- Learn the application of various thermodynamic laws for the analysis of Petroleum processes.
- Understand the concept and models of residual and excess Gibbs energy and the associated calculations for VLE, VLLE, SVE and SLE.
- Learn the application of the laws of thermodynamics for hydrocarbon characterization, thermodynamic behavior of Oil and Natural Gas, its handling, storage and transport.

UNIT-I:

Introduction: The scope of thermodynamics, defined quantities; temperature, volume, pressure, work, energy, heat, Joules Experiments, SI units.

The first law and other basic concepts: The first law of thermodynamics, thermodynamic state and state functions, enthalpy, The steady-state steady flow process, Equilibrium, The reversible process, constant-V and constant- P processes, heat capacity.

UNIT-II:

Volumetric properties of pure fluids: The PVT behavior of pure substances, virial equations, the ideal gas, the applications of the virial equations, Cubic equations of state, generalized correlations for gases.

UNIT-III:

The second law of thermodynamics: Statements of the second law, heat engines, thermodynamic temperature scales, thermodynamic temperature and the ideal-gas scale. Entropy, Entropy changes of an ideal gas, mathematical statement of the second law, the third law of thermodynamics. Calculation of ideal work and lost work, Examples on thermodynamic behavior of Oil and Natural Gas under Reservoir conditions.

UNIT-IV:

Thermodynamic properties of fluids: Property relations for homogeneous phases, Residual properties, two phase systems, thermodynamic diagrams, tables of thermodynamic properties, generalized property correlations for gases.

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Dr. D. Lingaraju, Chairman

Dr. V.S. R. K. Prasad, Member — Shri A. Doraiah, Member — Shri S. Swarna Raju, Member

Thermodynamics of flow processes; Principles of conservation of mass and energy for flow systems, Analysis of expansion processes; turbines, throttling; compression processes – compressors and pumps.

UNIT-V:

Solution thermodynamics: Basic concepts of chemical potential, Phase equilibria, partial properties, fugacity coefficient, residual and excess Gibbs free energy, Correlations for the estimation of fugacity coefficient, Residual and excess Gibbs energy in vapor liquid equilibria.

Phase Equilibria: Gamma/Phi formulation of VLE, VLE from Virial Equations Of State and cubic equations of state, Introduction to Vapor- Liquid–Liquid equilibrium (VLLE), Solid-Liquid equilibrium (SLE) and Solid-Vapor equilibrium (SVE), Equilibrium adsorption of gases on solids.

Outcomes:

After completion of the course, the students shall be able to:

- Become conversant with all the basic concepts of thermodynamics and gain working knowledge in open, closed, isothermal, isobaric and isentropic processes.
- Use thermodynamic tables and diagrams for the estimation of internal energy, specific volume, enthalpy and entropy.
- Apply equations such as ideal gas law, Vander Waal's equation and other cubic equations of state for the characterization of process parameters.
- Determine efficiencies of turbines, pumps, compressors, blowers and nozzles.
- Rigorously use residual and excess Gibbs free energy models for design of oil and natural gas processing systems.

Text Book:

1. Introduction to Chemical Engineering Thermodynamics, Smith, J. M., H. C. Van Ness and M.M. Abbott, 6th Edition, 8th reprint, McGraw Hill, 2006.

Reference Books:

1. Characterization and Properties of Petroleum Fractions, M. R. Riaze, ASTM, International, 2005.
2. Equation of State and PVT analysis, Tarek Ahmed, Gulf publishing company, 2007.
3. Engineering and Chemical Thermodynamics, Koretsky, M. D., John Wiley & Sons, 2004.
4. Introductory Chemical Engineering Thermodynamics, Richard Elliott, J. and Carl T. Lira, 2nd Edition, Prentice Hall, 2012.
5. Chemical, Biochemical and Engineering Thermodynamics, Stanley Sandler, 4th Edition, Wiley India Pvt. Ltd, 2006.
6. Thermodynamics: Applications in Chemical Engineering and the Petroleum Industry, Vidal, J., Edition Technip, 2003.
7. Chemical and Process Thermodynamics, Kyle, B.G., 3rd Edition, PHI Learning, 2008.
8. Chemical Engineering Thermodynamics, Thomas E. Dauber, McGraw Hill, 1985.

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B. TECH. PETROLEUM ENGINEERING

II Year- II Semester

L	T	P	C
3	0	0	3

INSTRUMENTATION, PROCESS DYNAMICS & CONTROL

Learning objectives:

- To learn the basic elements of an instrument and its static and dynamic characteristics.
- To study various types of industrial thermometers.
- To learn various types of instruments for measurement of pressure, vacuum, head and density measurement.
- Visualize and understand the behavior and logic of different types of advanced controllers and their strategies.
- To understand how Laplace transforms can be used to get solutions of transfer function equations for different types of systems.
- To understand the basic procedure to derive transfer functions for first order, pseudo second order and second order systems.
- To understand the importance of under damped second order systems in relation to the real life situations.
- To calculate the overall transfer function and thus offset calculation from the control system block diagram.
- To understand the concept of stability, stability criterion and frequency response analysis for sinusoidal forcing functions.
- To understand the behavior and tuning of a controller and the calculation of controller parameters.
- To understand the inherent and effective characteristics of different types of control valves and the usage of valve positioners to induce linear characteristic into a non-linear control valve.

UNIT-I:

Fundamentals: Elements of instruments, static and dynamic characteristics of instruments. Industrial Thermometers**:** Mercury in glass thermometer - Bimetallic thermometer - Pressure spring thermometer, Thermo-electricity – types of thermocouples – Thermocouple lead wires. Resistance-thermometers: RTD and bridge circuits (2 wire, 3 wire and 4 wire - method) - Radiation receiving elements- pyrometers.

UNIT-II:

Pressure, vacuum and head: Liquid column manometers - Measuring elements for gauge pressure and vacuum-indicating elements for pressure gauges - Measurement of absolute pressure - Measuring pressure in corrosive liquids - Static accuracy and response of pressure gauges.

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Shri A. Doraiah, Member
Shri S. Swarna Raju, Member

Density and specific gravity measurements- Direct measurement of liquid level - Pressure measurement in open vessels - Level measurements in pressure vessels - Measurement of interface level - Density measurement and level of dry materials.

UNIT-III:

Introduction to process dynamics and control, Response of First Order Systems, Physical examples of first order systems.

Response of first order systems in series, higher order systems: Second order and transportation lag. Control systems Controllers and final control elements.

UNIT-IV:

Closed loop transfer functions, Transient response of simple control systems.

Stability: Stability Criterion, Routh Test, Root locus, Introduction to frequency response, Bode stability criterion, concept on gain and phase margins

UNIT-V:

Advanced control strategies: Cascade control, Feed forward control, ratio control, dead time compensation, internal model control.

Controller tuning and process identification. Control valves.

Outcomes:

At the completion of the course students should be able to:

- Understand the basic elements of an instrument and its characteristics.
- Become familiar with various types of instruments for the measurement of various process variables like temperature, pressure, vacuum, head, and density.
- Usage of partial fractions and Laplace transforms for converting ordinary differential equations into simple algebraic equations which are easier to solve.
- Write different types of unsteady and steady state balances
- Describe a process, how it works and what the control objectives are.
- Describe processes with appropriate block diagrams.
- Numerically model a process.
- Identify the stability limits of a system.
- Apply the advance control strategies.
- Tune process controllers.
- Experimentally determine the dynamic behavior of a process.
- Design and operate control valves.

Text Book:

1. Process Systems Analysis and Control, D.R. Coughanowr, 3rd Ed. McGraw Hill
2. Industrial Instrumentation, Donald P. Eckman, CBS, 2004.

Reference Books:

1. Chemical Process Control, G. Stephanopoulos, Prentice Hall, 1984.

2. Coulson and Richardson's Chemical Engineering, Volume-3, 3rd Edition: Chemical and Biochemical Reactors and Process Control, Richardson J. F. et.al, Elsevier India, 2006.
3. Automatic Process Control, Donald P. Eckman, John wiley, Reprint 2011.
4. Instrumentation and Control Systems, K. Padmaraju, Y.J. Reddy, Mc Graw Hill Education, 2016.
5. Process Dynamics and Control, Dale Seaborg, Thomas F. Edgar, Duncan Mellichamp, 2nd Edition, Wiley India Pvt. Ltd., 2006.
6. Principles of Process Control. Patranabis, 3rd Edition McGraw-Hill Education Pvt. Ltd., 2012.
7. Modern Control Engineering, Katsuhiko Ogata, 5th Edition, Prentice Hall, 2010.
8. Principles and Practices of Automatic Process Control, Carlos A. Smith, Armando B. Corripio, 3rd International Edition, John Wiley and Sons, 2005.

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II Year- II Semester

L	T	P	C
0	0	3	1.5

PROCESS HEAT TRANSFER LAB

Learning Objectives:

- Fundamentals of process heat transfer will be demonstrated in a series of laboratory exercises like determination of thermal conductivities of composite wall and metal rod, natural convective and forced convective heat transfer coefficients, both film and overall coefficients, Stefen-Boltzman constant, emissivity of a metal plate etc. Students will achieve hands-on experience and acquire communication skills while conducting experiments in a team.

List of Experiments:

1. Determination of total thermal resistance and thermal conductivity of composite wall.
2. Determination of thermal conductivity of a metal rod.
3. Determination of natural convective heat transfer coefficient for a vertical rod.
4. Determination of critical heat flux point for pool boiling of water.
5. Determination of forced convective heat transfer coefficient for air flowing through a pipe.
6. Determination of overall heat transfer coefficient in double pipe heat exchanger.
7. Study of the temperature distribution along the length of a pin-fin under natural and forced convection conditions
8. Estimation of un-steady state film heat transfer coefficient between the medium in which the body is cooled.
9. Determination of Stefan – Boltzmann constant.
10. Determination of emissivity of a given plate at various temperatures.

Outcomes:

Upon successful completion of this lab course, the student will be able to:

- Understand the basics of experimental techniques for heat transfer measurements.
- Operate the heat transfer equipment like heat exchangers
- Process experimental data and obtain correlations to predict heat transfer coefficients for design of heat transfer systems.
- Conduct the experiments at R & D level in the industry
- Understand the professional and ethical responsibilities in the field of heat transfer.
- Produce a written laboratory report.

II Year- II Semester

L	T	P	C
0	0	3	1.5

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INSTRUMENTATION, PROCESS DYNAMICS & CONTROL LAB

Learning Objectives:

- To calibrate and determine the time lag of various first and second order instruments.
- To determine the response in single and two capacity systems with and with-out interaction.
- To understand the advanced control methods used for complex processes in the industries. Different experiments like Temperature, level and pressure control can be configured and studied.
- To study the open loop (Manual control) and the on/off controller, Proportional controller, PI controller, PD controller, PID controller, Tuning of controller (Open loop and close loop methods).
- To understand the control valve operation and its flow characteristics.
- To determine the damping coefficient and response of U-tube manometer.

Experiments:

1. Determination of time constant & transportation lag for mercury in glass thermometer with and without thermal well.
2. Sinusoidal response of mercury in glass thermometer with and without thermal well.
3. Study of dynamic response of single tank liquid level system, two tank non-interacting and interacting liquid level systems.
4. Study of dynamic response of two tank Determination of damping coefficient for U-tube:
    a. Water manometer
    b. Mercury manometer
5. Study of control valve characteristics and determine valve flow coefficient for the following valves:
    a. Equal percentage valve
    b. Quick opening valve
    c. Linear valve
6. Determination of hysteresis for the following valves:
    a. Equal percentage valve
    b. Quick opening valve
    c. Linear valve
7. Temperature control trainer:
    a. Open loop response
    b. On-off control
    c. P-control
    d. PID-control

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e. Auto tuning

8. Level control trainer:
    a. Open loop response
    b. On-off control
    c. P-control
    d. PID-control
    e. Auto tuning
9. Pressure control trainer:
    a. Open loop response
    b. On-off control
    c. P-control
    d. PID-control
    e. Auto tuning
10. Study of hysteresis of bourdon tube pressure gauge tester
11. Temperature Measurement apparatus:
    a. Study the characteristics of different types of temperature sensors: RTD, Thermistor, Temperature transmitter and thermocouple
    b. Determine the time constant and study the characteristics of bi-metallic thermometer
    c. Study the see back effect
12. Flow measurement apparatus:
    Study of different types of flow measurement devices: Venturi meter, orifice meter, water meter, rotameter and Pitot tube.

Outcomes:

The student will be able to:

- Estimate the dynamic characteristics of first and second order systems.
- Apply the advanced control methods used for complex processes in the industries.
- Screen and suggest controllers like On/Off, P, PI, PD and PID for process systems.
- Identify the stability of the system.

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II Year- II Semester

L	T	P	C
0	0	0	1.5

SOCIALLY RELEVANT PROJECTS
(HSSMS)

Awareness Programmes on:

1. Swachh Bharath Programme
2. Blood Donation Service activity
3. Health & Environment
4. Visit to Orphanage
5. Energy Saving Project (conventional)
6. Road Safety Program
7. Save Girl Child
8. Safety at home
9. Social Forestry
10. Self-defense for Women

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L	T	P	C
0	0	2	0

PHYSICAL FITNESS ACTIVITIES
(MC)

Prof. K. V. Rao Member	Shri S. K. S. Charyulu Member	Shri C. V. G. Krishna Member

Dr. D. Lingaraju
Chairman

Dr. V.S. R. K. Prasad Member	Shri A. Doraiah Member	Shri S. Swarna Raju Member

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MOOCS (NPTEL/ SWAYAM) FOR HONORS/MINORS DEGREE

Learning Objectives:

The students will be able to:

 Avail the expertise in a specific subject from nation-wide reputed faculty, through MOOC (Massive Open Online Course)

 Develop the ability for self-actualization and in getting opportunity for life-long learning

There shall be a Discipline Centric Elective Course through Massive Open Online Course (MOOC) as Program Elective course. The student shall register for the course (Minimum of 12 weeks) offered by SWAYAM/NPTEL through online with the approval of Head of the Department. The Head of the Department shall appoint one mentor for each of the MOOC subjects offered. The student needs to register the course in the SWAYAM/NPTEL portal. During the course, the mentor monitors the student's assignment submissions given by SWAYAM/NPTEL.

The student needs to submit all the assignments given and needs to take final exam at the center. The student has to earn a certificate by passing the exam. The student will be awarded the credits given in curriculum only by submission of the certificate. In case if student does not pass subjects registered through SWAYAM/NPTEL, the same or alternative equivalent subject may be registered again through SWAYAM/NPTEL in the next semester with the recommendation of Head of the Department and shall be passed in the examination.

The list of MOOCS courses is given in the appendix (to do honors in chemical engineering, the eligible student has to choose the subjects in chemical engineering from the list to fulfill the criteria of 20 credits). In order to get minor degree, a student has to select and do the courses in any one discipline other than chemical engineering to fulfil the criteria of 20 credits.

The total 20 credits for honors or minor degree should be obtained from the second semester to the end of eighth semester. A candidate can take a 3-credit course in each semester during the above mentioned period.

It may be noted that, each student is to get minimum 8.0 SGPA without any backlogs in each semester to do honors and minors degree.

Outcomes:

The students are able to:

 Overcome the digital divide in acquiring fast developing technologies / knowledge and be part of digital revolution.

 Acquire subject specific expert knowledge from National Resource Pool.

 Understand his /her academic / professional priorities for future development

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III Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
WELL LOGGING & FORMATION EVALUATION					

Learning objectives:

The students will be able to learn:

- The basic concepts of logging.
- Delineation of hydrocarbons through direct and indirect logging methods.
- The concepts of formation lithology through logs like S.P, G.R etc. and also depositional environment with the help of Gamma rays spectroscopy and Dip-meter tools.
- The physical properties of the subsurface, strata like resistivity, porosity, thickness etc. through tools like latero, induction, density, neutron, etc.
- The calculation of hydrocarbon saturation using the data acquired by the logging tools.
- The estimation of hydrocarbons reserves in a particular block.
- The interpretation of log data with the help of advanced technology tools namely, Scanner, NMR, Modular formation tester etc.

UNIT-I

Concepts of Well Logging: What is well logging? - logging terminology - borehole environment - borehole temperature and pressure - log header and depth scale-major components of well logging unit and logging setup- classification of well logging methods-log presentation- log quality control.

Direct Methods: Mud logging- coring – conventional and sidewall coring - core analysis.

UNIT-II

Open Hole Logging: SP Logging- origin of SP, uses of SP log-calculation of salinity of formation water- shaliness - factors influence SP log.

Resistivity Log: Single point resistance log (SPR)- conventional resistivity logs-response of potential and gradient logs over thin and thick conductive and resistive formations - limitations of conventional resistivity tools. Focused resistivity log-advantages of focused resistivity tools over conventional resistivity tools.

Micro-Resistivity Log: Conventional and focused micro resistivity logs and their application.

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Induction Log: Principle of induction tool and the advantages, criteria for selection of induction and lateral logging tool, determination of true resistivity (Rt) of the formation - resistivity index - Archie's equation.

UNIT-III

Gamma Ray Log: principle of radioactivity - uses of gamma ray log- determination of shaliness of formation-API counts- calibration of gamma ray tool - statistical fluctuation- time constant.

Natural Spectral Gamma ray log: Principle and application.

Caliper Log: Principle and application of caliper tool.

Density Log: Principle of density tool- environmental corrections - porosity determination - tool calibration, litho density log.

Neutron Log: Principle and application of neutron tool, porosity determination.

Sonic Log: Principle and application of sonic log - bore hole compensation - determination of primary and secondary porosity, determination of mechanical properties of rock, elastic constants, fractures etc.,

UNIT-IV

Cased Hole Logging: Gamma ray spectral log - neutron decay time log - determination of fluid saturation behind casing - cement bond log - casing collar log - depth control - free point locater - casing inspection logs.

Production Logging: Solving production problems with the help of fluid density log - temperature log and flow meter logs.

UNIT-V

Advances in Well Logging: Dip meter log - formation tester - cased hole resistivity logs -nuclear magnetic resonance log & scanner logs (sonic scanner, MR scanner RT scanner). Calculating the dip of the formations, collection of fluid samples from wells for confirmation of log interpretation, and also recording resistivity in cased holes.

Interpretation: Quick look interpretation - cross plots. Neutron - density, sonic - density, sonic - neutron cross plots - Hingle plot - mid plot – correlation - hydrocarbon reserve estimate.

