JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech. in PETROLEUM ENGINEERING
COURSE STRUCTURE & SYLLABUS (R18)

Applicable From 2018-19 Admitted Batch

I YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MA101BS	Mathematics - I	3	1	0	4
2	PH102BS	Engineering Physics	3	1	0	4
3	CS103ES	Programming for Problem Solving	3	1	0	4
4	ME104ES	Engineering Graphics	1	0	4	3
5	PH105BS	Engineering Physics Lab	0	0	3	1.5
6	CS106ES	Programming for Problem Solving Lab	0	0	3	1.5
7	*MC109ES	Environmental Science	3	0	0	0
		Induction Programme				
		Total Credits	**13**	**3**	**10**	**18**

I YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MA201BS	Mathematics - II	3	1	0	4
2	CH202BS	Chemistry	3	1	0	4
3	ME203ES	Engineering Mechanics	3	1	0	4
4	ME205ES	Engineering Workshop	1	0	3	2.5
5	EN205HS	English	2	0	0	2
6	CH206BS	Engineering Chemistry Lab	0	0	3	1.5
7	EN207HS	English Language and Communication Skills Lab	0	0	2	1
		Total Credits	**12**	**3**	**8**	**19.0**

II YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MA301BS	Probability and Statistics & Complex Variables	3	1	0	4
2	PE302PC	Chemical Process Calculations	3	1	0	4
3	PE303PC	General Geology	3	0	0	3
4	PE304PC	Surveying and Offshore Structures	3	0	0	3
5	SM305MS	Business Economics & Financial Analysis	3	0	0	3
6	PE306PC	Geology Lab	0	0	2	1
7	PE307PC	Basic Engineering (Mechanical + Electrical) Lab	0	0	4	2
8	PE308PC	Surveying Lab for Petroleum Engineers	0	0	2	1
9	*MC309	Constitution of India	3	0	0	0
		Total Credits	**18**	**2**	**8**	**21**

II YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	PE401ES	Elements of Mechanical Engineering	3	0	0	3

2	PE402PC	Chemical Engineering Fluid Mechanics	3	1	0	4
3	PE403PC	Petroleum Geology	3	1	0	4
4	PE404PC	Petroleum Exploration Methods	3	1	0	4
5	PE405PC	Process Heat Transfer	3	0	0	3
6	PE406ES	Mathematical Methods for Petroleum Engineering	0	0	2	1
7	PE407PC	Chemical Engineering Fluid Mechanics Lab	0	0	2	1
8	PE408PC	Process Heat Transfer Lab	0	0	2	1
10	*MC409	Gender Sensitization Lab	0	0	2	0
		Total Credits	**15**	**3**	**8**	**21**

III YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	PE501PC	Instrumentation and Process Control	3	1	0	4
2	PE502PC	Drilling Technology	3	0	0	3
3	PE503PC	Thermodynamics for Petroleum Engineers	3	0	0	3
4	SM506MS	Fundamentals of Management for Engineers	3	0	0	3
5	PE504PC	Well Logging & Formation Evaluation	3	0	0	3
6	PE505PC	Health, Safety & Environment in Petroleum Industry	3	0	0	3
7	PE506PC	Instrumentation & Process Control Lab	0	0	2	1
8	PE507PC	Drilling Fluids Lab	0	0	2	1
9	PE508PC	Energy & Environmental Engineering Lab	0	0	2	1
10	*MC510	Intellectual Property Rights	3	0	0	0
		Total Credits	**21**	**1**	**6**	**22**

III YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	PE601PC	Petroleum Refinery Engineering	3	0	0	3
2	PE602PC	Petroleum Reservoir Engineering	3	1	0	4
3	PE603PC	Petroleum Production Engineering & Design	3	0	0	3
4		Professional Elective - I	3	0	0	3
5		Open Elective - I	3	0	0	3
6	PE604PC	Well Completion Testing & Servicing	3	0	0	3
7	PE605PC	Petroleum Reservoir Engineering Lab	0	0	2	1
8	PE606PC	Petroleum Product Testing Lab	0	0	2	1
9	EN608HS	Advanced Communication Skills Lab	0	0	2	1
10	*MC609	Environmental Science	3	0	0	0
		Total Credits	**21**	**1**	**6**	**22**

***MC609 - Environmental Science – Should be Registered by Lateral Entry Students Only.**

IV YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	PE701PC	Petroleum Economics, Policies & Laws	3	0	0	3
2		Professional Elective – II	3	0	0	3
3		Professional Elective – III	3	0	0	3
4		Professional Elective - IV	3	0	0	3
5		Open Elective - II	3	0	0	3

6	PE702PC	Industrial Oriented Mini Project/ Summer Internship	0	0	0	2*
7	PE703PC	Seminar	0	0	2	1
8	PE704PC	Project Stage - I	0	0	6	3
		Total Credits	**15**	**0**	**8**	**21**

IV YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		Professional Elective – V	3	0	0	3
2		Professional Elective - VI	3	0	0	3
3		Open Elective - III	3	0	0	3
4	PE801PC	Project Stage -II	0	0	14	7
		Total Credits	**9**	**0**	**14**	**16**

***MC – Satisfactory/Unsatisfactory**

Note: Industrial Oriented Mini Project/ Summer Internship is to be carried out during the summer vacation between 6th and 7th semesters. Students should submit report of Industrial Oriented Mini Project/ Summer Internship for evaluation.

IMPORTANT: For Open Elective – I, Students should not opt for Fundamentals of Management for Engineers offered by CSE/IT, instead they are requested to opt for another subject.

Professional Elective - I

PE611PE	Surface Production Operations
PE612PE	Horizontal Well Technology
PE613PE	Transport Phenomena

Professional Elective – II

PE711PE	Optimization of Upstream Processes
PE712PE	Chemical Reaction Engineering
PE713PE	Offshore Engineering

Professional Elective – III

PE721PE	Shale Gas Reservoir Engineering
PE722PE	Petroleum Reservoir Stimulation
PE723PE	Petroleum Reservoir Modelling & Simulation

Professional Elective – IV

PE731PE	Pipeline Maintenance Engineering
PE732PE	Natural Gas Processing
PE733PE	Petrochemical Engineering

Professional Elective – V

PE811PE	Sub-Sea Engineering
PE812PE	Natural Gas Hydrates and Coal Bed Methane
PE813PE	Membrane Technology

Professional Elective – VI

PE821PE	Enhanced Oil Recovery Techniques
PE822PE	Multi-Phase Flow in Porous Media
PE823PE	Petroleum Management, Marketing & Finance

MA101BS: MATHEMATICS - I

B.Tech. I Year I Sem.	**L**	**T/P/D**	**C**
	3	**1/0/0**	**4**

Course Objectives: To learn

- Types of matrices and their properties.
- Concept of a rank of the matrix and applying this concept to know the consistency and solving the system of linear equations.
- Concept of Eigen values and eigenvectors and to reduce the quadratic form to canonical form
- Concept of Sequence.
- Concept of nature of the series.
- Geometrical approach to the mean value theorems and their application to the mathematical problems
- Evaluation of surface areas and volumes of revolutions of curves.
- Evaluation of improper integrals using Beta and Gamma functions.
- Partial differentiation, concept of total derivative
- Finding maxima and minima of function of two and three variables.

Course Outcomes: After learning the contents of this paper the student must be able to

- Write the matrix representation of a set of linear equations and to analyse the solution of the system of equations
- Find the Eigen values and Eigen vectors
- Reduce the quadratic form to canonical form using orthogonal transformations.
- Analyse the nature of sequence and series.
- Solve the applications on the mean value theorems.
- Evaluate the improper integrals using Beta and Gamma functions
- Find the extreme values of functions of two variables with/ without constraints.

UNIT-I: Matrices

Matrices: Types of Matrices, Symmetric; Hermitian; Skew-symmetric; Skew-Hermitian; orthogonal matrices; Unitary Matrices; rank of a matrix by Echelon form and Normal form, Inverse of Non-singular matrices by Gauss-Jordan method; System of linear equations; solving system of Homogeneous and Non-Homogeneous equations. Gauss elimination method; Gauss Seidel Iteration Method.

UNIT-II: Eigen values and Eigen vectors

Linear Transformation and Orthogonal Transformation: Eigen values and Eigenvectors and their properties: Diagonalization of a matrix; Cayley-Hamilton Theorem (without proof); finding inverse and power of a matrix by Cayley-Hamilton Theorem; Quadratic forms and Nature of the Quadratic Forms; Reduction of Quadratic form to canonical forms by Orthogonal Transformation

UNIT-III: Sequences & Series

Sequence: Definition of a Sequence, limit; Convergent, Divergent and Oscillatory sequences.
Series: Convergent, Divergent and Oscillatory Series; Series of positive terms; Comparison test, p-test, D-Alembert's ratio test; Raabe's test; Cauchy's Integral test; Cauchy's root test; logarithmic test. Alternating series: Leibnitz test; Alternating Convergent series: Absolute and Conditionally Convergence.