Outcomes:

The students are able to:

- Apply the basic concepts of logging.
- Delineate hydrocarbons through direct and indirect logging methods.
- Apply the concepts to determine the formation lithology through logs like S.P, G.R etc. and also depositional environment with the help of Gamma rays spectroscopy and Dip-meter tools.
- Calculate the physical properties of the subsurface, strata like resistivity, porosity, thickness etc. through tools like latero, induction, density, neutron, etc.

- Calculate hydrocarbon saturation using the data acquired by the logging tools.
- Estimate the hydrocarbons reserves in a particular block.
- Interpret the log data with the help of advanced technology tools namely, Scanner, NMR, Modular formation tester etc.

Text Books:

1. Formation Evaluation, Edward J. Lynch, Harper & Row, 1962.
2. Well Logging and Formation Evaluation, Toby Darling, Elsevier, New York, 2005.
3. Well Logging & Reservoir Evaluation, Oberto Serra, Editions Technip, 2007.

Reference Books:

1. Basic Well Logging and Formation Evaluation, Prof.Dr.JurgenSchon, First Edition, Bookboon publishers, 2015.

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DRILLING & WELL COMPLETIONS					

Learning Objectives:

The students will be able to:

- Understand the planning of drilling a well, the process of drilling and various equipment used for drilling and design of the drill string.
- Know the importance of drilling fluid and properties and hydraulics of drilling fluids.
- Understand different types of casings lowered in a well, the requirement of cementation in a well and cement slurry design.
- Learn the different tools used for directional drilling and various techniques, fishing, stuck pipe and well control concepts.
- Understand the fundamentals of well testing.
- Understand the planning and designing of well completion after testing of the hydrocarbon zones available.

UNIT-I

Overview of Drilling: Drilling plan - GTO -types of drilling, hydrostatic pressure, pore pressure, causes of abnormal pore pressure, abnormal pore pressure evaluation - measurement while drilling & logging while drilling data -direct measurements of pore pressure – drilling fluid properties - drilling fluid hydraulics calculations - bit hydraulics formation integrity tests – fracture gradient determination – theory of wellbore – FIT procedural guidelines – predicting fracture gradient.

UNIT-II

Wellbore stability – In-situ stress - determination of rock properties, failure criteria – stress distribution around a wellbore - safe mud weights to prevent hole collapse, kick tolerance use of kick tolerance to calculate wellbore pressures.

Casing: Functions of casing – types of casing – casing properties and specifications – casing connections – factors influencing casing design – combination strings – tension criterion - compression loads – biaxial effects – tri axial analysis.

Cementation: Introduction to cement slurries - cementing nomenclature - cement additives.

UNIT III

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(a) Directional Drilling: Well planning - deflection tools and techniques - face orientation - direction control with rotary assemblies - navigation drilling systems; horizontal wells – well profile design considerations – torque and drag –extended reach well design – multilateral wells. Kicks – BOP - special kick problems and procedures to free the pipes and fishing operations

b) Well Completion: Types of wells- types of completion. Perforation methods. Packers: Function – Application.

UNIT IV

Completion equipment (SSD, SSSV, mandrels, locks etc.) –Subsea well completions, permanent gauges - memory gauges - intelligent completion equipment. Tubing string design.

UNIT-V

Drill Stem Testing: General Procedure and considerations - test tool components and arrangement - analysis of test data. HPHT and horizontal well completions, work over operations, CTU & slick line operations.

Outcomes:

The students are able to:

- Plan the drilling of a well, using various drilling equipment.
- Assess the application of drilling fluids.
- Apply the hydraulics of drilling fluids for different situations.
- Design different types of casings and cementation.
- Use the different tools for directional drilling, fishing, stuck pipe and well control.
- Perform well testing.
- Plan and design of well completions.

Text Books:

1. Petroleum Engineering: Drilling and Well Completion, Carl Gatlin, Prentice-Hall, Inc., 1960.
2. Working Guide to Drilling Equipment and Operations, William Lyons, Gulf Publishing, 2009.
3 Well Completion and Servicing, D. Perrin, Micheal Caron, Georges Gaillot, Editions Technip, 1999.
4 Primer of Well Service, Workover and Completion, Petroleum Extension Service (PETEX), University of Texas at Austin, 1997.

Reference Books:

1. Drilling Engineering, J.J. Azar and G. Robello Samuel, Pennwell Books, 2007.
2. Oil Well Drilling Engineering: Principles and Practice, H. Rabia, Graham & Trotman, 1985.
3. Drilling Engineering: A Complete Well Planning Approach, Neal Adams, Tommie CharrierPennwell, 1985.
4. Practical Well Planning and Drilling Manual, Steve Devereux, Pennwell, 1998.
5. Formulas and Calculation for Drilling, Production and Workover, Norton J. Lapeyrouse, 2nd Edition, Gulf Publishing, 2002.
6. Applied Drilling Engineering, Adam T. Bourgoyne Jr., Keith K. Millheim, Martine E. Chenevert and F. S. Young Jr., Society of Petroleum Engineers, 1991.
7. Well Engineering and Construction, HussainRabia, Entrac Consulting, 2002.
8. Fundamentals of Drilling Engineering, Robert F. Mitchell, Stefan Z. Miska, Society of Petroleum Engineers, 2011.
9 Well Completion Design, Jonathan Bellarby, Elsevier, 2009.
10. Petroleum Engineering: Principles and Practice, J.S Archer & C.G. Wall, Graham & Trotman, Inc., 1986.
11. Advanced Well Completion Engineering, Wan Renpu, Gulf Professional Publishing, 2011.
12 Well Testing, John Lee, Society of Petroleum Engineers, 1982.

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PETROLEUM RESERVOIR ENGINEERING-I					

Learning Objectives:
The students will be able to learn:

- The basic concepts of reservoir engineering.
- PVT analysis for oil & gas reservoirs.
- The material balance applied to oil & gas reservoirs.
- The concepts of Darcy's law and its applications.
- The derivation of diffusivity equation and its applications.
- The derivation of well inflow equations for stabilized flow conditions.

UNIT-I
Basic Concepts in Reservoir Engineering: Calculation of hydrocarbon volumes- fluid pressure regimes- oil recovery and recovery factor-volumetric gas reservoir engineering – application of the real gas equation of state - gas material balance and recovery factor- hydrocarbon phase behavior.

UNIT-II
PVT analysis for oil: Definition of the basic PVT parameters – collection of fluid samples - determination of the basic parameters in the laboratory and conversion for field operating conditions - alternative manner of expressing PVT lab analysis results - complete PVT analysis.

UNIT-III
Material Balance Applied To Oil Reservoirs: General form -the material balance expressed as a linear equation- reservoir drive mechanism- solution gas drive- gas cap drive- natural water drive- compaction drive under related pore compressibility phenomena.

UNIT-IV
Darcy's Law and Applications: Darcy's law and field potential- sign convention- units and unit conversion- real gas potential – datum pressures- radial steady state flow and well stimulation- two phase flow- effective and relative permeabilities.

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UNIT-V

Radial Diffusivity Equation: The basic differential equation for radial flow in a porous medium- derivation of the basic radial differential equation – conditions of solution – the linearization of the equation for slightly compressible fluids.

Well Inflow Estimation for Stabilized Flow Conditions: Semi steady state solution – steady state solution – example of the application of the stabilized inflow equations – generalized form of inflow equation under semi steady state conditions.

Outcomes:

The students are able to:

- Apply the basic concepts of reservoir engineering.
- Calculate PVT properties for oil & gas.
- Perform the material balance for oil & gas reservoirs.
- Apply the concepts of Darcy's law.
- Adopt the diffusivity equation to solve reservoir engineering problems.
- Apply the well inflow equations for stabilized flow conditions to calculate deliverability of reservoirs.

Text Books:

1. Fundamentals of Reservoir Engineering, L.P. Dake, Elsevier Science, 1978 (17^{th} Impression 1998).
2. B. C. Craft – M. Hawkins Applied Petroleum Reservoir Engineering, Third Edition, Revised by Ronald E. Terry & J. Brandon Rogers, Prentice Hall, New York, 2014.

Reference Books:

1. Reservoir Engineering Handbook, Tarek Ahmed, 3^{rd}Edition, Gulf Professional Publishing, 2006.
2. Petroleum Engineering: Principles and Practice, J.S Archer & C.G. Wall, Graham &Trotman Inc. 1986.
3. Basic Reservoir Engineering, Rene Cosse, Editions Technip, 1993.
4. Petroleum Reservoir Engineering, James W. Amyx, Daniel M. Bass Jr., Robert L. Whiting, McGraw Hill, 1960.
5. Practical Reservoir Engineering and Characterization, Baker, R – Harvey W. Y and

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		3	**0**	**0**	**3**
PETROLEUM PRODUCTION ENGINEERING					

Learning Objectives:
The students will be able to learn:

- Fundamental concepts in petroleum production engineering.
- The concepts of reservoir deliverability and well bore performance.
- The calculations for choke performance in oil & gas wells, well deliverability - nodal analysis and production decline analysis.
- The theory, design and operation of equipment in various artificial lift techniques.
- The various methods of well stimulation.

UNIT-I
Petroleum Production System: Overall view, production from various types of reservoir based on drive mechanisms, field development method, safety control system.
Properties of Oil and Natural Gas: Solution gas-oil ratio, density of oil and gas, viscosity of oil and gas, formation volume factor of oil and gas, oil and gas compressibility, specific gravity of gas and gas pseudo critical pressure and temperature.

UNIT-II
Reservoir Deliverability: Flow regimes - transient, steady state, pseudo steady state IPR for various types of wells.
Well bore Performance: Single & multiphase liquid flow in oil wells, single phase & mist flow in gas wells.
Choke Performance: Sonic & subsonic flow, single & multiphase flow in oil & gas wells.

UNIT-III
Well Deliverability: Nodal analysis with bottom-hole node, well head node and choke node for oil and gas wells.
Forecast of Well Production: Oil and gas production during transient flow period and pseudo transient period.
Production Decline Analysis: Exponential, harmonic and hyperbolic decline methods-model identification-determination of model parameters.

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UNIT-IV

Artificial Lift Methods: Sucker rod pumping system- selection of unit and types of unit, Load & power requirements, performance analysis; electrical submersible pumps: principle, design & operation; gas lift system: types, evaluation of potential compression requirements, study of flow characteristics, principles of compression, types of compressors, selection of gas lift valves, types of valves, principles of valve operation, setting & testing.

UNIT-V

Well Stimulation: Well problem identification; matrix acidizing- design for sandstone & carbonate reservoirs, hydraulic fracturing – formation fracture pressure, geometry, productivity of fractured wells, hydro-fracture design, selection of fracturing fluid, propant, post frac evaluation.

Outcomes:

The students are able to:

- Apply the concepts in petroleum production engineering.
- Perform the calculations in reservoir deliverability and well bore performance.
- Perform the calculations for choke performance in oil & gas wells, well deliverability, and production forecasting and production decline analysis.
- Design and assess the application of equipment for various artificial lift systems.
- Design and execute matrix acidizing and hydro-fracturing operations.

Text Books:

1. Petroleum Production Engineering: A Computer Assisted Approach, BoyunGuo, William C. Lyons, Ali Ghalambor, Elsevier Science & Technology Books, 2007.
2. Petroleum Production Systems, M. J. Economides, A. Daniel Hill & C. E. Economides, Prentice Hall, 1994.

Reference Books:

1. Production Technology I-II, Institute of Petroleum Engineering, Herriot Watt University.
2. The Technology of Artificial Lift Method, Vol. 1, Brown E., Pennwell Books, 1977.

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		3	**0**	**0**	**3**
CBM RESERVOIR ENGINEERING (PROFESSIONAL ELECTIVE-I)					

Learning Objectives:
The students will be able to learn:

- The overview of scenario of CBM.
- The basic concepts of geology of coal.
- The basic principles of sorption and isotherms.
- The CBM reservoir characterization.
- The concepts of reserve estimation.
- The methods for drilling and completions of CBM wells.
- The concepts of hydro-fracturing of coal seams.
- The environmental aspects of CBM production.
- The methods of dealing with effluent production and disposal.

UNIT-I
Introduction: Overview of Coal Bed Methane (CBM) in India – CBM vs conventional reservoirs. Geological influences on cleat formation of coals – coal chemistry – significance of rank – cleat system and natural fracturing.

UNIT-II
Sorption: Principles of Adsorption-the isotherm construction-CH_4 retention by coal seams-CH_4 content determination in coal seams-the isotherm for recovery - prediction - model of the micro-pores-coal sorption of other molecular species. Reservoir analysis: coal as a reservoir - permeability-porosity-gas flow-reserve analysis-well spacing and drainage area-enhanced recovery.

UNIT-III
Well Construction: Drilling-Cementing. Formation evaluations, logging: borehole environment -tool measurement response in coal-wire line log evaluation of CBM wells -gas-in-place calculations -recovery factor -drainage area calculations - coal permeability/cleating-natural fracturing and stress orientation -mechanical rock properties in CBM evaluation.

UNIT – IV
Completions: Open hole completions -open hole cavitation process, cased hole completions- multi zone entry in cased hole.

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UNIT-V

Hydraulic Fracturing of Coal Seams: Need for fracturing coals - unique problems in fracturing coals - types of fracturing fluids for coal-in situ conditions - visual observation of fractures.

Water Production and Disposal: Water production rates from methane wells - chemical content - environmental regulations - water disposal techniques - economics of coal bed methane recovery - application of CO_2 sequestration.

Outcomes:

The students are able to:

- Assess the CBM reservoirs for commercial exploitation.
- Determine the coal properties for evaluation of coal formation.
- Construct of Langmuir isotherms for the CBM production behavior.
- Estimate the CBM reserves.
- Carryout drilling and completions of CBM wells.
- Plan and execute the hydro-fracturing of the coal seams.
- Assess the suitable environmental control methods of CBM production.

Text Books:

1. Fundamentals of Coal Bed Methane Reservoir Engineering, John Seidle, Pennwell Corp., 2011.
2. Coal Bed Methane: Principles and Practice, R. E. Rogers, 3rd Edition, Prentice Hall, 1994.
3. Coal Bed Methane, Robert A. Lamarre, American Association of Petroleum Geologists, 2008.

Reference Books:

1. Coal Bed Methane, Society of Petroleum, 1992.
2. A Guide to Coal Bed Methane Operations, B. A. Hollub, Society of Petroleum, 1992.

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III Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
EQUATION OF STATE AND PVT ANALYSIS (PROFESSIONAL ELECTIVE-I)					

Learning Objectives:
The students will be able to learn:

- The fundamentals of hydrocarbon phase behavior.
- The characterization of hydrocarbon-plus fractions.
- The calculation of PVT properties of crude oils.
- The concepts of equations of state and phase equilibria and their applications to petroleum fluids.
- The issues related to flow assurance.

UNIT – I:
Fundamentals of Hydrocarbon Phase Behavior: Single-component systems, two-component systems, three-component systems, multicomponent systems, classification of reservoirs and reservoir fluids, phase rule.

UNIT – II:
Characterizing Hydrocarbon-Plus Fractions: Generalized correlations, PNA determination, graphical correlations, splitting and lumping schemes.
Natural Gas Properties: Behavior of ideal gases and real gases.

UNIT – III:
PVT Properties of Crude Oils: Crude oil gravity, specific gravity of the solution gas, crude oil density, gas solubility, bubble-point pressure, oil formation volume factor, isothermal compressibility coefficient of crude oil, under saturated oil properties, total-formation volume factor, crude oil viscosity, surface/interfacial tension, PVT correlations for oil, gas and water-laboratory analysis of reservoir fluids.

UNIT – IV:
Equations of State and Phase Equilibria: Equilibrium ratios, flash calculations, equilibrium ratios for real solutions, equilibrium ratios for the plus fractions, vapor-liquid equilibrium calculations, EOS and its applications-simulation of laboratory PVT data by EOS- tuning EOS parameters, original fluid composition from a sample contaminated with oil-based mud.

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UNIT – V:

Flow Assurance: Assessment of risk, phase behavior of asphaltenes-asphaltene deposit envelope-modeling the asphaltene deposit-phase behavior of waxes- modeling wax deposit-prediction of wax appearance temperature-gas hydrates.

Outcomes:

The students are able to:

- Assess the phase behavior of hydrocarbon systems.
- Characterize the hydrocarbon-plus fractions for the PVT analysis.
- Calculate the PVT properties of reservoir fluids.
- Apply the concepts of equations of state and phase equilibria to the petroleum fluids.
- Assess the issues related to flow assurance and accordingly design the flow systems.

Text Book:

1. Equations of State and PVT Analysis: Applications for Improved Reservoir Modeling, 2nd Edition, Tarek Ahmed, Ph.D., P.E., Gulf Professional Publishing, 2016.

References Books:

1. Working guide to vapor liquid phase equilibria calculations, Tarek Ahmed, Elsevier, 2009.
2. The properties of petroleum fluids, William D. McCain, PennWell, 1990.
3. Petroleum reservoir rock and fluid properties, Abhijit Y. Dandekar, Taylor and Francis, CRC, 2006.

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III Year - I Semester

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MATHEMATICAL METHODS FOR PETROLEUM ENGINEERS - LABORATORY

Learning Objectives:

The students will be able to learn:

- The application of MATLAB to solve various rigorous and iterative problems related to various petroleum engineering topics.
- The what-if analysis for the variations in the parameters using mathematical methods.

List of problems:

1. Solution of simultaneous equations for steady state material balance on a separation train.
2. Linear regressions after proper transformation to a linear expression for vapor-pressure correlation by Clapeyron Equation.
3. Fitting polynomials & correlations using vapor pressure data.
4. Solution of single non-linear algebraic equation for bubble point calculation of an ideal binary mixture.
5. Least square method of analysis to obtain the relation between friction factor and Reynolds number.
6. Graphical integration for calculation of average velocity for flow of water.
7. Determination of molar volume and compressibility from Redlich – Kwong equation
8. Calculation of flow rate in a pipeline.
9. Calculation of compressibility factors using van der Waals equation.
10. Thermodynamic properties of steam from Redlich – Kwong equation
11. Method of lines for partial differential equations to obtain temperatures along the slab.
12. Correlation of experimental data on heat capacity, viscosity and thermal conductivity to polynomials.

Outcome:

- The students are able to write MATLAB code and solve typical problems encountered in petroleum engineering.

Textbook:

1. Problem solving in Chemical and Biochemical Engineering with POLYMATH, Excel and MATLAB, Michael B. Cutlip and Mordechai Shacham, 2nd edition, Prentice Hall, 2008

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		0	**0**	**3**	**1.5**
DRILLING FLUIDS LABORATORY					

Learning Objective:

The students will be able to learn:

- The determination of the properties of different drilling fluids.