UNIT-IV: Calculus

Mean value theorems: Rolle's theorem, Lagrange's Mean value theorem with their Geometrical Interpretation and applications, Cauchy's Mean value Theorem. Taylor's Series.

Applications of definite integrals to evaluate surface areas and volumes of revolutions of curves (Only in Cartesian coordinates), Definition of Improper Integral: Beta and Gamma functions and their applications.

UNIT-V: Multivariable calculus (Partial Differentiation and applications)

Definitions of Limit and continuity.

Partial Differentiation; Euler's Theorem; Total derivative; Jacobian; Functional dependence & independence, Maxima and minima of functions of two variables and three variables using method of Lagrange multipliers.

TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

REFERENCE BOOKS:

1. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

PH102BS: ENGINEERING PHYSICS

B.Tech. I Year I Sem.	**L**	**T/P/D**	**C**
	3	**1/0/0**	**4**

Course Objectives:

- The course aims at making students to understand the basic concepts of Principles of Physics in a broader sense with a view to lay foundation for the various engineering courses.
- Students will be able to demonstrate competency and understanding of the concepts found in Mechanics, Harmonic Oscillations, Waves in one dimension, wave Optics, Lasers, Fiber Optics and a broad base of knowledge in physics.
- The main purpose of this course is to equip engineering undergraduates with an understanding of the scientific method, so that they may use the training beneficially in their higher pursuits.
- Today the need is to stress principles rather than specific procedures, to select areas of contemporary interest rather than of past interest, and to condition the student to the atmosphere of change he will encounter during his carrier.

Course outcomes: Upon graduation, the graduates will have:

- The knowledge of Physics relevant to engineering is critical for converting ideas into technology.
- An understanding of Physics also helps engineers understand the working and limitations of existing devices and techniques, which eventually leads to new innovations and improvements.
- In the present course, the students can gain knowledge on the mechanism of physical bodies upon the action of forces on them, the generation, transmission and the detection of the waves, Optical Phenomena like Interference, diffraction, the principles of lasers and Fibre Optics.
- Various chapters establish a strong foundation on the different kinds of characters of several materials and pave a way for them to use in at various technical and engineering applications.

UNIT-I: Introduction to Mechanics

Transformation of scalars and vectors under Rotation transformation, Forces in Nature, Newton's laws and its completeness in describing particle motion, Form invariance of Newton's second law, Solving Newton's equations of motion in polar coordinates, Problems including constraints and friction, Extension to cylindrical and spherical coordinates.

UNIT-II: Harmonic Oscillations

Mechanical and electrical simple harmonic oscillators, Complex number notation and phasor representation of simple harmonic motion, Damped harmonic oscillator: heavy, critical and light damping, Energy decay in a damped harmonic oscillator, Quality factor, Mechanical and electrical oscillators, Mechanical and electrical impedance, Steady state motion of forced damped harmonic oscillator, Power observed by oscillator.

UNIT-III: Waves in one dimension

Transverse wave on a string, The wave equation on a string, Harmonic waves, Reflection and transmission of waves at a boundary, Impedance matching, Standing waves and their Eigen frequencies, Longitudinal waves and the wave equations for them, Acoustic waves and speed of sound, Standing sound waves.

UNIT-IV: Wave Optics

Huygen's principle, Superposition of waves and interference of light by wave front splitting and amplitude splitting, Young's double slit experiment, Newton's rings, Michelson's interferometer, Mach-Zehnder interferometer, Fraunhofer diffraction from a single slit and circular aperture, Diffraction grating- resolving power.

UNIT-V: Lasers and Fibre Optics

Lasers: Introduction to interaction of radiation with matter, Coherence, Principle and working of Laser, Population inversion, Pumping, Types of Lasers: Ruby laser, Carbon dioxide (CO_2) laser, He-Ne laser, Applications of laser. Fibre Optics: Introduction, Optical fibre as a dielectric wave guide, Total internal reflection, Acceptance angle, Acceptance cone and Numerical aperture, Step and Graded index fibres, Losses associated with optical fibres, Applications of optical fibres.