List of Experiments:

1. Measurement of drilling fluid weight.
   Equipment: The Baroid mud balance
2. Measurement of mud viscosity.
   Equipment: Marsh funnel
3. Measurement of pH of mud.
   Equipment: pH meter and hydrion pH dispensers
4. Determination of mud rheology (Viscosity, Gel strength, and Yield point).
   Equipment: The Baroid rheometer
5. Determination of the loss of liquid from a mud.
   Equipment: Standard API filter press
6. Measurement of a drilling mud cake and evaluate resistivity.
   Equipment: Baroid digital resistivity meter
7. Measurement of the effect of adding bentonite on mud properties.
8. Drilling fluid contamination test (Salt, Gypsum & Cement contamination) and their effect on the drilling fluid properties.
9. Measurement of solid and liquid content and emulsification characteristics of drilling fluid.
   Equipment: Sand content set, fann emulsion and electrical stability testers
10. Measurement of Oil, water, solid and clay content.
    Equipment: Oil/ water retort kit

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11. Measurement of water ratios for Portland cement slurry.
    (Effect of water ratio on free water separation normal and minimum water content and thickening time)
    Equipment: The atmospheric consistometer

12. Measurement of specific gravity of cement slurry
    Equipment: specific gravity bottles

13. Measurement of consistency of cement
    Equipment: vi-cat apparatus
14. Measurement of initial and final setting times of given cement slurry

15. Measurement of compressive strength of cement test moulds and effect of temperature and pressure on setting of the slurry.
    Equipment: Compressive strength testing machine

Outcomes:
The students are able to**:**

- Assess the quality of various muds and their applications in drilling safely accounting the desired parameters.
- Carry out consultation jobs for healthy construction of open oil / gas wells.

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		0	**0**	**3**	**1.5**
DRILLING SIMULATION LABORATORY					

Learning Objectives:
The students will be able to learn:

- The drilling simulation lab familiarizes student not only the normal drilling operations but also abnormal conditions in drilling.
- The acquaintance with the drilling operations preventing abnormal conditions like Wall kicks, Blowouts, Mud losses etc.
- The knowledge of how to handle the BOP, Panels, Choke manifold, remote panel etc., in case of any emergency situation.
- The drilling simulation lab covers all abnormal drilling operations that help the student to have total knowledge of the drilling in live conditions.

The following experiments are to be carried out using a drilling simulator:

1. **Familiarization and line-up of operational components – I**: Sand pipe manifold, draw work console, drilling console.
2. **Familiarization and line-up of operational components – II:** Blow out preventer (BOP) panel, remote panel.
3. **Familiarization and line-up of operational components – III:** Choke manifold.
4. **Operation of major components – I:** Mud pumps, operating slow circulation rate, operating the rotary table,
5. **Operation of major components – II:** Pulling weight on bit running in and pulling out of hole, remote choke panel operating.
6. **Kick identifications:** Setting flow alarms (deviation mud volume), setting flow alarms for return mud volume, identifying kick warning signs.
7. **Well shut in procedures:** Utilizing shut in procedures to kill well, well control computations.
8. Studies on the effect of weight on drill bit and rotary speed on the rate of penetration and wear of the bit.
9. Studies on the effect of mud density on the penetration and wear of the bit.
10. Studies on the effect of flow rate on the penetration and wear of the bit.

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Outcomes:

The students are able to:

- Familiarize with abnormal drilling operations and handle any drilling situation without any panic.
- Conversant with the BOP, control panel, remote control panel etc.
- Identify the abnormal activities much in advance and plan to prevent the Kick, blowout etc.
- Become a drilling engineer by improving the rate of drilling even in critical conditions.

University College of Engineering Kakinada (A)
Department of Petroleum Engineering & Petrochemical Engineering
R19 Course Structure
B. TECH. PETROLEUM ENGINEERING

III Year- I Semester

L	T	P	C
0	0	1	0.5

SOCIALLY RELEVANT PROJECT FOR PETROLEUM ENGINEERS

Learning Objectives:
The students will be able to learn:

- Identify socially relevant projects based on petroleum engineering
- Work as a team to develop the project.

After identifying a socially relevant project, a team of students will develop a prototype project for execution. A few of the projects are suggested below.

Some of the Socially Relevant Projects:

11. Development of a prototype plant for the conversion of plastics
12. Development of a water purification system for villages
13. Development of a waste water treatment system for villages
14. Utilization of coringa leaves
15. Development of natural pesticides
16. Home biogas plant based on spoiled carbohydrate materials
17. Development of solar powered cycle.
18. Design of wind mills on abandoned offshore platform.
19. Development of prototype equipment for absorption of CO_2.
20. Development of domestic biogas plant based on spoiled carbohydrate materials.

Outcomes:
The students are able to:

- Assess the needs and problems of society.
- Design and implement the system in the project.
- Develop a sense of social and civic responsibility.
- Acquire leadership qualities to work in a team.
- Develop competence required for working together and sharing responsibility.

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University College of Engineering Kakinada (A)
Department of Petroleum Engineering & Petrochemical Engineering
R19 Course Structure
B. TECH. PETROLEUM ENGINEERING

III Year- I Semester

L	T	P	C
0	0	0	0

PHYSICAL FITNESS ACTIVITY

University College of Engineering Kakinada (A)
Department of Petroleum Engineering & Petrochemical Engineering
R19 Course Structure
B. TECH. PETROLEUM ENGINEERING

III Year- I Semester

L	T	P	C
0	0	0	0

INDUSTRIAL VISITS

Learning Objectives:
The students will be able to be aware of industrial environment, culture, requirements, nature of jobs and to develop accordingly.

Visits to Industries:
During the semester, all the students are required to visit minimum 6 major industries like ONGC, RIL, GAIL, OIL, Halliburton, Schlumberger, GE and petroleum refineries etc. accompanied by two faculty members. After each visit, every student should submit a very brief report on the details of industry with flow diagrams and salient features of the operations that include safety and environmental aspects.

Evaluation of the report:
The reports of the industrial visits will be evaluated by a committee appointed by Head of the Department.

Outcomes:
The students will be able to:

- Differentiate between the academic training and its relevance to industry.
- Understand the industrial safety measures.

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University College of Engineering Kakinada (A)
Department of Petroleum Engineering & Petrochemical Engineering
R19 Course Structure
B. TECH. PETROLEUM ENGINEERING
MOOCS (NPTEL/ SWAYAM) FOR HONORS/MINORS DEGREE

Learning Objectives:
The students are able to:

- Avail the expertise in a specific subject from nation-wide reputed faculty, through MOOC (Massive Open Online Course)
- Develop the ability for self-actualization and in getting opportunity for life-long learning

There shall be a Discipline Centric Elective Course through Massive Open Online Course (MOOC) as Program Elective course. The student shall register for the course (Minimum of 12 weeks) offered by SWAYAM/NPTEL through online. The course is selected in consultation with MOOCS coordinator/Mentor and with the approval of Head of the Department. During the course, the coordinator monitors the student's progress in the SWAYAM/NPTEL courses.

The students need to submit all the assignments given and take final exam. Each student has to earn a certificate by passing the exam. Each student will be awarded the credits given in curriculum only after submission of the certificate. If student does not pass the subjects registered through SWAYAM/NPTEL, the same or alternative equivalent subject may be registered and studied again through SWAYAM/NPTEL in the next semester to submit the certificate.

The list of MOOCS/department courses is given in the Appendix – I to do honors in petroleum engineering. The eligible student is expected to choose the subjects from the list. To fulfill the criteria of qualifying for honors degree, 20 credits should be obtained at the end of final semester. In order to get minor degree, a student has to select and do the courses in any one discipline (from the list given in the Appendix – II) other than petroleum engineering to fulfil the criteria of 20 credits.

The total 20 credits for honors or minors degree should be obtained from the second semester to the end of eighth semester. A candidate can take a 3-credit course in each semester during the above mentioned period.
It may be noted that, each student is to get minimum 8.0 SGPA without any backlogs in each semester to do honors / minors degree.

Outcomes:
The students will be able to:

- Overcome the digital divide in acquiring fast developing technologies / knowledge and be part of digital revolution.
- Acquire subject specific expert knowledge from National Resource Pool.
- Understand his /her academic / professional priorities for future development.

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University College of Engineering Kakinada (A)
Department of Petroleum Engineering & Petrochemical Engineering
R19 Course Structure
B. TECH. PETROLEUM ENGINEERING

III Year - II Semester		L	T	P	C
		3	0	0	3
PETROLEUM REFINERY & PETROCHEMICAL ENGINEERING					

Learning Objectives:
The students will be able to:

- Understand the properties and their significance of crude oils and petroleum fractions.
- Know the details of the various petroleum refinery processes including primary, secondary and supporting processes.
- Learn the various aspects of environmental pollution, its control and waste disposal methods.
- Understand the process technologies for the various petrochemical products.

UNIT-I
Introduction: Overall refinery operations & Indian scenario.
Refinery feed stocks: Crude oil classification - composition and properties – evaluation of crude oils.

UNIT-II
Petroleum Products and their specifications: LPG – gasoline - diesel fuels - jet and turbine fuels – lube oils - heating oils – residual fuel oils - wax and asphalt- petroleum coke - all product specifications - product blending.

UNIT-III
Crude distillation: Atmospheric and vacuum distillation units, auxiliary equipment such as desalters, pipe-still heaters and heat exchanger trains etc.
Catalytic reforming and isomerization: Catalytic reforming processes (for petroleum and petrochemical feed stocks) – isomerization processes - feed stocks - feed preparation – process variables - yields.
Environmental issues: Pollution in petroleum processes and operations-control, and disposal methods.

UNIT-IV
Thermal & Catalytic cracking processes: Visbreaking- delayed coking –fluid catalytic cracking and hydrocracking - feed stocks — catalysts - process variables – product recoveries- yield estimation.

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Hydro treating & Hydro processing: Naphtha, kerosene, diesel, VGO & resid, hydro treating / hydro processing – feed stocks – process description and process variables.

UNIT-V

Petrochemical Industry: – Indian petrochemical industry- feed stocks – process description and process variables - naphtha cracking-gas cracking and gas reforming.
Chemicals from gas reforming: Methanol- acetic acid- ammonia and urea.

Chemicals from ethylene: Ethylene oxide-monoethylene glycol - ethyl benzene-styrene.
Polymers: LDPE, HDPE & LLDPE and polypropylene – PVC - polystyrene.

Outcomes:
The students are able to:

- Estimate the quantities of various petroleum products obtained from various types of crude oil processing.
- Analyze and design the various petroleum refinery processes including primary, secondary, treatment and supporting processes.
- Assess the various aspects of environmental pollution to design the control and waste disposal methods.
- Design the processes and equipment for various petrochemical products.

Text Books:

1. Petroleum Refining: Technology and Economics, J.H. Gary and G. E. Handwerk, 4th Edition, Marcel Dekkar, Inc., 2001.
2. Elements of Petroleum Processing, D S Jones, Wiley 1995.
3. Petrochemical Process Technology, ID Mall, Macmillan India Ltd., 2007.

Reference Books:

1. Petroleum Refining Engineering, WL Nelson, 4th Edition, McGraw Hill Company, 1958.
2. Chemical Technology of Petroleum, W. S. Gruese and D.R. Stevens, McGraw Hill, 1960.
3. Fundamentals of Petroleum Chemical Technology, P Belov, Mir Publishers, 1970.
4. Petrochemical Processes, A. Chauvel and G.Lefebvre, Volume 1 & 2, Gulf Publishing Company, 1989.
5. Chemistry of Petrochemical Processes, Sami Mater, Lewis F. Hatch, 2nd Edition, Gulf Professional Publishing, 2001.

6. Chemicals from Petroleum: An Introductory Survey, Waddams, A.L., 4th Edition, Gulf Publishing, 1978.
7. Handbook of Petrochemicals Production Processes, R.A. Meyers, TRW,Inc., 2005.
8. Petrochemical Processes Handbook, Hydrocarbon Processing, 2010.

Prof. K. V. Rao
Member

Shri S. K. S. Charyulu
Member

Shri C. V. G. Krishna
Member

Dr. D. Lingaraju
Chairman

Dr. V.S. R. K. Prasad
Member

Shri A. Doraiah
Member

Shri S. Swarna Raju
Member

University College of Engineering Kakinada (A)
Department of Petroleum Engineering & Petrochemical Engineering
R19 Course Structure
B. TECH. PETROLEUM ENGINEERING

III Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
PETROLEUM RESERVOIR ENGINEERING-II					

Learning Objectives:
The students will be able to learn:

- The fundamentals as well as advanced topics in reservoir engineering like the constant terminal rate solution.
- The principles of oil and gas well testing to evaluate productivity and reservoir parameters.
- The concepts of gas and water coning.
- The theory on natural water influx in oil and gas reservoirs.
- The principles of water and gas flooding.

UNIT – I
Radial Diffusivity Equation: The constant terminal rate solution of the radial diffusivity equation and its application to oil well testing: the constant terminal rate solution – transient, semi steady state and steady state flow conditions – dimensionless variables.
General Theory of Well Testing: The Mathews, Brons, Hazebroek pressure build up theory - pressure build up analysis techniques – single rate and multi rate drawdown testing – the effects of partial well completion – after flow analysis.

UNIT– II
Gas Well Testing: Linearization and solution of the basic differential equation for the radial flow of a real gas – the Russel, Goodrich et. al. solution technique – the al Hussain, Ramey, Crawford solution techniques – non-Darcy flow – determination of the non- Darcy coefficient - the constant terminal rate solution for the flow of a real gas – general theory of gas well testing – single and multi-rate drawdown testing of gas wells.

UNIT– III
Pressure Build up Testing of Gas Wells: Pressure build up analysis in solution gas drive reservoirs-analysis of well tests using type curves- interference and pulse tests - flow after flow tests in gas wells- isochronal & modified isochronal tests- use of pseudo pressure in gas well test analysis- injection well testing.

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UNIT– IV

Gas and Water Coning: Basic concepts in coning, Coning in vertical and horizontal wells, critical rate and breakthrough time calculations from various correlations-After breakthrough time calculations.

Natural Water Influx: The unsteady state water influx theory of hurst and van everdingen and its application in history matching – the approximate water influx theory of fetkovich for finite aquifers predicting the amount of water influx – application of influx calculation techniques to steam soaking.

UNIT– V

Immiscible Displacement: Physical assumptions and their implication – the fractional flow equation – buckley-leverette one dimensional displacement – oil recovery calculation – displacement under segregated flow conditions – allowance for the effect of finite capillary transition zone in displacement calculations – displacement in stratified reservoir.

Outcomes:

The students will be able to:

- Apply the fundamentals as well as advanced topics to derive diffusivity equation and its solutions applicable to oil and gas wells.
- Analyze oil and gas well test data to evaluate productivity and reservoir parameters.
- Apply the concepts of gas and water coning to calculate critical rates and break through times.
- Estimate the water influx in oil and gas reservoirs using steady state and un-steady state equations.
- Apply the principles of water and gas flooding to improve recoveries.

Text Books:

1. Fundamentals of Reservoir Engineering, L.P. Dake, Elsevier Science, 1978 (17thImpression 1998).
2. Reservoir Engineering Handbook, Tarek Ahmed, 3rd Edition, Gulf Professional Publishing, 2006.
3. B. C. Craft – M. Hawkins, Ronald E. Terry & J. Brandon Rogers, 3rd revised Edition, Prentice Hall, New York, 2014.

Reference Books:

1. Petroleum Engineering: Principles and Practice, J.S Archer & C.G. Wall, Graham &Trotman Inc. 1986.
2. Basic Reservoir Engineering, Rene Cosse, Editions Technip, 1993.

3. Petroleum Reservoir Engineering, James W Amyx, Daniel M. Bass Jr., Robert L. Whiting, McGraw Hill, 1960.

III Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Petroleum Exploration and Engineering (OPEN ELECTIVE-I for other branches)					

Learning Objectives:
The students will be able to learn:

- The basics on hydrocarbons, natural gas, crude oil, hydrates, heavy oil, oil sands.
- The basics of geology, formation of petroelum, migration, traps, shale oil and gas, abiogenic theory of petroleum formation.
- The fundamentals of petroleum exploration and drilling.
- The concepts of production from onshore and offshore reservoirs.
- The scenarios of accidents during drilling and production.
- The scenario of future of petroleum industry.

UNIT – I:
Petroleum and Human Society: Introduction, Alternatives to Petroleum , Climate.
What is Petroleum?: Introduction, Hydrocarbons, Natural Gas, Crude Oil, Hydrates, Heavy Oil, Oil Sands.

UNIT – II:
Where Does Petroleum Come from and where is it Now?: Introduction, background in geology, formation of petroelum, migration, traps, shale oil and gas, abiogenic theory of petroleum formation.

UNIT – III:
Finding Petroleum: Introdcution, seeps and anticlines, gravity surveys, seismic surveys, magnetic surveyes, surface geochemisty, drilling.
Drilling: Introduction, cable drilling, rotary drilling: introduction, drill bits, drilling mud, casing and cementing, drilling rigs, operation of rotary drilling rig, directiona, horizontal and multilateral drilling, blowout prevention, fishing.

UNIT – IV:
Producing Petroleum on Land: Introduction, oil and gas flow in rocks; single-phase flow, oil and gas flow in rocks: multi-phase flow, interfacial tension, fracturring, pressure maintenance, well spacing, gas production from hydrates.

Producing Petroelum Under the Sea: Introduction, early history, mobiel submersible drilling rigs, jack-up platforms, fixed platforms, floating systems, seabed systems, moving petroleum from offshore.

UNIT – V:

Petroleum Accidents: Introduction, drilling accidents, onshore production accidents, offshore production accidents, transportation accidents.

The Future of Petroleum: Introduction, technological development, economic and political developments.

Outcomes:

The students are able to:

- Assess the deposits of crude oil, natural gas, hydrates, heavy oils and oil sands & their exploitation.
- Apply the basics of geology, formation of petroelum, migration, entrapment, shale oil and gas in the exploitation of oil and gas.
- Analyse petroleum exploration and drilling operations.
- Apply the concepts of production from onshore and offshore reservoirs.
- Evaluate the accidents during drilling and production.
- Assess the future of petroleum industry.

Text Book:

1. Introduction to Petroleum Exploration and Engineering, Andrew Palmer, World Scientific Publishing Co. Pte. Ltd., 2017.

University College of Engineering Kakinada (A)
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R19 Course Structure
B. TECH. PETROLEUM ENGINEERING

III Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
FUNDAMENTALS OF OFFSHORE OPERATIONS **OPEN ELECTIVE-II (for other branches)**					

Leaning Objectives:
The students will be able to learn:

- The history and basic concepts of offshore operations of oil and gas.
- The details of various types of drilling rigs and their structures.
- The concepts of drilling an offshore well.
- The techniques of drilling of exploration & development wells and completions.
- The concepts of production and workover operations.
- The various modes of oil and gas transportation.

UNIT – I:
Introduction: First offshore operations in the U.S., the scope of offshore operations.
Oil and Gas: Characteristics of oil and gas, characteristics of rock, types of rocks, origin of oil and gas, migration and accumulation of oil and gas, traps.
Exploration: Magnetic surveys, gravity surveys, seismic surveys, drilling locations.

UNIT – II:
Drilling Rigs: Bottom-supported units, floating units.

UNIT – III:
Drilling a Well: Bits and drilling fluid, circulating system, rotating systems, power system, hoisting system, drilling personnel.

UNIT – IV:
Exploration Drilling: Selecting a rig, drilling from bottom-supported units, drilling from floating units, formation evaluation and well abandonment.
Development Drilling and Completion: Drilling platforms, mobile offshore drilling units, directional and horizontal drilling, well completion.

UNIT – V:
Production and Workover: Reservoir drive mechanisms, handling oil, gas, and water, artificial lift, additional recovery techniques, well servicing and workover.
Oil and Gas Transportation: Transportation by pipeline, transportation by tanker.
Outcomes:
The students are able to:

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- Apply the basic concepts of offshore operations of oil and gas.
- Analyze the details of various types of drilling rigs and their structures.
- Apply the concepts of drilling to drill an offshore well.
- Carry out various techniques of drilling of exploration & development wells and completions.
- Apply the concepts of production and workover operations to offshore wells.
- Assess the various modes of oil and gas transportation for application.

Text Book:

1. A Primer of Offshore Operations, 3rd Edition, Ron Baker, Petroleum Extension Services, the University of Texas at Austin, 1998.

University College of Engineering Kakinada (A)
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R19 Course Structure
B. TECH. PETROLEUM ENGINEERING

III Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
FUNDAMENTALS OF OIL AND GAS PRODUCTION **OPEN ELECTIVE-II (for other branches)**					

Learning Objectives:
The students will be able to learn:

- The history of oil and gas production.
- The concepts of reservoir engineering and horizontal drilling.
- The biogenic and abiogenic theories of oil and gas formation.
- The concepts of logging, testing and completing oil wells.
- The properties of reservoir fluids and hydrocarbon phase diagrams.
- The concepts of primary, secondary and tertiary recovery of oil.
- The details of remedial operations and workover.

UNIT-I
The history of production: Oily beginnings - a case for casing - more fireworks - underground mysteries - water, water, everywhere - breathings of the earth - crisis and reservoir engineering - horizontal drilling - the great offshore.

UNIT-II
The Reservoir: Origin – transformation - characterization – discovery – the origin of hydrocarbon.

UNIT-III
Logging, testing, and completing: Overview – logging – logging types – coring – original hydrocarbon in place – open hole testing – completions – cased – hole logging and measurements.

UNIT-IV
Hydrocarbon in reservoir: Phases – phase diagrams – reservoir fluid categories –gas wells versus oil wells.
Production: The motivating force- drive mechanisms- producing phases - primary production -secondary recovery - pressure maintenance and water flooding - tertiary recovery.

UNIT-V

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Remedial operations and workovers: Decision making - workover rigs - coiled tubing - subsea completions - well problems - well stimulation - changing production intervals.

Outcomes:

The students are able to:

- The history of oil and gas production.
- The concepts of reservoir engineering and horizontal drilling.
- The biogenic and abiogenic theories of oil and gas formation.
- The concepts of logging, testing and completing oil wells.
- The properties of reservoir fluids and hydrocarbon phase diagrams.
- The concepts of primary, secondary and tertiary recovery of oil.
- The details of remedial operations and workover.

Text book:

1. Oil and Gas Production in Nontechnical Language, Martin S. Raymond and William L. Leffler, PennWell, 2006.

Reference books:

University College of Engineering Kakinada (A)
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R19 Course Structure
B. TECH. PETROLEUM ENGINEERING

III Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
PETROLEUM ASSET MANAGEMENT (PROFESSIONAL ELECTIVE-II)					

Learning Objectives:
The students will be able to learn:

- The principles of asset management for oil and gas industry.
- The details of processes and modeling paradigms needed to develop the skills to increase reservoir output, profitability and decrease speculation.
- The technical diversity of modern reservoir management teams.
- The principles of reservoir management.
- The concepts and terminology to create an interdisciplinary approach for solving day to day problems in petroleum assets.

UNIT-I
Asset Management: The corporate dimension – data gathering – interpreting the main data.

UNIT-II
Developing a Decision Making Frame Work: Populating asset management plans – creating a strategic outline and business case for investment – the corporate asset management plan; developing an integrated asset management and capital planning system.

UNIT-III
Concepts of Reservoir Management: Reservoir management process – data acquisition, analysis and management - reservoir performance analysis and forecast – reservoir management economics – reservoir management case studies.

UNIT-IV

Industrial Asset Management Strategies for the Oil and Gas Sector: Over view of onshore and offshore assets – integration and optimization methodology – a case study in OPEX of the assets – evaluation of asset performance.

UNIT-V

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An Asset Management Model: Typical oil field workflow – workflows for asset management – an automated approach to data quality management – change management – risk based asset management model.

Outcomes:

The students are able to:

- Apply the principles of asset management for oil and gas industry.
- Evaluate the processes and modeling paradigms needed to develop the skills to increase reservoir output, profitability and decrease speculation.
- Develop modern reservoir management teams keeping in mind the technical diversity.
- Implement the concepts of reservoir management.
- Create an interdisciplinary approach for solving day to day problems in petroleum assets.

Text Books:

1. A guide to Asset Management and Capital Planning in Local authorities, CIPFA, 2008.
2. The Big Picture: Integrated Asset Management Cedric Bouleau et al, Oil field Review, 2007/2008.
3. Integrated Petroleum Reservoir Management, A team approach, Abdus, Satter and Ganesh C. Thakur, PennWell, Tulsa, 1994.
4. Integrated Reservoir Asset Management: Principles and Best Practices: Fanchi John R Fanchi¸ Gulf Professional Publishing, 2010.

Reference Book:

1. Handling Risk and Uncertainty in Petroleum Exploration and Asset Management, American Association of Petroleum Geologists, 2015.

University College of Engineering Kakinada (A)
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B. TECH. PETROLEUM ENGINEERING

III Year - II Semester

L	T	P	C
3	0	0	3

ACIDIZING CONCEPTS AND DESIGN
(PROFESSIONAL ELECTIVE-II)

Learning Objectives:
The students will be able to learn:

- The applications of inorganic acids and organic acids for acidizing for different formations.
- The concepts of acid treatment design considering the aspects of drilling, completion, work-over and production.
- The considerations of rock and fluid properties for the design of acidization.
- The concepts of applications of nitrogen in acidizing.
- The use of acid systems and additives for acid fracturing.
- The applications of well testing pre and post fracturing.

UNIT – I:
Acid Types: Inorganic acids, organic acids.
Acid Chemistry: general chemistry, reactions of hydrochloric acid (HCL), reactions of hydrofluoric acid (HF), reactions of acetic acid, reactions of formic acid.
Acidizing Limestones, Dolomite and Sandstone Formations: Limestone and dolomite, sandstone acidizing.
Acid Treatments: Soaking-agitation (perforation cleaning), fracture acidizing (limestones and dolomites), matrix acidizing.
Acidizing Damage: Formation de-consolidation, fines mobilization, reaction by-products, additive incompatibility, iron compounds, emulsions and sludge.

UNIT – II:
Introduction to Acid Treatment Design: Geographic probability, primary considerations.
Drilling, Completion and Work-Over Design Considerations: Drilling Considerations, drilling mud damage, drilling fluid damage in horizontal wells, cementing considerations, lost circulation materials (LCM), perforating considerations, new completion considerations, work-over considerations, disposal wells design considerations.
Production Considerations: Production curves, bottom hole temperature design factors.

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UNIT – III:

Formation Fluid and Rock Characteristic Considerations: Mineralogy design factors, geological probability, permeability design factors, porosity design factors, reservoir solubility, and acid insoluble organic deposits.

Fluid Design Considerations: Pipe pickling treatment design factors, preflushes, diverting treatment options and design criteria, selective acidizing (water stimulation prevention), post-flush design considerations, over-flushing, retarded acid systems, emulsified acid, chemically retarded acid, organic retarded acids, spearhead acid control, gelled acid, cross-linked acid, retarded mud acid systems, sandstone acid, acid strength.

UNIT – IV:

Applications of Nitrogen in Acidizing: Atomized acid, nitrified acid, foamed acid.

Viscosity and Friction Pressure: Viscosity, Newtonian fluids, non-Newtonian fluids, friction pressure, friction reducing agents, flow patterns.

Job Design Considerations: Spotting fluids in the wellbore, pressure design considerations, injection rate and surface treating pressure, establishing pump rate and surface treating pressure, shut-in times.

Acid Fracturing Design and Concepts: Introduction to hydraulic fracturing, candidate selection, acid-fracturing design concepts, acid fracturing design considerations, fracture geometry considerations, fracture propagation models, rock solubility.

UNIT – V:

Acid Systems and Additives for Fracturing: Materials and techniques for acid fluid-loss control, materials and techniques for acid spending control, materials and techniques for improved fracture conductivity.

Successful Acid Fracturing Stimulations: Acid fracturing main variables, acid volume, acid strength used in acid fracturing, gelled acid, pump rates and completions for optimum results, pad volume and characteristics, acid fracturing diversion techniques, typical fracture treatments in the north sea.

Well Testing Prior to Fracturing: In situ state of stress tests, step rate tests, pump in/flow back tests, mini-frac treatments.

Treatment Evaluations: Acid Jobs That Do Not Work: Quality Control

Method of Diluting Raw Acid: Acid strength determination by titration, loading and mixing HCl acid, loading and mixing HCl : HF acid.

Outcomes:
The students are able to:

- Assess the applications of inorganic acids and organic acids for acidizing for different formations.
- Carry out the acid treatment design considering the aspects of drilling, completion, work-over and production.
- Consider the rock and fluid properties for the design of acidization.
- Use nitrogen in acidizing based on fluid properties.
- Use the different acid systems and additives for fracturing.
- Apply the concepts of well testing to analyse the performance of fracturing.

Text Book:

1. Acidizing Concepts and Design, Acidizing Seminar, BP Indonesia, BJ Services, 2016

Reference Book:

1. Acidizing Fundamentals, Bert B. Williams, John L. Gidley, Robert S. Schechter, Society of Petroleum Engineers of AIME, 1979.

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R19 Course Structure
B. TECH. PETROLEUM ENGINEERING

III Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRODUCTION OPTIMIZATION USING NODAL ANALYSIS (PROFESSIONAL ELECTIVE-III)					

Learning Objectives:
The students will be able to learn:

- The nodal analysis of production systems with reference to flow capacity and pressure losses in normal production wells and artificial lift wells.
- The performance equations of the oil and gas reservoirs.
- The concepts of flow in pipes and restrictions.
- The design principles of artificial lift systems.
- The application of nodal analysis to the single and multi-well production systems including injection wells.

UNIT-I:
Production Systems Analysis: introduction, pressure losses in complete system, node locations, systems analysis approach, determination of flow capacity, effect of flow-line size and tubing size, well restricted by inflow and piping system, finding optimum tubing size, effect of gas rate on outflow and effect of perforating density on inflow.

UNIT-II:
Reservoir Performance: Introduction; well performance equations (factors affecting productivity index and inflow performance, drawdown, effect of depletion and IPR behavior of gas wells); predicting present time IPRs for oil wells (Vogel method, Fetkovich method, Jones, Blount and Glaze method, constructing IPRs when no stabilized tests are available, IPR construction for special cases); Predicting future IPRs for oil wells (Standing method, Fetkovich method and combining Vogel and Fetkovich); predicting present time IPRs for gas wells (Use of back pressure equation, Jones-Blount-Glaze method, and predicting future IPRs for gas wells); well completion effects (open hole completions, perforated completions and Gravel-packed completions).

UNIT-III
Flow in Pipes and Restrictions: Introduction, basic equations and concepts (single-phase, two-phase flow variables, modification of the pressure gradient equation for two-phase flow); fluid property calculations (density, velocity, viscosity, isothermal

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compressibility, interfacial tension, formation volume factor; predicting flowing temperatures in wells and pipelines); well-flow correlations (Poettmann and carpenter method, Hagedorn and brown method, Duns and Ros method, Orkiszewski method, Flow in annuli, Flow in directional wells, pipeline flow correlations); pressure drop through restrictions (Surface chokes, subsurface safety valves, and pipe fittings).

UNIT-IV

Total System Analysis: Introduction, tubing size selection, flow-line size effect, effect of stimulation, systems analysis for wells with restrictions (surface chokes and subsurface safety valves), evaluating completion effects, nodal analysis of injection wells, effect of depletion, relating performance to time, analyzing multi-well systems.

UNIT-V:

Artificial Lift Design: Introduction; continuous flow gas lift, well performance, valve spacing, gas lift valve performance and Otis design procedure; submersible pump selection, sucker rod or beam pumping; hydraulic pumping.

Outcomes:

The students are able to:

- Carry out the nodal analysis for normal production wells and artificial lift wells.
- Calculate the performance of the oil and gas reservoirs.
- Apply the concepts of flow in pipes and restrictions during the nodal analysis.
- Design the artificial lift systems using nodal analysis.
- Apply the nodal analysis to compute performance of single and multi-well production systems including injection wells.

Text Books:

1. Dale Beggs H. Production Optimization Using Nodal Analysis. OGCI and Petroskills, 2003.
2. Boyun Guo., Williams C. Lyons, Ali Ghalambor. Petroleum Production Engineering, A Computer-Assisted Approach, Gulf professional publishing, 2007.

Reference Books:

1. Gilbert W E. (1954). Flowing and Gas-Lift Well Performance. API Drill. Prod. Practice.
2. Nind T E W. (1964). Principles of Oil Well Production. McGraw-Hill.
3. Brown K E., and H D Beggs. (1978). The Technology of Artificial Lift Methods, vol 1, Penn Well Publ. Co., Tulsa, Oklahoma.

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B. TECH. PETROLEUM ENGINEERING

III Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
FUNDAMENTALS OF LIQUEFIED NATURAL GAS (PROFESSIONAL ELECTIVE-III)					

Learning Objectives:
The students will be able to learn:

- The properties of LNG.
- The overview of LNG industry and the concepts of base load LNG plants and development of the LNG projects.
- The details of supporting functional units in LNG plants.
- The different liquefaction process technologies of natural gas.
- The description of different functional units in the receiving terminals
- Classification of LNG ships, Cargo measurement and calculations.
- The regasification process including the design of vaporizers.
- The HSE aspects of LNG plants.

UNIT-I
Introduction: Overview of LNG industry: History of LNG industry – base load LNG – developing an LNG Project – world and Indian scenario – properties of LNG.

UNIT-II
Supporting Functional Units in LNG Plants: Gas pre-treatment: slug catcher – NGL stabilization column – acid gas removal unit – molecular sieve dehydrating unit – mercury and sulfur removal unit – NGL recovery – nitrogen rejection – helium recovery.

UNIT-III
Liquefaction Technologies: Propane precooled mixed refrigerant process – description of air-products: C_3MR LNG process – liquefaction – LNG flash and storage.
Cascade process: Description of Conoco Phillips Optimized Cascade (CPOC) process – liquefaction – LNG flash and storage.
Other Liquefaction Processes: Description of Linde MFC LNG process - precooling and liquefied petroleum gas (LPG) recovery – liquefaction and sub cooling - trends in LNG train capacity – strategy for grassroots plant - offshore LNG production.

UNIT-IV

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Receiving Terminals: Receiving terminals in India – main components and description of marine facilities – storage capacity – process descriptions.
Integration with adjacent facilities – gas inter changeability – nitrogen injection – extraction of C_2^+ components.

Major equipment in LNG industry – cryogenic heat exchangers: spiral-wound heat exchangers – plate & fin heat exchangers – cold boxes; compressors types; LNG pumps and liquid expanders – loading arms and gas turbines.

LNG Shipping Industry: LNG Shipping Industry - LNG fleet– Types of LNG ships – Moss – Membrane – prismatic; Cargo measurement and calculations.

UNIT-V
Regasification of LNG: Design of terminals - FLNG
Vaporizers: Submerged combustion vaporizers- open rack vaporizers – shell and tube vaporizers: direct heating with seawater, and indirect heating with seawater. Ambient air vaporizers: Direct heating with ambient air – indirect heating with ambient air, LNG tanks.
Safety, Security and Environmental Issues: Safe design of LNG facilities – security issues for the LNG industry – environmental issues – risk based analysis of an LNG plant.

Outcomes:
The students are able to:
- Assess the world wide LNG industry.
- Design and develop the base load LNG plants.
- Assess the requirement of supporting functional units in LNG plants.
- Screen and select the liquefaction process technologies of natural gas for LNG project.
- Oversee the installation, commissioning different functional units in the receiving terminals at marine facility.
- Classify ships for LNG transportation.
- Perform calculations for the measurement of LNG cargo.
- Design the regasification system including vaporizers.
- Implement the HSE systems for LNG plants.

Text Book:

1. LNG: Basics of Liquefied Natural Gas, 1st Edition, Stanley Huang, Hwa Chiu and Doug Elliot, PETEX, 2007.

2. Liquefied Gas Handling Principles on Ships and in Terminals, 3rd Edition, McGuire and White, Witherby Publishers, 2000.

Reference Books:

1. Handbook of liquefied natural gas, Saeid Mokhatab, John Y. Mak, Jaleel V. Valappil, David A. Wood, Elsevier, 2014.
2. Marine Transportation of LNG (Liquefied) and Related Products, Richard G. Wooler, Gornell Marine Press, 1975.
3. Natural Gas by Sea: The Development of a New Technology, Roger Rooks, Wither by, 1993.
4. LNG: A Nontechnical Guide, Michael D'Tusiani, Gordon Shearer PennWell Books, 2007.
5. Natural Gas Transportation, Storage and Use, Mark Fennell Amazon Digital Services, Inc., 2011.
6. Liquefied Natural Gas, Walter Lowenstein Lom, Wiley 1974.
7. Liquefied Natural Gas, C. H. Gatton, Noyes, 1967.