TEXT BOOKS:

1. Engineering Mechanics, 2nd ed.- MK Harbola, Cengage Learning
2. I. G. Main, "Vibrations and waves in physics', 3rd Edn, Cambridge University Press, 2018.
3. Ajoy Ghatak, "Optics", McGraw Hill Education, 2012

REFERENCE BOOKS:

1. H. J. Pain, "The physics of vibrations and waves", Wiley, 2006
2. O. Svelto, "Principles of Lasers"
3. "Introduction to Mechanics", M.K.Verma, Universities Press

CS103ES/CS203ES: PROGRAMMING FOR PROBLEM SOLVING

B.Tech. I Year I Sem.	L	T/P/D	C
	3	1/0/0	4

Course Objectives:

- To learn the fundamentals of computers.
- To understand the various steps in program development.
- To learn the syntax and semantics of C programming language.
- To learn the usage of structured programming approach in solving problems.

Course Outcomes: The student will learn

- To write algorithms and to draw flowcharts for solving problems.
- To convert the algorithms/flowcharts to C programs.
- To code and test a given logic in C programming language.
- To decompose a problem into functions and to develop modular reusable code.
- To use arrays, pointers, strings and structures to write C programs.
- Searching and sorting problems.

UNIT - I: Introduction to Programming

Introduction to components of a computer system: disks, primary and secondary memory, processor, operating system, compilers, creating, compiling and executing a program etc., Number systems
Introduction to Algorithms: steps to solve logical and numerical problems. Representation of Algorithm, Flowchart/Pseudo code with examples, Program design and structured programming
Introduction to C Programming Language: variables (with data types and space requirements), Syntax and Logical Errors in compilation, object and executable code , Operators, expressions and precedence, Expression evaluation, Storage classes (auto, extern, static and register), type conversion, The main method and command line arguments
Bitwise operations: Bitwise AND, OR, XOR and NOT operators
Conditional Branching and Loops: Writing and evaluation of conditionals and consequent branching with if, if-else, switch-case, ternary operator, goto, Iteration with for, while, do-while loops
I/O: Simple input and output with scanf and printf, formatted I/O, Introduction to stdin, stdout and stderr. Command line arguments

UNIT - II: Arrays, Strings, Structures and Pointers:

Arrays: one- and two-dimensional arrays, creating, accessing and manipulating elements of arrays
Strings: Introduction to strings, handling strings as array of characters, basic string functions available in C (strlen, strcat, strcpy, strstr etc.), arrays of strings
Structures: Defining structures, initializing structures, unions, Array of structures
Pointers: Idea of pointers, Defining pointers, Pointers to Arrays and Structures, Use of Pointers in self-referential structures, usage of self-referential structures in linked list (no implementation)
Enumeration data type

UNIT - III: Preprocessor and File handling in C:

Preprocessor: Commonly used Preprocessor commands like include, define, undef, if, ifdef, ifndef
Files: Text and Binary files, Creating and Reading and writing text and binary files, Appending data to existing files, Writing and reading structures using binary files, Random access using fseek, ftell and rewind functions.

UNIT - IV: Function and Dynamic Memory Allocation:

Functions: Designing structured programs, Declaring a function, Signature of a function, Parameters and return type of a function, passing parameters to functions, call by value, Passing arrays to functions, passing pointers to functions, idea of call by reference, Some C standard functions and libraries

Recursion: Simple programs, such as Finding Factorial, Fibonacci series etc., Limitations of Recursive functions
Dynamic memory allocation: Allocating and freeing memory, Allocating memory for arrays of different data types

UNIT - V: Introduction to Algorithms:
Algorithms for finding roots of a quadratic equations, finding minimum and maximum numbers of a given set, finding if a number is prime number, etc.
Basic searching in an array of elements (linear and binary search techniques),
Basic algorithms to sort array of elements (Bubble, Insertion and Selection sort algorithms),
Basic concept of order of complexity through the example programs

TEXT BOOKS:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. B.A. Forouzan and R.F. Gilberg C Programming and Data Structures, Cengage Learning, (3rd Edition)

REFERENCE BOOKS:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice
2. Hall of India
3. R.G. Dromey, How to solve it by Computer, Pearson (16th Impression)
4. Programming in C, Stephen G. Kochan, Fourth Edition, Pearson Education.
5. Herbert Schildt, C: The Complete Reference, Mc Graw Hill, 4th Edition

ME104ES/ME204ES: ENGINEERING GRAPHICS

B.Tech. II Year I Sem.	L	T/P/D	C
	1	0/0/4	3

Pre-requisites: Nil

Course objectives:

- To provide basic concepts in engineering drawing.
- To impart knowledge about standard principles of orthographic projection of objects.
- To draw sectional views and pictorial views of solids.

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

- Preparing working drawings to communicate the ideas and information.
- Read, understand and interpret engineering drawings.

UNIT – I

Introduction to Engineering Drawing: Principles of Engineering Graphics and their Significance, Conic Sections including the Rectangular Hyperbola – General method only. Cycloid, Epicycloid and Hypocycloid, Scales – Plain & Diagonal.

UNIT- II

Orthographic Projections: Principles of Orthographic Projections – Conventions – Projections of Points and Lines, Projections of Plane regular geometric figures. Auxiliary Planes.

UNIT – III

Projections of Regular Solids – Auxiliary Views - Sections or Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views – Sections of Sphere

UNIT – IV

Development of Surfaces of Right Regular Solids – Prism, Cylinder, Pyramid and Cone,
Intersection of Solids: Intersection of – Prism vs Prism- Cylinder Vs Cylinder

UNIT – V

Isometric Projections: Principles of Isometric Projection – Isometric Scale – Isometric Views – Conventions – Isometric Views of Lines, Plane Figures, Simple and Compound Solids – Isometric Projection of objects having non- isometric lines. Isometric Projection of Spherical Parts. Conversion of Isometric Views to Orthographic Views and Vice-versa –Conventions

Introduction to CAD: (For Internal Evaluation Weightage only):

Introduction to CAD Software Package Commands. - Free Hand Sketches of 2D- Creation of 2D Sketches by CAD Package

TEXT BOOKS:

1. Engineering Drawing N.D. Bhatt / Charotar
2. Engineering Drawing / N. S. Parthasarathy and Vela Murali/ Oxford

REFERENCE BOOKS:

1. Engineering Drawing / Basant Agrawal and McAgrawal/ McGraw Hill
2. Engineering Drawing/ M. B. Shah, B.C. Rane / Pearson.
3. Computer Aided Engineering Drawing – K Balaveera Reddy et al – CBS Publishers

PH105BS: ENGINEERING PHYSICS LAB

B.Tech. I Year I Sem.	L	T/P/D	C
	0	0/3/0	1.5

List of Experiments:

1. Melde's experiment:
   To determine the frequency of a vibrating bar or turning fork using Melde's arrangement.

2. Torsional pendulum:
   To determine the rigidity modulus of the material of the given wire using torsional pendulum.

3. Newton's rings:
   To determine the radius of curvature of the lens by forming Newton's rings.

4. Diffraction grating:
   To determine the number of lines per inch of the grating.

5. Dispersive power:
   To determine the dispersive power of prism by using spectrometer.

6. Coupled Oscillator:
   To determine the spring constant by single coupled oscillator.

7. LCR Circuit:
   To determine quality factor and resonant frequency of LCR circuit.

8. LASER:
   To study the characteristics of LASER sources.

9. Optical fibre:
   To determine the bending losses of Optical fibres.

10. Optical fibre:
    To determine the Numerical aperture of a given fibre.

Note: Any 8 experiments are to be performed

CS106ES/CS206ES: PROGRAMMING FOR PROBLEM SOLVING LAB

B.Tech. I Year I Sem.	**L**	**T/P/D**	**C**
	0	**0/3/0**	**1.5**

[Note:The programs may be executed using any available Open Source/ Freely available IDE
Some of the Tools available are:
CodeLite: https://codelite.org/
Code::Blocks: http://www.codeblocks.org/
DevCpp : http://www.bloodshed.net/devcpp.html
Eclipse: http://www.eclipse.org
This list is not exhaustive and is NOT in any order of preference]

Course Objectives: The students will learn the following:

- To work with an IDE to create, edit, compile, run and debug programs
- To analyze the various steps in program development.
- To develop programs to solve basic problems by understanding basic concepts in C like operators, control statements etc.
- To develop modular, reusable and readable C Programs using the concepts like functions, arrays etc.
- To Write programs using the Dynamic Memory Allocation concept.
- To create, read from and write to text and binary files

Course Outcomes: The candidate is expected to be able to:

- formulate the algorithms for simple problems
- translate given algorithms to a working and correct program
- correct syntax errors as reported by the compilers
- identify and correct logical errors encountered during execution
- represent and manipulate data with arrays, strings and structures
- use pointers of different types
- create, read and write to and from simple text and binary files
- modularize the code with functions so that they can be reused

Practice sessions:

a. Write a simple program that prints the results of all the operators available in C (including pre/ post increment , bitwise and/or/not , etc.). Read required operand values from standard input.
b. Write a simple program that converts one given data type to another using auto conversion and casting. Take the values form standard input.