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B. TECH. PETROLEUM ENGINEERING

III Year - II Semester		L	T	P	C
		3	0	0	3
UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY					

Human Values Courses

This course also discusses their role in their family. It, very briefly, touches issues related to their role in the society and the nature, which needs to be discussed at length in one more semester for which the foundation course named as "H-102 Universal Human Values 2: Understanding Harmony"is designed which may be covered in their III or IV semester. During the Induction Program, students would get an initial exposure to human values through Universal Human Values – I. This exposure is to be augmented by this compulsory full semester foundation course.

Universal Human Values 2: Understanding Harmony

Course code: HSMC (H-102)
Credits: L-T-P-C 2-1-0-3 or 2L:1T:0P 3 credits
Pre-requisites: None. Universal Human Values 1 (desirable)

1. OBJECTIVE:

The objective of the course is four fold:

1. Development of a holistic perspective based on self-exploration aboutthemselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

2. COURSE TOPICS:

The course has 28 lectures and 14 practice sessions in 5 modules:

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and ExperientialValidation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

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Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony
and co-existence) rather than as arbitrariness in choice based on liking-disliking

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
8. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
10. Understanding the characteristics and activities of 'I' and harmony in 'I'
11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
12. Programs to ensureSanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

13. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
14. Understanding the meaning of Trust; Difference between intention and competence
15. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
16. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
17. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

18. Understanding the harmony in the Nature

19. Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self-regulation in nature

20. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space

21. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

22. Natural acceptance of human values

23. Definitiveness of Ethical Human Conduct

24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order

25. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

26. Case studies of typical holistic technologies, management models and production systems

27. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations

28. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. to discuss the conduct as an engineer or scientist etc.

3. READINGS:

3.1 Text Book

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

3.2 Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal

10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

4. *MODE OF CONDUCT (L-T-P-C 2-1-0-3 or 2L:1T:0P 3 credits)*

Lectures hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.
Tutorial hours are to be used for practice sessions.
While analysing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.
In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration. Scenarios may be used to initiate discussion. The student is encouraged to take up" ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.
Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic humanvalues.
It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.
This course is to be taught by faculty from every teaching department, including HSS faculty. Teacher preparation with a minimum exposure to at least one 8-day FDP on Universal Human Values is deemed essential.

5. ASSESSMENT:

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.
Example:
Assessment by faculty mentor: 10 marks Self-assessment: 10 marks
Assessment by peers: 10 marks
Socially relevant project/Group Activities/Assignments: 20 marks Semester End Examination: 50 marks
The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

6. OUTCOME OF THE COURSE:

By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would

become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

This is only an introductory foundationalinput. It would be desirable to follow it up by

a) faculty-student or mentor-mentee programs throughout their time with the institution

b) Higher level courses on human values in every aspect of living. E.g. as a professional

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III Year - II Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
PETROLEUM RESERVOIR ENGINEERNG LABORATORY					

Learning Objectives:
The students will be able to learn:

- Experimental determinations of reservoir (Oil as well as gas) properties such as saturation, porosity, absolute & relative permeability.
- Capillary pressure, fluid properties like density, viscosity and surface tension.

List of Experiments:

1. Determination of effective porosity by gas expansion method.
   Equipment: Helium Porosimeter (Nitrogen gas can be used in place of helium).
2. Determination of porosity and pore size distribution by mercury injection.
   Equipment: Mercury Porosimeter.
3. Measurement of surface tension & interfacial tension with the ring Tensiometer.
   Equipment: Tensiometer.
4. Determination of fluid density using Pycnometer and hydrometer methods.
   Equipment: Pycnometer and hydrometer.
5. Liquid viscosity measurement using capillary tube viscometer (Ostwald type).
   Equipment: Capillary tube viscometer.
6. Determination of capillary pressure of reservoir rock (core) using porous plate method.
   Equipment: Capillary pressure cell.
7. Measurement of contact angle (between oil, water and solid surface) using imaging method.
   Equipment: The image system set-up.
8. Measurement of air permeability.
   Equipment: Constant head Permeameter with the Hassler cell.
9. Absolute permeability measurement of water.
   Equipment: The Darcy apparatus.
10. Determination of relative permeability of oil-water using unsteady state method.
    Equipment: Relative permeability apparatus.
11. Determination of relative permeability of gas-oil using unsteady state method.
    Equipment: Relative permeability apparatus.

Outcomes:
The students are able to:

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B. TECH. PETROLEUM ENGINEERING

III Year - II Semester		L	T	P	C
		0	0	3	1.5
PETROLEUM ANALYSIS LABORATORY					

Learning Objectives:

The students will be able to learn:

- The analysis of crude oil and its products.
- The tests for various properties of crude oils and their products.
- The generation of distillation characteristics (ASTM curves) of crude oil, diesel, gasoline and kerosene.
- The determination of water content in different petroleum products.
- The corrosiveness of petroleum products on materials.

List of experiments:

1. Determination of Distillation characteristics of Gasoline / Diesel / Kerosene.
2. Determination of Reid Vapor Pressure of Crude oil / Gasoline.
3. Determination of Viscosity of Diesel and lubricating oils.
4. Determination of Smoke Point of Kerosene.
5. Determination of Carbon Residue of petroleum products.
6. Determination of Flash & Fire points of gasoline, kerosene and other products.
7. Estimation of water content in petroleum products.
8. Estimation of calorific value of solid, liquid and gaseous fuels.
9. Determination of Aniline point of Gasoline and Diesel oil.
10. Determination of Cloud & Pour Points of petroleum products.
11. Detection of Corrosiveness of petroleum products

Outcomes:

The students are able to:

- Use the analysis of crude oil and its products in the design of refinery operations.
- Generate distillation characteristics (ASTM curves) of crude oil, diesel, gasoline and kerosene for designing primary distillation columns.
- Assess the limits of water content in different petroleum products while meeting the specifications.
- Screen and select the appropriate material construction for refinery process units.

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III Year-II Semester

L	T	P	C
3	0	0	0

(MC)
IPR & Patenting

Learning Objectives:

 To acquire detailed knowledge of IPR Laws and its relevance, application and practice in Engineering Discipline, the student has to know the increasingly assumed role of Intellectual Property globally with the rapid pace of technological and scientific innovations created by the human intellect and to understand the TRIPS Agreement and the functions WIPO, WTO to enhance the protection different IPRs and the enforcement of competition law to prevent unfair competition

 To acquire a comprehensive knowledge about Copyright as an exclusive right given by the law to the creators of literary, scientific, dramatic, musical and artistic works and producers of cinematography films and sound recordings, thereby protecting and rewarding creativity and ensure moral and economic rights of Authors of those creative works, which induces others to do the same is the basis for socio- economic development and progress of the society

 To acquire a comprehensive knowledge about Patent as an exclusive right granted for the inventions arising from the human intellect and its considerable commercial value of those scientific inventions having potential for industrial application are being protected for a limited duration to encourage the innovations.

 Study about Trade Marks Law gives an insight about Trade Mark as a statutory right provides protection to the owner of the mark by ensuring the exclusive right to use it, or to authorize another to use the same for consideration which will promote initiative and enterprise worldwide and hinders the efforts of unfair competitors. Trade Secrets and confidential information relating to the business enterprises and why this key strategic asset needs to be protected

 Study of Information Technology Act and Cyber Laws provide a detailed insight to regulate online and digital transactions and promoting E-governance, E-commerce, E-banking with required confidentiality, data security and to prevent cyber-crimes.

UNIT – I:

Introduction to Intellectual Property Rights (IPRs): Concept of Property - Introduction to IPR – IPR Tool Kit – International Instruments and IPR – WIPO - TRIPS – WTO – IPR Laws - IPR Protection and Regulation - Copyrights and Neighbouring Rights – Industrial Property –

Patents – Designs - Traditional Knowledge – Geographical Indications - Emerging Areas of IPR.

Law of Unfair Competition – Competition Commission.

UNIT – II:

Copyrights and Neighbouring Rights: Introduction to Copyrights – Principles of Copyright Protection – Law Relating to Copyrights - Subject Matters of Copyright – Copyright Ownership – Transfer and Duration – Right to Prepare

Derivative Works – Rights of Distribution – Rights of Performers **–** Copyright Registration – Limitations – Infringement of Copyright – Case Law.

UNIT – III:

Patents: Introduction to Patents - Patent Laws in India – Patent Requirements – Product Patent and Process Patent - Patent Search - Registration and Grant of Patent – Exclusive and Monopoly Rights – Limitations - Ownership - Transfer — Revocation of Patent – Patent Appellate Board - Infringement of Patent – Double Patenting — Compulsory Licensing - Patent Cooperation Treaty – New developments - Software Protection and Computer related Innovations.

UNIT – IV:

Trademarks & Trade Secrets: Introduction to Trademarks – Trademark Laws – Functions of Trademark – Marks Covered under Trademark Law - Trade Mark Registration – Maintenance – Transfer - Deceptive Similarities - Infringement – Remedies.

Introduction to Trade Secrets – Laws Relating to Trade Secrets – Safeguarding Trade Secrets – Physical Security – Employee Access Limitation – Confidentiality Agreements – Breach of Contract – Remedies.

UNIT – V:

Cyber Laws and Cyber Crimes: Introduction to Cyber Laws – Information Technology Act 2000 - Protection of Online and Computer Transactions - E-commerce - Data Security – Privacy - Authentication - Confidentiality - Digital Signatures – Certifying Authorities - Cyber Crimes - Prevention - Punishment – Liability of Network Providers.

Outcomes:

After studying these units, the student is expected to be able to assume:

 The significance of innovations, distinguish different kinds of IPRs and know the legislative framework, practice and procedure relating to Patents, Copyrights, Trademarks, Designs, Trade Secrets, Geographical Indications, Traditional Knowledge and certain emerging areas.

 The various components of copyright law, its protection and enforcement to know the application of copyright law, its duration, advantages and issues of ‘fair use’ and ‘plagiarism’ in the digital era.

 The Patent law in India and its global instruments and spell out the procedural requirements of novelty, non-obviousness and inventive step involved in obtaining a

Patent, its exclusive rights besides assignment and licensing patterns, commercial exploitation and how the patent does benefit the society.

 The conceptual and legal framework relating to Trade Marks and its infringement and gives an insight how the Trademark is commercially advantageous to its owner to prevent unfair competition and further safeguarding the trade secrets of the business enterprises.

 The importance of E-commerce, data security, online transactions and how the confidentiality and privacy can be safeguarded through the digital signatures and the prevention and punishment of cybercrimes under the law.

Texts Books:

1. Intellectual Property Rights (Patents & Cyber Law), Dr. A. Srinivas. Oxford University Press, New Delhi.

2. Deborah E.Bouchoux: Intellectual Property, Cengage Learning, New Delhi.

3. PrabhuddhaGanguli: Intellectual Property Rights, Tata Mc-Graw –Hill, New Delhi

4. Richard Stim: Intellectual Property, Cengage Learning, New Delhi.

5. Kompal Bansal &Parishit Bansal Fundamentals of IPR for Engineers, B. S. Publications (Press).

6. Cyber Law - Texts & Cases, South-Western's Special Topics Collections.

7. R.Radha Krishnan, S.Balasubramanian: Intellectual Property Rights, Excel Books. New Delhi.

8. M.Ashok Kumar and MohdIqbal Ali: Intellectual Property Rights, Serials Pub.

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III Year-II Semester

L	T	P	C
0	0	2	0

(MC)
EMPLOYABILITY SKILLS – I
PYTHON PROGRAMMING

Course objectives:

1. Describe the core syntax and semantics of Python programming language.
2. Discover the need for working with the strings and functions.
3. Illustrate the process of structuring the data using lists, dictionaries, tuples and sets.
4. Indicate the use of regular expressions and built-in functions to navigate the file system.
5. Infer the Object-oriented Programming concepts in Python.

Course Outcomes:

COs	Course Outcomes	Bloom's Level
CO1	Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.	L2
CO2	Express proficiency in the handling of strings and functions.	L2
CO3	Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets.	L3
CO4	Identify the commonly used operations involving file systems and regular expressions.	L2
CO5	Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python.	L3

UNIT-I:Introduction: History of python, Applications of python, running python scripts, Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, Control Flow- if, if-elif-else, for, while, break, continue, pass.

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Chairman

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Member

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Member

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Member

UNIT-2: Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings, Lists, Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, The del Statement.

UNIT-3: Dictionaries: Creating Dictionary, Accessing and Modifying key: value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, The del Statement, Tuples and Sets, Creating Tuples, Basic Tuple Operations, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Tuple Methods, Using zip() Function, Sets, Set Methods, Traversing of Sets, Frozen set.

UNIT-4: Functions: Defining functions, calling functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length Arguments, anonymous functions, Scope of the variable in a function-Global and Local Variables. Modules: Creating modules, import statement, from import statement, name spacing.

UNIT-5: Object Oriented Programming in Python: Classes and Objects, Creating Classes in Python, Creating Objects in Python, The Constructor Method, Classes with Multiple Objects, Class Attributes versus Data Attributes, Encapsulation, Inheritance, The Polymorphism. **Error and Exceptions:** Difference between an error and Exception, Handling Exception, try except block, Raising Exceptions, User Defined Exceptions.

Text Books:

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson.
2. Learning Python, Mark Lutz, Orielly.

Reference Books:

1. Think Python, Allen Downey, Green Tea Press.
2. Core Python Programming, W.Chun, Pearson.
3. Introduction to Python, Kenneth A. Lambert, Cengage.

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University College of Engineering Kakinada (A)
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III Year- II Semester

L	T	P	C
0	0	0	0

SUMMER INTERNSHIP (4-6 WEEKS)

Learning Objectives:
The main objective of the internship is to gain up-to-date, practical experience in the real-working situation, in contrast to information gained during studies concerning mainly theoretical background of petroleum engineering.

The students are guided (through the Industry representative) to learn the following aspects:

- Application of the engineering skills, learned in class room, in real world.
- Working as a team to deliver the results along with senior engineering professionals, technicians, managers etc.
- Working safely in industrial environment.
- Result oriented approach in plant operation, troubleshooting and engineering work.
- Present and / or report the work / project outcomes to various disciplines, departments & interest groups with confidence.

Every Student should undergo summer training (summer internship program) in a petroleum industry (like ONGC)/service providing industry (like Halliburton) for 4-6 weeks and submit a report.

The internship reports are evaluated for 50 marks (2- credits) by committee constituted by the Head of the Department.

Outcomes:
The students are able to:

- Work safely in industrial environment.
- Work with various interest groups, disciplines, professionals, managers and technicians etc.

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- Polish the engineering skills by applying the practical knowledge in day-to-day operations, trouble-shooting and minor-modifications.
- Build relations between university and industry that helps mutual collaboration and cooperation over long-term.
- Develop/strengthen the basic skills of interviewing, analysis, report writing, communication, decision-making, and problem solving.

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MOOCS (NPTEL/ SWAYAM) FOR HONORS/MINORS DEGREE

Learning Objectives:
The students are able to:

- Avail the expertise in a specific subject from nation-wide reputed faculty, through MOOC (Massive Open Online Course)
- Develop the ability for self-actualization and in getting opportunity for life-long learning

There shall be a Discipline Centric Elective Course through Massive Open Online Course (MOOC) as Program Elective course. The student shall register for the course (Minimum of 12 weeks) offered by SWAYAM/NPTEL through online. The course is selected in consultation with MOOCS coordinator/Mentor and with the approval of Head of the Department. During the course, the coordinator monitors the student's progress in the SWAYAM/NPTEL courses.

The students need to submit all the assignments given and take final exam. Each student has to earn a certificate by passing the exam. Each student will be awarded the credits given in curriculum only after submission of the certificate. If student does not pass the subjects registered through SWAYAM/NPTEL, the same or alternative equivalent subject may be registered and studied again through SWAYAM/NPTEL in the next semester to submit the certificate.

The list of MOOCS/department courses is given in the Appendix – I to do honors in petroleum engineering. The eligible student is expected to choose the subjects from the list. To fulfill the criteria of qualifying for honors degree, 20 credits should be obtained at the end of final semester. In order to get minor degree, a student has to select and do the courses in any one discipline (from the list given in the Appendix – II) other than petroleum engineering to fulfil the criteria of 20 credits.

The total 20 credits for honors or minors degree should be obtained from the second semester to the end of eighth semester. A candidate can take a 3-credit course in each semester during the above mentioned period.
It may be noted that, each student is to get minimum 8.0 SGPA without any backlogs in each semester to do honors / minors degree.

Outcomes:
The students will be able to:

- Overcome the digital divide in acquiring fast developing technologies / knowledge and be part of digital revolution.
- Acquire subject specific expert knowledge from National Resource Pool.
- Understand his /her academic / professional priorities for future development.

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B. TECH. PETROLEUM ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
HSE IN PETROLEUM INDUSTRY					

Learning Objectives:
The students will be able to learn:

- The environment issues and all related acts.
- The properties of drilling fluids and its toxic effects on environment.
- The methods to dispose of drilling cuttings after appropriate treatment.
- The different methods for treatment of produced water and its disposal as per state pollution control board norms.
- The oil mines regulations.
- The application of HAZOP in various petroleum operations.
- The concepts of disaster management.

UNIT-I
Introduction to environmental control in the petroleum industry: Overview of environmental issues- a new attitude-air emissions.
Drilling and production operations: Drilling- production.

UNIT-II
The impact of drilling and production operations: Measuring toxicity- hydrocarbons- salt- heavy metals- production chemicals- drilling fluids- produced water- nuclear radiation- air pollution- acoustic impacts- effects of offshore platforms- risk assessment.
Environmental transport of petroleum wastes: Surface paths- subsurface paths- atmospheric paths, planning for environmental protection.
Waste treatment methods: Treatment of water- treatment of solids- treatment of air emissions-waste water disposal: surface disposal.

UNIT-III
Oil mines regulations: Introduction-returns, notices and plans- inspector, management and duties- drilling and workover- production- transport by pipelines- protection against gases and fires- machinery, plants and equipment- general safety provisions- miscellaneous-remediation of contaminated sites- site assessment- remediation process.

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UNIT-IV

Toxicity, physiological, asphyxiation, respiratory, skin effect of petroleum hydrocarbons and their mixtures - sour gases with their threshold limits-toxicity of additives for acidizing and hydro-fracturing.

UNIT-V

Hazard identification- Hazard evaluation- HAZOP and what if reviews- developing a safe process and safety management- personal protection systems and measures – safe installation and operation of electrical equipment.

Classification of fires- the fire triangle- distinction between fires and explosions- flammability characteristics of liquids and vapors- well blowout fires and their control- fire fight equipment- suppression of hydrocarbon fires.

Outcomes:

The students are able to:

- Assess the environment issues.
- Design safe drilling fluids and control the toxic effects of drilling fluids on environment.
- Devise different methods drill cuttings disposal.
- Assess the different methods for treatment of produced water and select appropriate methods.
- Implement the oil mines regulations in petroleum operations.
- Apply the HAZOP in various petroleum operations to identify the risk.
- Apply the concepts of disaster management to prevent accidents.

Text Books:

1. Environmental Control in Petroleum Engineering, John C. Reis, Gulf Publishing Company, 1996.
2. Application of HAZOP and What if Reviews to the Petroleum, Petrochemical and Chemical Process Industries, Dennis P. Nolan, Noyes Publications, 1994.
3. Oil Industry Safety Directorate (OISD) Guidelines, Ministry of Petroleum & Natural Gas, Government of India and Oil Mines Regulations-1984, Directorate General of Mines Safety, Ministry of Labor and Employment, Government of India.

Reference Books:

1. Guidelines for Process Safety Fundamentals in General Plant Operations Centre for Chemical Process Safety, American Institute of Chemical Engineers, 1995.

2. Guidelines for Fire Protection in Chemical, Petrochemical and Hydrocarbon Processing Facilities, Centre for Chemical Process Safety, American Institute of Chemical Engineers, 2003.
3. Guidelines for Hazard Evaluation Procedures Centre for Chemical Safety, Wiley- AIChE, 3rd Edition, 2008.
4. Guideline for Process Safety Fundamentals in General Plant Operations, Centre for Chemical Process Safety, AIChE, 1995.
5. Chemical Process Industry Safety, K S N Raju, Mc Graw Hill, 2014.

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IV Year - I Semester		L	T	P	C
		3	0	0	3
DESIGN AND OPERATION OF SURFACE FACILITIES					

Learning Objectives:
The students will be able to learn:

- The details of surface facilities for oil and gas processing.
- The concepts of separation and design of separators.
- The concepts of oil field emulsion and electrical emulsion resolution.
- The concepts for the design and operation of desalting and heater treater equipment for crude oils.
- The design principles of the vapor recovery system.
- The various methods of produced water treatment and design principles of water treating equipment.
- The types of heat exchangers & storage tanks and their design for surface facilities.
- The methods of injection of water and gas along with the design of pumps and compressors.
- The concepts of natural gas processing.
- The design principles of pipelines for oil and gas transport.

UNIT-I
Surface facilities: Oil and gas properties, equipment for surface facilities for onshore and offshore production of oil and gas.

UNIT-II
Separation of oil and gas: Equilibrium flash calculations, types of separators and internal part of a separator, factors influencing separation-separator design using actual separator data.

UNIT-III
Oil field emulsion and their electrical emulsion resolution: Theory of emulsion and desalting, dehydration: Heat, chemical additives and electrical treatments-Electrical dehydrators, automated dehydration, operating procedures- resolution of oil in water emulsion-trouble shooting-water oil treatment system.

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UNIT-IV

Vapor recovery: Evaporation, fundamentals of vapor recovery system-equipment required-design of vapor recovery system.

Design of produced water treatment methods: Various methods-design of equipment.

Design of heat exchangers and storage tanks for surface facilities: Various types of heat exchangers- design of double pipe and shell & tube heat exchangers-classification of aboveground storage tanks and their design.

UNIT-V

Injection of water and gas: Design of pumps and compressors.

Natural gas processing: Gas specifications of natural gas, gas dehydration-treating.

Oil and gas transport in pipelines: Design of gas gathering lines. Design of cross country pipelines for oil and gas transportation.

Outcomes:

The students are able to:

- Assess the requirement of surface facilities for oil and gas processing.
- Design various types of separators.
- Design desalting, emulsifying, and heater treater equipment.
- Design the vapor recovery system.
- Assess the various methods of produced water treatment and their design.
- Design exchangers and storage tanks for surface facilities.
- Assess the requirement of water and gas injection. Accordingly the design of suitable pumps and compressors.
- Design equipment for dehydration, acid removal and NGL separation in natural gas processing.
- Design of pipelines for oil and gas transport.

Text Books:

1. Surface Production Operations : Design of Oil Handling Systems and Facilities, Volume 1, Third Edition, Maurice Stewart & Ken E. Arnold, Gulf Professional Publishing, 2007.
2. Surface Production Operations: Design of Gas-Handling Systems and Facilities, VOLUME II, Third Edition, Maurice Stewart, Gulf Professional Publishing, 2014.
3. Surface Production Operations: Facility Piping and Pipeline Systems, Volume III, Third Edition, Maurice Stewart, Gulf Professional Publishing, 2016.
4. Surface Production Operations: Volume IV: Pumps and Compressors, Volume III, Maurice Stewart, Gulf Professional Publishing, 2019.
5. Above ground storage tank, Philip E. Myers, McGraw Hill,1997.

6. Petroleum and Gas Field Processing, H. K. Abdel-Aal and Mohamed Aggour and M.A. Fahim, Marcel Dekkar Inc., 2003.

Reference Books:

1. Kumar, S., (1987) Gas Production Engineering, Gulf Publishing Company, Texas.
2. Campbell, J. M., (1998) Gas Conditioning and Processing (Vol I, II, III), Campbell & Co., USA.
3. Ikoku, Chi U., (1984) Natural Gas Production Engineering, John Wiley & Sons Inc.
4. Surface production operations IV: Pumps and Compressors, 1st edition, Maurice Stewart, 2018.
5. Surface Production Operations: Pressure Vessels, Heat Exchangers and Aboveground Storage Tanks, Design, Construction, Inspection and Testing, volume 5, Maurice Stewart, 2021.

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IV Year - I Semester		L	T	P	C
		3	0	0	3
ENHANCED OIL RECOVERY (EOR) TECHNIQUES (PROFESSIONAL ELECTIVE-IV)					

Learning Objectives:
The students will be able to learn:

- The concepts of secondary / tertiary recovery of crude oils of reservoirs.
- The fundamentals of injection methods and CO_2 flooding.
- The basic concepts of polymer flooding and its application.
- The basic concepts of alkaline and surfactant flooding and their application.
- The basic concepts of steam flooding, in-situ combustion and microbial techniques for enhanced oil recovery and their applications.
- The environmental issues in enhanced oil recovery methods.

UNIT-I
Introduction: Different secondary and tertiary oil recovery techniques. Methods to improve the recovery factor at pore scale and macro scale, displacement and sweep efficiency.

UNIT-II
Gas injection: Introduction, predictive performance, gas injection in carbonate reservoirs, inert gas injection, candidates for gas injection.
Miscible flooding: Introduction, sweep efficiency - high pressure gas injection, enriched gas drive, LPG slug drive; predictive technique, field applications.
Carbon dioxide flooding: Process description, field projects, CO_2 sources- problem areas, designing a CO_2 flood, guidelines for selection of miscible CO_2 projects, Immiscible CO_2 flooding conclusions.

UNIT-III
Polymer flooding: Introduction, polymer products and theory of use, planning polymer flood projects.
Polyacrylamides: Introduction, polyacrylamides chemistry, application of PAM/AA in enhanced oil recovery, factors affecting flow in porous media, Field considerations-site factors, Field operation.

UNIT-IV
Alkaline flooding: Introduction, types of caustic used, entrapment of residue oil, displacement mechanisms in alkaline flooding, crude oil properties, alkali

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consumption, pH of injected caustic, effect of sodium ions and sodium chloride, effect of divalent ions, reservoir selection- documented alkaline flooding - field tests.

Surfactant flooding: Introduction, classification of EOR surfactants, mechanism of oil displacement by surfactant flooding, ultra-low interfacial tension in relation to oil displacement by surfactant flooding, factors influencing oil recovery, surfactant gas flooding for oil recovery, interfacial phenomena in surfactant gas flooding, mechanism of surfactant loss in porous media, present status of the use of surfactants in oil recovery.

UNIT-V

Steam flooding for enhanced oil recovery: Introduction, theory- screening criteria for steam flood prospects, reservoir rock and fluid properties, heat losses and formation heating, oil recovery calculations, an overview of steam flood modeling, parametric studies in steam flooding, economics of the steam flooding process.

In-situ combustion technology: Introduction, reservoir characteristics, ignition-ignition methods, process in-situ combustion, use of in-situ combustion, conclusions, current status of in-situ combustion.

Microbial enhanced oil recovery: Microorganisms, historical development of microbial enhancement of oil recovery, laboratory experiments - potential of microbial enhancement oil recovery, field application of microbial enhancement of oil recovery. Environmental issues in enhanced oil recovery methods.

Outcomes:

The students are able to:

- Assess the secondary / tertiary recovery methods required for specific crude oil reservoirs.
- Design the injection and CO_2 flooding systems.
- Apply the basic concepts of polymer flooding for its design.
- Apply the basic concepts of alkaline and surfactant flooding for their design.
- Design the steam flooding, in-situ combustion and microbial systems for enhanced oil recovery.
- Assess the environmental issues involved in screening and implementing the enhanced oil recovery methods.

Text Books:

1. Applied Enhanced Oil Recovery, AurelCarcoana, Prentice Hall, 1992.
2. Enhanced Oil Recovery, Larry W. Lake, Prentice Hall, 1998.

Reference Books:

1. Enhanced Oil Recovery Processes and Operations, E.C. Donaldson, G. V. Chillingarian, T.F. Yew, Elsevier, 1998.
2. Basic Concepts in Enhanced Oil Recovery Processes, Marc Baviere, SCI, 1991.
3. Enhanced Oil Recovery: Proceedings of the Third European Symposium on Enhanced Oil Recovery, F. John Fayers, Elsevier, 1981.
4. Fundamentals of Enhanced Oil Recovery, H. R. Van Pollew and Associates, PennWell, 1980.
5. Enhanced Recovery of Residual and Heavy Oil, M. M. Schumacher, Noyes Data Corp., 1980.
6. Recent Advances in Enhanced Oil and Gas Recovery, IstvanLaktos, Academy Kiado, 2001.
7. Enhanced Oil Recovery, Don W. Greew, G. Paul Willfite, Society of Petroleum Engineers, 1998.
8. Enhanced Oil Recovery: Field Planning and Development Strategies, Vladmir Alvarado, Eduardo Marriglee, Gulf Professional Publishing, 2010.

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B. TECH. PETROLEUM ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
ADVANCED WELL COMPLETION ENGINEERING (PROFESSIONAL ELECTIVE-IV)					

Learning Objectives:
The students will be able to learn:

- The application of basic concepts of well reservoir engineering in well completions.
- The details of various types of well completions and factors affecting well completions.
- The material selection criteria and stress analysis in the system design.
- The selection criteria and details of the well completion equipment.
- The methods for installing well completion equipment for the onshore and offshore wells.
- Fundamental of well completion techniques and installation system.

UNIT-I
Basics of well reservoir engineering in well completions: IPR, perforation, well stimulation techniques including fracturing. Sand controls- introduction- rock strength analysis- sand control prediction and mitigation techniques including installation of screens, gavel pack job-sand consolidation methods

UNIT-II
Well completion life: Introduction- types of well completion- factors affecting well completion-TPR- flow through tubing, well completion fluid properties and production and injection tubing sizing analysis.

UNIT-III
Material selection and stress analysis: Selection of control lines for Injection of corrosion inhibitors, scale inhibitors and use of other seals. Load and stress analysis of tubing including burst pressure, collapse, axial load calculation and some design factors.

UNIT-IV
Well completion equipment: Introduction- types of completion equipment- surface and subsurface equipment. Rating of SSSV, packer, landing nipple locks and sling sleeve and side pocket mandrel selection. Selection of control lines and subsea isolation valve.

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UNIT-V

Well completion installation system: Introduction-onshore and subsea well completion installation system. Well bore cleanup operations-well fluid displacement. Filtration prior to well flow

Outcomes:

The students are able to:

- Apply the basic concepts of well reservoir engineering in well completions.
- Screen the various types of well completions.
- Analyze the factors affecting well completions.
- Select the suitable materials of construction for well completion equipment.
- Carry out the stress analysis for the system design like tube design.
- Install the well completion equipment for onshore and offshore wells.

Text Books:

1. Advanced Well Completion Engineering, Wan Renpu, Gulf Professional Publishing, 2011.
2. Well Completion Design, Jonathan Bellarby, Elsevier, 2009.

Reference Books:

1. Well Completion and Servicing, D. Perrin, Micheal Caron, Georges Gaillot, Editions Technip, 1999.
2. Primer of Well Service, Workover and Completion, Petroleum Extension Service (PETEX), University of Texas at Austin, 1997.
3. Petroleum Engineering: Principles and Practice, J.S Archer & C.G. Wall, Graham & Trotman, Inc., 1986.

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IV Year - I Semester		L	T	P	C
		3	0	0	3
SUBSEA ENGINEERING (PROFESSIONAL ELECTIVE-V)					

Learning Objectives:
The students will be able to learn:

- The overview of subsea engineering and field development.
- The concepts of subsea distribution system, control and power supply.
- The details of the subsea vessels for installation and positioning.
- The concepts of Subsea System Engineering including flow assurance, hydraulics and operability.
- The issues related to wax, asphaltenes and hydrates.
- The basic concepts of heat transfer & thermal insulation with reference to flow assurance
- The concepts of subsea corrosion and sand management.

UNIT-I
Overview of Subsea Engineering: Introduction – Subsea production systems – Flow Assurance & System engineering – Subsea structures & Equipment – Subsea pipelines.
Subsea Field Development: Subsea field development overview – Deepwater or Shallow-Water development – Wet Tree & Drain tree systems – Subsea Tie-back development – Stand-Alone development – Artificial lift methods and Constraints – Subsea processing – Template, Clustered Well Systems & Daisy chain –Subsea field development assessment.

UNIT-II
Subsea Distribution System: Introduction – Design Parameters – SDS component design requirements.
Subsea Control: Introduction – Types of control systems – Topside equipment – SCMMB – SCM – Subsea transducers & Sensors – HIPPS – SPCS – IWOCS.
Subsea Power Supply: Introduction – Electrical power system – Hydraulic power system.

UNIT-III

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Installation of Vessels: Introduction – Typical installation vessels – Vessel requirements & selection – Installation - positioning & Analysis.

Subsea System Engineering: Introduction – Typical flow assurance process - System design & Operability.

Hydraulics: Introduction – Composition & Properties of hydrocarbon – Emulsion – Phase behaviour – Hydrocarbon flow – Slugging & Liquid handling – Slug catcher design – Pressure surge – Line sizing.

UNIT-IV

Wax &Asphaltenes: Introduction - wax - wax management – wax remediation – asphaltenes – asphaltenes control design philosophies.

Hydrates: Introduction – physics & phase behaviour – hydrate prevention – hydrate remediation – hydrate control design philosophies – recovery of thermodynamic hydrate inhibitors.

UNIT-V

Heat Transfer & Thermal Insulation: Introduction – heat transfer fundamentals – u value – steady state heat transfer – transient heat transfer – thermal management strategy & insulation.

Subsea Corrosion & Scale: Introduction – pipeline internal corrosion – pipeline external corrosion – scales – overview of erosion & sand management.

Outcomes:

The students are able to:

- Assess the aspects of subsea engineering and field development.
- Apply the concepts of subsea distribution system, control and power supply.
- Plan and select the subsea vessels for installation and positioning.
- Apply the concepts of subsea system engineering including flow assurance, hydraulics and operability.
- Assess the issues related to wax, asphaltenes and hydrates.
- Apply the concepts of heat transfer & thermal insulation for flow assurance.
- Apply the concepts of corrosion and sand management in subsea operations.

Text Books:

1. Subsea Engineering Handbook, Yong Bai & Qiang Bai, Gulf Professional Publishing, New York, 2012.
2. Offshore Drilling and Completions Training Manual, Drill – Quip, Inc.
3. Manual on Subsea Technology, IOGPT, ONGC.

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B. TECH. PETROLEUM ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
PETROLEUM ECONOMICS, POLICIES AND REGULATIONS (PROFESSIONAL ELECTIVE-V)					

Leaning Objectives:
The students will be able to learn:

- The importance of petroleum sector in the world economy, both the macro and micro-economic environment and as applicable to India.
- The principles, methods and techniques of petroleum engineering economics.
- The concepts of managing and mitigating uncertainty and risk.
- The application of economic methods to evaluate projects.
- The valuing of petroleum assets and the concepts of portfolio management.
- The scenario of demand and marketing of petroleum products.
- The policies and regulations for oil & gas sector.

UNIT-I
Macro-Economic Approach of Petroleum Industry: Political environment related to petroleum industry and issues related to government and corporate interests, need for understanding petroleum economics required to make investment decisions; introduction, role and value of oil & gas, evolution of national oil companies, organization of petroleum exporting countries.

UNIT-II
Principles, Methods and Techniques of Petroleum Engineering Economics: Introduction, outline and key terminologies and generic issues of micro-economic analysis applicable to all sectors of the oil and gas supply chain, capital budgeting and capital efficiency, sources of revenue and cost and profitability analysis, operating expenditures (OPEX) and their fixed, variable and marginal components, economic indicators and yardsticks used to rank asset values (npv, irr, etc.)
Managing and Mitigating Uncertainty and Risk: Risk, uncertainty and decision analysis, analysis of alternative selections and replacements**,** managing and mitigating uncertainty and risk -breakeven and sensitivity analysis, optimization techniques, geopolitical risks and opportunities and hedging strategies to mitigate market and price risks, asset valuation process: fair market value, probability and risk.

UNIT-III

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Application and Project Evaluation: Project lifecycles, optimum economic life and multi-year cash flows, oil fields exploration and drilling operations, estimation of oil reserves and evaluation of an oil property, project financial analysis, project development - utilization oil fields - production operations - oil transportation - crude oil processing.

UNIT-IV

Valuing Petroleum Assets, Portfolios and Companies: Asset valuation process: fair market value, probability and risk, risk adjustments when valuing petroleum reserve categories, the portfolio approach to asset and corporate management, portfolio characterization, balance and diversification.

Demand and Marketing of Petroleum Products: Crude oil fundamentals, price of crude, crude oil prices in transactions, internal markets and prices, marketing and sale of motor, aviation, lubricant, asphalt and propane transportation: fundamentals of transportation, pipelines, oil tankers, downstream transportations, distribution of petroleum products.