Simple numeric problems:

a. Write a program for fiend the max and min from the three numbers.
b. Write the program for the simple, compound interest.
c. Write program that declares Class awarded for a given percentage of marks, where mark <40%= Failed, 40% to <60% = Second class, 60% to <70%=First class, >= 70% = Distinction. Read percentage from standard input.
d. Write a program that prints a multiplication table for a given number and the number of rows in the table. For example, for a number 5 and rows = 3, the output should be:
e. 5 x 1 = 5
f. 5 x 2 = 10
g. 5 x 3 = 15
h. Write a program that shows the binary equivalent of a given positive number between 0 to 255.

Expression Evaluation:

a. A building has 10 floors with a floor height of 3 meters each. A ball is dropped from the top of the building. Find the time taken by the ball to reach each floor. (Use the formula s = ut+(1/2)at^2 where u and a are the initial velocity in m/sec (= 0) and acceleration in m/sec^2 (= 9.8 m/s^2)).
b. 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)
c. Write a program that finds if a given number is a prime number
d. Write a C program to find the sum of individual digits of a positive integer and test given number is palindrome.
e. A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.
f. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
g. Write a C program to find the roots of a Quadratic equation.
h. Write a C program to calculate the following, where x is a fractional value.
i. 1-x/2 +x^2/4-x^3/6
j. Write a C program to read in two numbers, x and n, and then compute the sum of this geometric progression: 1+x+x^2+x^3+…….+x^n. For example: if n is 3 and x is 5, then the program computes 1+5+25+125.

Arrays and Pointers and Functions:

a. Write a C program to find the minimum, maximum and average in an array of integers.
b. Write a functions to compute mean, variance, Standard Deviation, sorting of n elements in single dimension array.
c. Write a C program that uses functions to perform the following:
d. Addition of Two Matrices
e. ii. Multiplication of Two Matrices
f. iii. Transpose of a matrix with memory dynamically allocated for the new matrix as row and column counts may not be same.
g. Write C programs that use both recursive and non-recursive functions
h. To find the factorial of a given integer.
i. ii. To find the GCD (greatest common divisor) of two given integers.
j. iii. To find x^n
k. Write a program for reading elements using pointer into array and display the values using array.
l. Write a program for display values reverse order from array using pointer.
m. Write a program through pointer variable to sum of n elements from array.

Files:

a. Write a C program to display the contents of a file to standard output device.
b. Write a C program which copies one file to another, replacing all lowercase characters with their uppercase equivalents.
c. Write a C program to count the number of times a character occurs in a text file. The file name and the character are supplied as command line arguments.
d. Write a C program that does the following:
   It should first create a binary file and store 10 integers, where the file name and 10 values are given in the command line. (hint: convert the strings using atoi function)
   Now the program asks for an index and a value from the user and the value at that index should be changed to the new value in the file. (hint: use fseek function)
   The program should then read all 10 values and print them back.

e. Write a C program to merge two files into a third file (i.e., the contents of the first file followed by those of the second are put in the third file).

Strings:

a. Write a C program to convert a Roman numeral ranging from I to L to its decimal equivalent.
b. Write a C program that converts a number ranging from 1 to 50 to Roman equivalent
c. Write a C program that uses functions to perform the following operations:
d. To insert a sub-string in to a given main string from a given position.
e. ii. To delete n Characters from a given position in a given string.
f. Write a C program to determine if the given string is a palindrome or not (Spelled same in both directions with or without a meaning like madam, civic, noon, abcba, etc.)
g. Write a C program that displays the position of a character ch in the string S or – 1 if S doesn't contain ch.
h. Write a C program to count the lines, words and characters in a given text.

Miscellaneous:

a. Write a menu driven C program that allows a user to enter n numbers and then choose between finding the smallest, largest, sum, or average. The menu and all the choices are to be functions. Use a switch statement to determine what action to take. Display an error message if an invalid choice is entered.
b. Write a C program to construct a pyramid of numbers as follows:

```
1          *          1          1          *
1 2        * *        2 3        2 2        * *
1 2 3      * * *      4 5 6      3 3 3      * * *
                                 4 4 4 4    * *
                                            *
```

Sorting and Searching:

a. Write a C program that uses non recursive function to search for a Key value in a given
b. list of integers using linear search method.
c. Write a C program that uses non recursive function to search for a Key value in a given
d. sorted list of integers using binary search method.
e. Write a C program that implements the Bubble sort method to sort a given list of
f. integers in ascending order.
g. Write a C program that sorts the given array of integers using selection sort in descending order
h. Write a C program that sorts the given array of integers using insertion sort in ascending order
i. Write a C program that sorts a given array of names