UNIT-V

Oil & Gas Policies and Regulations: Petroleum, oil & gas rules and regulations in India, the oil fields regulations and development act, new exploration licensing policy (NELP), functions of directorate general of hydrocarbons, petroleum and natural gas regulatory board.

Outcomes:

The students are able to:

- Assess the importance of petroleum sector in the world economy, both the macro and micro-economic environment and as applicable to India.
- Apply the principles, methods and techniques of petroleum engineering economics in the evolution of petroleum projects.
- Apply the concepts of managing, mitigating uncertainty and risk in the financial aspects of the company.
- Value the petroleum assets.
- Apply the concepts of portfolio management.
- Assess the demand and marketing of petroleum products.
- Apply the policies and regulations in project implementation and operation of petroleum projects.

Text Books:

1. Petroleum Economics and Engineering, Third Edition, Hussein K. Abdel-Aal, Mohammed A. Alsahlawi, CRC Press, 2013.
2. Petroleum Economics, Heriot-Watt University, 2003.

Reference books:

1. The Global Oil & Gas Industry: Management, Strategy and Finance, Andrew Inkpen & Michael H. Moffett, 2011.
2. Petroleum Economics, Jean Masseron, Technip; 4th revised Edition, 2000.

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B. TECH. PETROLEUM ENGINEERING

IV Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
CORROSION CONTROL IN PETROLEUM INDUSTRY (OPEN ELECTIVE-II for other branches)					

Learning Objectives:
The students will be able to learn:

- The fundamentals of electrochemistry and materials science relevant to corrosion phenomena.
- The causes of mechanisms of various types of corrosion.
- The methods for predicting, measuring, and analyzing corrosion performance of materials.
- The practices for the prevention and remediation of corrosion.
- The evaluation of various corrosion resistant materials for the application in oil and gas industry.

UNIT-I
Introduction to Oilfield Chemistry and Corrosion: Fundamentals of oilfield chemistry including corrosion chemistry.
Classification of corrosion: General corrosion, localized corrosion, MIC, FAC, SCC, CO_2 and H_2S corrosion.
Thermodynamics of electrochemical corrosion: Pourbaix and Evans diagrams, electrochemical reactions, polarization and corrosion rate calculation and measurement. Corrosion tests and standards.

UNIT-II
Advanced Oilfield Corrosion: Introduction to coating and corrosion protection, CO_2 and H_2S corrosion mechanisms in oilfield environments, review and application of CO_2 corrosion models, microbiological induced corrosion in oil field, Pipeline corrosion monitoring, inspection and control strategies - applications to Oil & Gas industry, mitigation of corrosion with inhibitor applications, corrosion inhibitor evaluation.

UNIT-III
Materials Selection: In service failure modes; methodologies of materials and process selection in structural and functional design: qualitative and quantitative; materials specification and sourcing: alloy designations and materials equivalences; databases and materials information sources; Maintenance, monitoring and lifetime predictions

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UNIT-IV

Failure Analysis: Approach to failure analysis; tools of failure analysis; fractography-mechanical failure, environmental effects; characteristics of fracture; weld failure; failure of polymers, ceramics and composites: special features of mechanical failure and environment;

Failure prevention: Design codes and inspection procedures; failure in electronic components and devices; case studies relevant to the individual programme of study.

UNIT-V

Metals and Alloys: Phase diagrams and phase equilibria; metallic crystal structures and microstructure; mechanical properties, deformation and strengthening mechanisms - applications to oil & gas industry.

Outcomes:

The students are able to:

- Assess the concepts of electrochemistry and materials science relevant to corrosion phenomena.
- Assess the causes of mechanisms of various types of corrosion.
- Apply the methods for predicting, measuring, and analyzing corrosion performance of materials.
- Implement the practices for the prevention and remediation of corrosion.
- Evaluate the various corrosion resistant materials for the application in oil and gas industry.

Text Books:

1. Mars G. Fontana, “Corrosion engineering”, McGraw-Hill, 1967, ISBN: 007021460.
2. Denny A Jones, “Principles and prevention of corrosion (second edition)”, Prentice Hall, N. J. 1996.
3. H. H. Uhlig and R. W. Revie, “Corrosion and corrosion control” Wiley (NY), 1987.
4. L. L. Shreir, “Corrosion. Vol I and II, Butterworths, Kent 1976.

Reference Books:

1. M. Pourbaix, “Atlas of Electrochemical Equilibrium in aqueous solutions”, NACE, Houston 1974.
2. J. O. M. Bockris and A. K. N. Reddy, “Modern Electrochemistry”. Vol I and II, Plenum Press (NY).
3. J. D. A. Miller, “Microbial Aspects of Metallurgy, Medical and Tech. Pub. CO. Lancaster” 1971.

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IV Year - I Semester		L	T	P	C
		3	0	0	3

UNCONVENTIONAL HYDROCARBON RESOURCES

(OPEN ELECTIVE-II for other branches)

Learning Objectives:
The students will be able to learn:

- The various sources of CBM, shale gas and oil and natural gas hydrates.
- The concepts and design of CBM systems.
- The concepts of shale gas and oil reservoirs.
- The concepts of natural gas hydrates exploration.
- The methodologies for the extraction of gas from hydrates.

UNIT-I
Introduction: CBM, shale gas, shale oil, gas hydrates, distinction between conventional and unconventional systems. Indian and global scenario.

UNIT-II
Coal Bed Methane (CBM): Coal chemistry – significance of rank – cleat system and natural fracturing. Principles of adsorption-the isotherm construction-ch_4 retention by coal seams-CH_4 content determination in coal seams, reserve analysis-well spacing and drainage area-enhanced recovery. Hydraulic fracturing of coal seams: water production and disposal, economics of coal bed methane recovery.

UNIT-III
Shale Gas: Formation of shale gas, extraction of shale gas, shale gas potential. Relevant technology: hydro-fracturing, relevant environmental issues.

Shale oil: Properties of shale oil, history, production techniques. Well head sand gathering. Advantages and limitations of oil production technology in shale oil. Technical and economic aspects of shale oil production.

UNIT-IV
Natural gas hydrates: Global occurrence & distribution of natural gas hydrates, properties, formation, and disassociation of gas hydrates, bottom simulating

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reflectors (BSR), drilling for gas hydrates, technology used for the exploration of gas hydrates, methodologies for the extraction of gas hydrates.

UNIT V

Exploitation of natural gas hydrates: Methodologies for the extraction of gas hydrates-status of gas hydrate production research and development in India.

Outcomes:

The students are able to:

- Assess the various sources of CBM, shale gas and oil and natural gas hydrates.
- Design and operate the CBM systems.
- Apply the concepts of shale gas and oil reservoirs for exploitation.
- Device exploration methods for natural gas hydrates.
- Apply the methodologies for the extraction of gas from hydrates.

Text Books:

1. Natural Gas Hydrates, John Carrol, Gulf Publishers, 3rd edition, 2014
2. A Guide to Coal Bed Methane Operations, B. A. Hollub, Society of Petroleum, 1992.
3. Fundamentals of Coal Bed Methane Reservoir Engineering, John Seidle, Pennwell Corp., 2011.
4. Unconventional Oil and Shale Gas: Growth, Extraction, and Water Management Issues, AMBER L. TUFT, Nova Science Publishers, 2015.

Reference Books:

1. Sustainable Shale Oil and Gas, Brian F. Thomas, Vikram Rao, Rob Knight, Elsevier, 2017.
2. Shale Oil and Gas Handbook: Theory, Technologies, and Challenges, Sohrab Zendehboudi, Alireza Bahadori, Elsevier, 2017.
3. Shale Oil and Gas Production Processes, James Speight, Elsevier, 2020.
4. Deep Shale Oil and Gas, James G. Speight, Elsevier, 2017.
5. Collet, A. Johnson, C. Knapp, and R. Boswell, eds., Natural gas hydrates—Energy resource potential and associated geologic hazards: AAPG Memoir 89, p. 146– 219.
6. Rappel, C., Tapping methane hydrates for unconventional natural gas, Elements, 3(3), 193-199, 2007.
7. Introduction to Geophysical Prospecting, Milton B. Dobrin, and Carl H. Savit, 4thEdition, McGraw Hill, 1988.

8. Outlines of Geophysical Prospecting: A Manual for Geologists, M.B. Ramachandra Rao, EBD Educational Pvt Ltd., 1993.
9. Shale Oil and Gas Book, Shorab, Zedenbondi and AlirezaBahador, 2nd edition, 1986.
10. Collet, A. Johnson, C. Knapp, and R. Boswell, eds., Natural gas hydrates—Energy resource potential and associated geologic hazards: AAPG Memoir 89, p. 146 – 219, 2010.
11. Rappel, C., Tapping methane hydrates for unconventional natural gas, Elements, 3(3), 193-199, 2007.

Web Links:

1. www.energytomorrow.org/Shale_Gas.asp
2. www.guardian.co.uk/business/2011/apr/08/shell-oil-gas-james-smith
3. http://www.naturalgas.org/naturalgas/exploration.aspp

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IV Year - I Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
PETROLEUM EQUIPMENT DESIGN & SIMULATION LABORATORY					

Learning Objectives:
The students will be able to learn:

- The concepts of design and simulation of various equipment used in petroleum industry.

The following numerical experiments have to be simulated using C/C++/Simulink using MATLAB/UNISIM for obtaining design and simulation (repeated simulations provide the design of equipment):

1. Oil- Water separator.
2. Gas- Oil-Water separator.
3. Lean / rich amine heat exchanger.
4. Air cooled heat exchanger.
5. CO_2 and H_2S absorber unit using, MEA/DEA amine solution.
6. Stripping unit.
7. Single stage flash vaporization unit.
8. Three stage flash vaporization unit.
9. Liquid pumping system & simulation of water-hammer phenomena.
10. Gas Compressor unit.

Outcomes:
The students are able to:

- Design and simulate the two-phase and three phase separators.
- Design and simulate compressors and flash vaporization units.
- Design and simulate absorber-stripper unit for removal of CO_2 and H_2S from natural gas.
- Size /rate the pipeline & pumping systems.
- Do thermal sizing or rating of shell & tube exchangers as per TEMA specifications and API guidelines.
- Generate sized equipment data sheets as per the industry standards with required information for detailed design / manufacture.

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IV Year - I Semester		L	T	P	C
		0	0	3	1.5
PETROLEUM RESERVOIR SIMULATION LABORATORY					

Learning Objectives:
The students will be able to learn:

- The simulation of reservoirs for different production scenarios to find an optimal one before the reservoir is actually put on production.
- The reservoir simulation models for existing reservoirs to study production decline and production forecasts.
- The reservoir simulation models for new reservoirs to maximize recovery of oil and gas to make investment decisions.

Reservoir Simulation Experiments:
The students will be trained in the software Package ECLIPSE, or any other equivalent software to model and solve reservoir engineering problems.

1. File organization and structure
2. Selection of suitable by grid sensitivity studies.
3. Screening Criteria
   i. Fluid properties
   ii. Rock properties
4. Well Pattern and Boundary Conditions
5. Aquifer modeling (single and multiphase fluid flow: Oil-Water/Oil-Water-Gas)
6. History matching consisting of adjusting the parameters of the model such as permeability and porosity until the computed results for the historical period are close to historical data
7. Prediction of properties permeability, relative permeability, saturation etc.

Outcomes:
The students are able to:

- Simulate reservoirs for different production scenarios to find an optimal one before the reservoir is actually put on production.
- Carry out reservoir simulation with different models for existing reservoirs to study production decline and production forecasts.
- Carry out reservoir simulation with different models for new reservoirs to maximize recovery of oil and gas to make investment decisions.
- Present results of the simulation studies in a written report.

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IV Year - I Semester

L	T	P	C
0	0	0	1

PRESENTATION/SEMINAR
(SUMMER INTERNSHIP PROGRAM REPORT)

Learning Objectives:
The students will be able to learn:

- The preparation of the document in a proper format for the submission as summer training/internship report.
- The skills to prepare power point presentation by editing the material from the internship report.
- The oral skills to present the PPT with confidence.
- The sharing of knowledge acquired during the training with fellow students.

A summer internship report is a documentation of a student's work—a record of the original work done by the student in the summer internship of 4 - 6 week duration.

The presentation of the summer training report by the candidates should be conducted by a committee constituted by the Head of the Department for evaluation.

Summer training report of the students shall be evaluated for 50 marks by the committee.

Outcomes:
The students are able to:

- Prepare the documents/reports in the desired formats/the power point presentations very effectively.
- Present the PPTs with confidence in the technical groups/seminars/meetings.
- Enhance written and oral communication skills.
- Share the technical knowledge and experience to colleagues in the plant and elsewhere.

IV Year - I Semester

L	T	P	C
0	0	0	2

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PROJECT WORK (PHASE – 1)

Learning Objectives:
The students are able to learn to:

- Explore the given/chosen topic in detail by doing literature search from journals articles and books.
- Identify the gaps in the existing research/technology.
- Formulate the problem statement of the project and to work out the methodology of addressing the topic.
- Make some preliminary investigations on the topic experimentally or theoretically or both.
- Make an interim technical report consisting of preliminary investigations for presenting it to a committee.

The project work may consist of any one of the following:

a) The project work should consist of a comprehensive design project of one of the petroleum industry in the form of a report with the following chapters:

The project work may consist of any one of the following:

a) The project work should consist of a comprehensive design project of any one of the petroleum upstream processes concerned with reservoir, drilling, production, surface production operations, stimulation, enhanced oil recovery in the form of a report.

b) Modeling & Simulation of any petroleum upstream unit concerned with reservoir, drilling, production, surface production operations, stimulation, enhanced oil recovery.

c) Any experimental work with physical interpretations.

An interim report, which intended as a compilation of literature survey and the results in the preliminary investigations is to be submitted by all the students. It is evaluated by a committee constituted by Head of the Department for 50 marks (2 credits)

Outcomes:
The students are able to:

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- Carry out literature survey for any project.
- Do research work by bridging the gaps in the existing research/technology.
- Write the problem statements of any projects.
- Develop methodology to make calculations/simulations.
- Make the interim technical reports for the preliminary investigations.

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	L	T	P	C
IV Year - I Semester	**3**	**0**	**0**	**0**

(MC)

PROFESSIONAL ETHICS AND HUMAN VALUES

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Member

Shri S. K. S. Charyulu
Member

Shri C. V. G. Krishna
Member

Dr. D. Lingaraju
Chairman

Dr. V.S. R. K. Prasad
Member

Shri A. Doraiah
Member

Shri S. Swarna Raju
Member

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IV Year - I Semester	**L**	**T**	**P**	**C**
		0	**2**	**0**

(MC)
EMPLOYABILITY SKILLS – II
FUNDAMENTALS OF FINANCE AND ACCOUNTING

Learning Objectives:
The students will be able to learn:

- The basics of financial markets and financial management.
- The financial reports which are the end products of the accounting system.
- The accounting principles, conventions and concepts underlying financial reporting.
- The examining the objectives of developing ability to interpret and analyze financial statements.
- About the financial markets; financial institutions, financial market reforms; primary and secondary markets and sources of investment information.

UNIT – I:
Introduction to accounting: The nature of accounting - balance sheet - balance sheet transactions - types of ownership.
Accounting rules and concepts: Accounting differences between proprietorships, partnerships, and corporations – stockholders and the board of directors – credibility and role of auditing – the accounting profession – career opportunities for accountants.

UNIT – II:
Recording transactions and preparing financial statements: The double-entry accounting system – debits and credits – the recording process – classified balance sheet – income statement – profitability evaluation ratios.
Statement of cash flows: Overview of statement of cash flows – preparing a statement of cash flows – cash flow from operating activities – statement of cash flows and balance sheet equation – importance of cash flow.

UNIT – III:
Inventories and cost of goods sold: Gross profit and cost of goods sold – perpetual and periodic inventory systems – cost of merchandise acquired – comparing account procedures for periodic and perpetual inventory systems – principal inventory valuation methods – effects of inventory errors.
Long-lived assets and depreciation: Overview of long-lived assets – contrasting long lived asset expenditures with expenses – acquisition cost of tangible assets –

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depreciation of buildings and equipment – depreciation and cash flow – expenditures after acquisition.

UNIT – IV:

Financial statement analysis: Sources of information about companies – objectives of financial statement analysis – evaluating trends and components of the business – financial ratios – operating performance and financing decisions.

Indian financial system: Instruments (features and behavior, uses), markets and players

UNIT – V:

Introduction to foreign exchange market:

Introduction to financial derivatives:

Outcomes:

The students are able to:

- Apply the principles of financial management for accounting.
- Gain fair understanding the financial markets, reports which are the end products of the accounting system.
- Apply the accounting principles, conventions and concepts underlying financial reporting.
- Develop the ability to interpret and analyze financial statements with improved confidence.
- Analyze the financial markets; financial institutions, financial market reforms; primary and secondary markets and sources of investment.

Text books:

1. Introduction to Financial Accounting, Horngren, Sundem, Elliott and Philbrick, 9th edition, Pearson Education India Ltd., 2008.
2. Financial Markets and Institutions, Anthony Saunders and Marcia Millon Cornet , 6th Edition
3. Financial Institutions & Markets: Structure, Growth and Innovations, Bhole, L. M. and Jitendra Mahakud, Tata McGraw Hill, 5th edition, 2009.

Reference books:

1. Principles of Managerial Finance, Gitman, 10th edition, Pearson Education, 2004.
2. Foundations of Financial Markets & Institutions, Fabozzi, 3rd edition, Pearson Education, 2004.
3. Indian Financial System, Pathak, 2nd edition, Pearson Education, 2008.
4. Financial Markets and Institutions, Mishkin, F.S., Eakins, S.G., Jayakumar, T. and Pattnaik, R.K, 8th edition.

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MOOCS (NPTEL/ SWAYAM) FOR HONORS/MINORS DEGREE

Learning Objectives:
The students are able to:

- Avail the expertise in a specific subject from nation-wide reputed faculty, through MOOC (Massive Open Online Course)
- Develop the ability for self-actualization and in getting opportunity for life-long learning

There shall be a Discipline Centric Elective Course through Massive Open Online Course (MOOC) as Program Elective course. The student shall register for the course (Minimum of 12 weeks) offered by SWAYAM/NPTEL through online. The course is selected in consultation with MOOCS coordinator/Mentor and with the approval of Head of the Department. During the course, the coordinator monitors the student's progress in the SWAYAM/NPTEL courses.

The student needs to submit all the assignments given and needs to take final exam at the center. The student has to earn a certificate by passing the exam. The student will be awarded the credits given in curriculum only by submission of the certificate. If student does not pass the subjects registered through SWAYAM/NPTEL, the same or alternative equivalent subject may be registered and studied again through SWAYAM/NPTEL in the next semester. The student is expected to submit the certificate for the new course provided by SWAYAM/NPTEL.