Suggested Reference Books for solving the problems:

i. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
ii. B.A. Forouzan and R.F. Gilberg C Programming and Data Structures, Cengage Learning, (3rd Edition)
iii. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice
iv. Hall of India
v. R.G. Dromey, How to solve it by Computer, Pearson (16th Impression)
vi. Programming in C, Stephen G. Kochan, Fourth Edition, Pearson Education.
vii. Herbert Schildt, C: The Complete Reference, Mc Graw Hill, 4th Edition

***MC109ES: ENVIRONMENTAL SCIENCE**

B.Tech. I Year I Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**0**

Course Objectives:

- Understanding the importance of ecological balance for sustainable development.
- Understanding the impacts of developmental activities and mitigation measures.
- Understanding the environmental policies and regulations

Course Outcomes:

- Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles and environmental regulations which in turn helps in sustainable development

UNIT-I

Ecosystems: Definition, Scope, and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnification, ecosystem value, services and carrying capacity, Field visits.

UNIT-II

Natural Resources: Classification of Resources: Living and Non-Living resources, **water resources:** use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. **Mineral resources:** use and exploitation, environmental effects of extracting and using mineral resources, **Land resources:** Forest resources, **Energy resources:** growing energy needs, renewable and non-renewable energy sources, use of alternate energy source, case studies.

UNIT-III

Biodiversity and Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act.

UNIT-IV

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, **Air Pollution:** Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. **Water pollution:** Sources and types of pollution, drinking water quality standards. **Soil Pollution:** Sources and types, Impacts of modern agriculture, degradation of soil. **Noise Pollution:** Sources and Health hazards, standards, **Solid waste:** Municipal Solid Waste management, composition and characteristics of e-Waste and its management. **Pollution control technologies:** Wastewater Treatment methods: Primary, secondary and Tertiary.
Overview of air pollution control technologies, Concepts of bioremediation. **Global Environmental Issues and Global Efforts: C**limate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol. NAPCC-GoI Initiatives.

UNIT-V

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio-

economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP). **Towards Sustainable Future:** Concept of Sustainable Development Goals, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

TEXT BOOKS:

1 Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2 Environmental Studies by R. Rajagopalan, Oxford University Press.

REFERENCE BOOKS:

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHI Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.
6. Introduction to Environmental Science by Y. Anjaneyulu, BS. Publications.

MA201BS: MATHEMATICS - II

B.Tech. I Year II Sem.	**L**	**T/P/D**	**C**
	3	**1/0/0**	**4**

Course Objectives: To learn

- Methods of solving the differential equations of first and higher order.
- Evaluation of multiple integrals and their applications
- The physical quantities involved in engineering field related to vector valued functions
- The basic properties of vector valued functions and their applications to line, surface and volume integrals

Course Outcomes: After learning the contents of this paper the student must be able to

- Identify whether the given differential equation of first order is exact or not
- Solve higher differential equation and apply the concept of differential equation to real world problems
- Evaluate the multiple integrals and apply the concept to find areas, volumes, centre of mass and Gravity for cubes, sphere and rectangular parallelopiped
- Evaluate the line, surface and volume integrals and converting them from one to another

UNIT-I: First Order ODE

Exact, linear and Bernoulli's equations; Applications: Newton's law of cooling, Law of natural growth and decay; Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

UNIT-II: Ordinary Differential Equations of Higher Order

Second order linear differential equations with constant coefficients: Non-Homogeneous terms of the type $e^{ax}, \sin ax, \cos ax,$ polynomials in x, $e^{ax}V(x)$ and $x\,V(x)$; method of variation of parameters; Equations reducible to linear ODE with constant coefficients: Legendre's equation, Cauchy-Euler equation.

UNIT-III: Multivariable Calculus (Integration)

Evaluation of Double Integrals (Cartesian and polar coordinates); change of order of integration (only Cartesian form); Evaluation of Triple Integrals: Change of variables (Cartesian to polar) for double and (Cartesian to Spherical and Cylindrical polar coordinates) for triple integrals.

Applications: Areas (by double integrals) and volumes (by double integrals and triple integrals), Centre of mass and Gravity (constant and variable densities) by double and triple integrals (applications involving cubes, sphere and rectangular parallelopiped).

UNIT-IV: Vector Differentiation

Vector point functions and scalar point functions. Gradient, Divergence and Curl. Directional derivatives, Tangent plane and normal line. Vector Identities. Scalar potential functions. Solenoidal and Irrotational vectors.