The list of MOOCS/department courses is given in the Appendix – I (to do honors in petroleum engineering. The eligible student is expected to choose the subjects from the list. To fulfill the criteria of qualifying for honors degree, 20 credits should be obtained at the end of final semester. In order to get minor degree, a student has to select and do the courses in any one discipline (from the list given in the Appendix – II) other than petroleum engineering to fulfil the criteria of 20 credits.
The total 20 credits for honors or minors degree should be obtained from the second semester to the end of eighth semester. A candidate can take a 3-credit course in each semester during the above mentioned period.
It may be noted that, each student is to get minimum 8.0 SGPA without any backlogs in each semester to do honors and minors degree.

Outcomes:
The students will be able to:

- Overcome the digital divide in acquiring fast developing technologies / knowledge and be part of digital revolution.
- Acquire subject specific expert knowledge from National Resource Pool.
- Understand his /her academic / professional priorities for future development.

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IV Year - II Semester		L	T	P	C
		3	0	0	3
OFFSHORE DEEPWATER DRILLING AND PRODUCTION (PROFESSIONAL ELECTIVE-VI)					

Learning Objectives:

The students will be able to learn:

- The basic concepts of offshore environment.
- The application of different offshore platforms used for drilling and production.
- The basics of stability criteria for offshore platforms.
- The methods of offshore drilling, completion and production operations in comparison with onshore operations.
- The concepts of ROV, diving and safety in offshore operations.

UNIT-I:
Introduction to offshore oil and gas operations: Sea States / Offshore Environment-Meteorology, oceanography, ice, sea bed soil.

UNIT-II:
Offshore Fixed Platforms: Types, description and operations, includes compliant platforms.
Offshore Mobile Units: Types, description and installation. Station keeping methods like conventional mooring & dynamic positioning system.

UNIT-III:
Buoyancy and stability: Concepts
Offshore Drilling: Difference in drilling from land, from fixed platform, jackup, ships and semi submersibles. Use of conductors and risers. Deep sea drilling.

UNIT-IV:
Offshore Well Completion - Platforms and subsea completions, deep water applications of subsea technology.
Offshore Production: Oil processing platforms, gas processing platforms, water injection platforms, storage, SPM and SBM, transportation and utilities.

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UNIT-V:

Deep water technology: Introduction, definition & prospects. Deep water regions, deep water drilling rig, selection and deployment, deep water production system, emerging deep water technologies special equipment and systems, remote operation vessels (ROV).

Diving and Safety: Principles of diving, use of compression and decompression chambers, life boats-safety in diving.

Outcomes:

The students are able to:

- Assess the offshore environment for various operations.
- Assess the application of offshore platforms for drilling and production.
- Apply the stability criteria for designing offshore platforms.
- Analyze the methods of offshore drilling, completion and production operations in comparison with onshore operations.
- Apply the deep water technology in the exploitation of offshore oil and gas.
- Apply the concepts of ROV, diving and safety in offshore operations.

Text Books:

1. Offshore Petroleum Drilling and Production, By Sukumar Laik, 1st Edition, Published June 30, 2020 by CRC Press
2. Dynamics of Offshore Structures,by James F. Wilson , 2nd Edition-2002
3. The Technology of Offshore Drilling: Completion and Production by Inc. ETA Offshore Seminars 1866.
4. Introduction to Offshore Structures: Design, Fabrication, Installation Hardcover by W.J. Graff-1981.
5. Deepwater Petroleum Exploration & Production by William L. Leffler, Richard Pattarozzi, Gordon Sterling PennWell Books, 2003.

Reference Books:

1. Floating Drilling: Equipment and Its Use, by Riley Sheffield Volume 2 of Floating Drilling and Volume 2 of Practical drilling technology-1980
2. Handbook On Nondestructive Testing of Concrete By V.M. Malhotra And N.J. Carino, Second Edition Crc Press-2004
3. Offshore Handbook Vol.1 to 5: Gulf Pub. Co.
4. Offshore Pipeline Design, Analysis, and Methods By A. H. Mousselli, Publisher:PennWell Books 1981.
5. Drilling and Producing Offshore, by R. Stewart Hall, Publisher : Pennwell Corp- 1984)

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IV Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
PIPELINE ENGINEERING (PROFESSIONAL ELECTIVE-VI)					

Learning Objectives:
The students will be able to learn:

- The elements of pipeline design, route selection & survey and geotechnical guidelines for construction.
- The concepts of natural gas transmission.
- The principles and design of gas compression systems.
- The fundamentals of liquid flow and design of pumps.
- The concepts of pipeline protection, instrumentation and pigging.
- The details of mechanical design of pipelines and selection of suitable materials.

UNIT-I
Elements of pipeline design: Fluid properties – environment - effects of pressure and temperature - supply/demand scenario - route selection - codes and standards - environmental and hydrological considerations – economics - materials/construction – operation - pipeline protection - pipeline integrity monitoring.
Pipeline route selection, survey and geotechnical guidelines: Introduction - preliminary route selection - key factors for route selection - engineering survey - legal survey - construction / as-built survey - geotechnical design.
Pipeline construction: construction – commissioning.

UNIT-II
Natural gas transmission: General flow equation – steady state - impact of gas molecular weight and compressibility factor on flow capacity - flow regimes – widely used steady-state flow equations – summary of the impact of different gas and pipeline parameters on the gas flow efficiency – pressure drop calculation for pipeline in series and parallel – pipeline gas velocity – erosional velocity – optimum pressure drop for design purposes – pipeline packing – determining gas leakage using pressure drop method – wall thickness/pipe grade – temperature profile – optimization process – gas transmission solved problems.

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Shri S. Swarna Raju, Member

UNIT-III

Gas compression: Types of compressors – compressor drivers – compressor station configuration – thermodynamics of isothermal and adiabatic gas compression – temperature change in adiabatic gas compression – thermodynamics of polytrophic gas compression – gas compressors in series – centrifugal compressor horsepower – enthalpy / entropy charts (mollier diagram) – centrifugal compressor performance curve- reciprocation compressors.

Coolers: Gas coolers – air-cooled heat exchangers –heat transfer equations for coolers – fan air mass flow rate – required fan power – gas pressure drop in coolers – iterative procedure for calculations based on unknown T_2.

UNIT-IV

Liquid flow and pumps: Fully developed laminar flow in a pipe – turbulent flow – multiphase flow - centrifugal pumps – retrofitting for centrifugal pumps (radial-flow) –pump station control – pump station piping design

Pipeline protection, Instrumentation and Pigging: Pipeline coating – cathodic protection – cathodic protection calculations for land pipelines – internal corrosion – flow meters and their calibration – sensors – pigs.

UNIT-V

Pipeline mechanical design: Codes and standards – location classification – pipeline design formula – expansion and flexibility – joint design for pipes of unequal wall thickness – valve assemblies – scraper traps – buoyancy control – crossings – depth of cover – aerial markings – warning signs.

Materials selection: Elements of design – materials designation standards.

Outcomes:

The students are able to:

- Apply the elements of pipeline design, route selection & survey and geotechnical guidelines for construction.
- Design pipelines for natural gas transmission.
- Design of natural gas compression systems.
- Design of liquid pumping systems.
- Use the different methods of pipeline protection, instrumentation and pigging for monitoring pipeline systems.
- Carry out mechanical design of pipelines and selection of suitable materials.

Text Books:

1. Pipeline Design and Construction: A Practical Approach, M. Mohitpour, H. Golshan and M.A. Murray, 2nd Edition, ASME Press, 2007.
2. Pipeline Engineering, Henry Liu, Lewis Publishers (CRC Press), 2003.

Reference Books:

1. Piping Calculation Manual, E. Shashi Menon, McGraw-Hill, 2004.
2. Piping and Pipeline Engineering: Design, Construction, Maintenance Integrity and Repair, George A. Antaki, CRC Press, 2003.
3. Pipeline Planning and Construction Field Manual, E. Shashi Menon, Gulf Professional Publishing, 2011.
4. Pipeline Rules of Thumb Handbook, E. W. McAllister, 7th Edition, 2009.
5. Liquid Pipeline Hydraulics, E. Shashi Menon, Mareel Dekker, Inc., 2004.
6. Gas Pipeline Hydraulics, E. Shashi Menon, Taylor & Francis, 2005.

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R19 Course Structure
B. TECH. PETROLEUM ENGINEERING

IV Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
APPLIED MATHEMATICS IN RESERVOIR ENGINEERING (PROFESSIONAL ELECTIVE-VII)					

Learning Objectives:
The students will be able to learn:

- The concepts of necessary applied mathematics to formulate, solve and analyze engineering problems.
- The application Fourier series and Laplace transform to solve reservoir engineering problems.
- The application of complex integration.
- Application of partial differential equations to solve the reservoir engineering problems.

UNIT-I
Diffusion equation: Derivation of one-dimensional non-linear diffusivity equation with quadratic pressure-gradient term; dimensionless form; derivation of transient diffusivity equation in radial coordinates in non-dimensional form; superposition in space and time; well boundary conditions using bottom hole pressure and specified flow rate.

UNIT-II
Laplace transform: Linearity of the Laplace transform operator; existence conditions; Laplace transform of a time derivative, periodic functions and dirac-delta function; first and second shift theorems; convolution; application of Laplace transforms in solving linear differential equations with initial conditions and system of linear simultaneous differential equations.

UNIT-III
Petroleum engineering applications of Laplace Transforms: Line source solution; Bessel and modified Bessel equations; finite well radius solution; constant pressure inner boundary condition; Incorporating storage, skin and dual-porosity; numerical inversion of Laplace transforms.

UNIT-IV
Fourier transforms: Fourier transform theorem - linearity, Fourier series of periodic functions; trigonometric series; Euler's formulae; half range series; shift theorem, similarity theorem, convolution theorem, Parseval's theorem and derivatives; Fourier sine and cosine transforms; one-dimensional pressure diffusion; heat equation;

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elliptic problem; radial problems; inverting Fourier transforms numerically: discrete Fourier transforms and fast Fourier transforms.

UNIT-V

Complex Integration: Cauchy's integral theorem and its application; integral formula for simply and multiply connected domains and its applications; Taylors and Laurents' series and their application; singular points; Liouvilles theorem with applications; residue theorem and applications; contour integration; boundary value problems.

Outcomes:

The students are able to:

- Analyze and solve reservoir engineering problems using Laplace Series.
- Analyze and solve reservoir engineering problems using Fourier series.
- Apply the analytic function of a complex variable, Cauchy integral theorem and residue theorem to solve contour integrations.
- Be competent in solving linear PDEs using classical analytical solution methods.

Text Books:

1. A Text Book of Engineering Mathematics (Vol-I and II), P.N.Wartikar and J.N.Wartikar, 07th edition, Pune VidhyarthiGrihaPrakashan, Pune, 2013.
2. Applied Mathematics in Reservoir Engineering, Rosalind Archer, Stanford University, 2000.

Reference Books:

1. Analytical Solutions to Productivity and Pressure Transient Equations by Jing Lu, Shawket Ghedan and Djebbar Tiab, VDM Verlag Dr. Muller, 2010.
2. ErusingKreyszig; Advanced Engineering Mathematics; New International Ltd.
3. J. Brown and R. Churchill; Complex Variables and Its applications; McGraw-Hill Higher Education.
4. Frank Ayres; Theory and Problems of Matrices; Schaum Outline Series.
5. K.P. Gupta; Special Functions; Krishna Prakashan Media.

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IV Year - II Semester		L	T	P	C
		3	0	0	3
ADVANCES IN SEISMIC EXPLORATION (PROFESSIONAL ELECTIVE-VII)					

Learning Objectives:

The students will be able to learn:

- The fundamentals of seismic prospecting.
- The seismic data processing and interpretation.
- The seismic attributes.
- The principles of OBC (Ocean Bottom Cable).
- The fundamentals of 2D-3C and 3D-3C.

UNIT – I

Fundamentals of Seismic Prospecting: Different types of seismic waves compressional waves (P waves), shear waves(S waves), airwave, Rayleigh waves, love waves, seismic data acquisition, both land and marine.

Methodology of refraction and reflection surveys recording instruments & energy sources in seismic reflection and refraction surveys: common depth point (CDP) profiling & stacking- 2D, 3D, & 4D seismic surveys- field procedures.

UNIT – II

Seismic Data Processing and Interpretation: Objective of seismic data processing application of different corrections to seismic data, stacking, prestack and post stack time migration**,** prestack depth migration.

Interpretation – structural and stratigraphic interpretation of reflection data, advances in 2D and 3D interpretation. Preparation of time and depth structures maps. Reserves calculations of identified structures.

UNIT – III

Attributes: Emerging and future trends in different seismic attributes their quantitative and qualitative interpretation. Seismic Modelling and inversion, calculation of different reservoir properties from seismic inversion and attributes.

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Introduction to seismic visualization centers. Virtual reality and their use in the interpretation for the Exploration and production of oil and gas reservoirs.

UNIT IV

Introduction to OBC (Ocean bottom Cable): Data acquisition, its processing and interpretation, 3 Component seismic surveys.

UNIT V

Introduction to 2D-3C and 3D-3C: Data acquisition, processing and interpretation Oil and gas reservoirs.

Outcomes:

The students are able to:

- Apply the concepts of seismic prospecting.
- Process and interpret seismic data.
- Apply the seismic attributes to calculate reservoir parameters.
- Apply the OBC (Ocean Bottom Cable) for improving data acquisition.
- Apply 2D-3C and 3D-3C concepts for reservoir modelling.

Text Books:

1. Outlines of Geophysical Prospecting: A Manual for Geologists, M.B. Ramachandra Rao, EBD Educational Pvt Ltd., 1993.
2. Field Geophysics, John Milsom and AsgerEriksen, 4th Edition, John Wiley, 2011.
3. Potential benefits of 3D-3C seismic data for the reservoir characterization of a extra-heavy oil res... by Simon Ramos, David Vidal, ,Yaraixa Perezand and Pedro Alvarez, September 2012.

Reference Books and Published Articles:

1. Introduction to Geophysical Prospecting, Milton B. Dobrin, and Carl H. Savit, 4th Edition, McGraw Hill, 1988.
2. Elements of Geology: Oil and Gas Exploration Techniques, J. Guillemot, Technip 1991
3. García, G., J. Silva, F. Artola, and E. Marquez, 2010, Enhanced density estimation from prestack inversion of multicomponent seismic data: The Leading Edge, 20, 1220–1226.

3.

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Member

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L	T	P	C
3	0	0	3

OPEN ELECTIVE – III (FOR PETROLEUM ENGINEERING)

The students are required to take one of the courses from NPTEL / SWAYAM.

- NPTEL – DATA ANALYSIS & DECISION MAKING
- NPTEL – E-BUSINESS
- NPTEL – INNOVATION, BUSINESS MODELS & ENTREPRENEURSHIP

If the above courses are not available from the list of NPTEL / SWAYAM portal, the student should do the course suggested by the department.

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L	T	P	C
3	0	0	8

PROJECT WORK
(PHASE-2)

Learning Objectives:
The students will be able to learn:

- The design and simulation aspects for the topics necessary in the project work.
- To develop competence in experimental work.
- The integration of knowledge gained in gathering the information required for the project.
- The gaps between theory and practice.
- The improvement of personal qualities like maturity, initiative and creativity.
- The application of communication skills both oral and written.
- The solutions to problems of a non-routine nature.
- The compilation of the work for final technical report to present it in a committee

The project work may consist of any one of the following:

The project work may consist of any one of the following:

d) The project work should consist of a comprehensive design project of any one of the petroleum upstream processes concerned with reservoir, drilling, production, surface production operations, stimulation, enhanced oil recovery in the form of a report.

e) Modeling & Simulation of any petroleum upstream unit concerned with reservoir, drilling, production, surface production operations, stimulation, enhanced oil recovery.

f) Any experimental work with physical interpretations.

The final report, consisting of compilation of literature survey, design and simulation calculations/experimental work, interpretation of results, case studies, cost

estimation if any, conclusions and recommendations, will be submitted by all the students. A committee constituted by Head of the Department will review and evaluate the projects.

Outcomes:

The students are able to:

- Carry out design and simulation of equipment and processes required for the project.
- Be competent in experimental work.
- Integrate the knowledge gained in gathering the information required for the project.
- Identify the gaps between theory and practice.
- Improve the personal qualities like maturity, initiative and creativity.
- Develop communication skills, both oral and written.
- Solve the problems of non-routine nature.
- Compile the final technical report for presenting it to a committee.

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MOOCS (NPTEL/ SWAYAM) FOR HONORS/MINORS DEGREE

Learning Objectives:
The students are able to:

- Avail the expertise in a specific subject from nation-wide reputed faculty, through MOOC (Massive Open Online Course)
- Develop the ability for self-actualization and in getting opportunity for life-long learning

There shall be a Discipline Centric Elective Course through Massive Open Online Course (MOOC) as Program Elective course. The student shall register for the course (Minimum of 12 weeks) offered by SWAYAM/NPTEL through online. The course is selected in consultation with MOOCS coordinator/Mentor and with the approval of Head of the Department. During the course, the coordinator monitors the student's progress in the SWAYAM/NPTEL courses.

The students need to submit all the assignments given and take final exam. Each student has to earn a certificate by passing the exam. Each student will be awarded the credits given in curriculum only after submission of the certificate. If student does not pass the subjects registered through SWAYAM/NPTEL, the same or alternative equivalent subject may be registered and studied again through SWAYAM/NPTEL in the next semester to submit the certificate.

The list of MOOCS/department courses is given in the Appendix – I to do honors in petroleum engineering. The eligible student is expected to choose the subjects from the list. To fulfill the criteria of qualifying for honors degree, 20 credits should be obtained at the end of final semester. In order to get minor degree, a student has to select and do the courses in any one discipline (from the list given in the Appendix – II) other than petroleum engineering to fulfil the criteria of 20 credits.

The total 20 credits for honors or minors degree should be obtained from the second semester to the end of eighth semester. A candidate can take a 3-credit course in each semester during the above mentioned period.
It may be noted that, each student is to get minimum 8.0 SGPA without any backlogs in each semester to do honors / minors degree.

Outcomes:
The students will be able to:

- Overcome the digital divide in acquiring fast developing technologies / knowledge and be part of digital revolution.
- Acquire subject specific expert knowledge from National Resource Pool.
- Understand his /her academic / professional priorities for future development.

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