UNIT-V: Vector Integration

Line, Surface and Volume Integrals. Theorems of Green, Gauss and Stokes (without proofs) and their applications.

TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

REFERENCE BOOKS:

1. Paras Ram, Engineering Mathematics, 2nd Edition, CBS Publishes
2. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.

CH102BS/CH202BS: CHEMISTRY

B.Tech. I Year II Sem.	**L**	**T/P/D**	**C**
	3	**1/0/0**	**4**

Course Objectives:

- To bring adaptability to the concepts of chemistry and to acquire the required skills to become a perfect engineer.
- To impart the basic knowledge of atomic, molecular and electronic modifications which makes the student to understand the technology based on them.
- To acquire the knowledge of electrochemistry, corrosion and water treatment which are essential for the Engineers and in industry.
- To acquire the skills pertaining to spectroscopy and to apply them for medical and other fields.
- To impart the knowledge of stereochemistry and synthetic aspects useful for understanding reaction pathways

Course Outcomes: The basic concepts included in this course will help the student to gain:

- The knowledge of atomic, molecular and electronic changes, band theory related to conductivity.
- The required principles and concepts of electrochemistry, corrosion and in understanding the problem of water and its treatments.
- The required skills to get clear concepts on basic spectroscopy and application to medical and other fields.
- The knowledge of configurational and conformational analysis of molecules and reaction mechanisms.

UNIT - I:

Molecular structure and Theories of Bonding: Atomic and Molecular orbitals. Linear Combination of Atomic Orbitals (LCAO), molecular orbitals of diatomic molecules, molecular orbital energy level diagrams of N_2, O_2 and F_2 molecules. π molecular orbitals of butadiene and benzene.

Crystal Field Theory (CFT): Salient Features of CFT – Crystal Field Splitting of transition metal ion d-orbitals in Tetrahedral, Octahedral and square planar geometries. Band structure of solids and effect of doping on conductance.

UNIT - II:

Water and its treatment: Introduction – hardness of water – Causes of hardness - Types of hardness: temporary and permanent – expression and units of hardness – Estimation of hardness of water by complexometric method. Potable water and its specifications. Steps involved in treatment of water – Disinfection of water by chlorination and ozonization. Boiler feed water and its treatment – Calgon conditioning, Phosphate conditioning and Colloidal conditioning. External treatment of water – Ion exchange process. Desalination of water – Reverse osmosis. Numerical problems.

UNIT - III:

Electrochemistry and corrosion: Electro chemical cells – electrode potential, standard electrode potential, types of electrodes – calomel, Quinhydrone and glass electrode. Nernst equation Determination of pH of a solution by using quinhydrone and glass electrode. Electrochemical series and its applications. Numerical problems. Potentiometric titrations. Batteries – Primary (Lithium cell) and secondary batteries (Lead – acid storage battery and Lithium ion battery).

Causes and effects of corrosion – theories of chemical and electrochemical corrosion – mechanism of electrochemical corrosion, Types of corrosion: Galvanic, water-line and pitting corrosion. Factors affecting rate of corrosion, Corrosion control methods- Cathodic protection – Sacrificial anode and impressed current cathodic methods. Surface coatings – metallic coatings – methods of application. Electroless plating of Nickel.

UNIT - IV:

Stereochemistry, Reaction Mechanism and synthesis of drug molecules: Introduction to representation of 3-dimensional structures, Structural and stereoisomers, configurations, symmetry and chirality. Enantiomers, diastereomers, optical activity and Absolute configuration. Conformation alanalysis of n- butane.

Substitution reactions: Nucleophilic substitution reactions: Mechanism of S_N1, S_N2 reactions. Electrophilic and nucleophilic addition reactions: Addition of HBr to propene. Markownikoff and anti Markownikoff's additions. Grignard additions on carbonyl compounds. Elimination reactions: Dehydro halogenation of alkylhalides. Saytzeff rule. Oxidation reactions: Oxidation of alcohols using $KMnO_4$ and chromic acid.

Reduction reactions: reduction of carbonyl compounds using $LiAlH_4$ & $NaBH_4$. Hydroboration of olefins. Structure, synthesis and pharmaceutical applications of Paracetamol and Aspirin.

UNIT - V:

Spectroscopic techniques and applications: Principles of spectroscopy, selection rules and applications of electronic spectroscopy. vibrational and rotational spectroscopy. Basic concepts of Nuclear magnetic resonance Spectroscopy, chemical shift. Introduction to Magnetic resonance imaging.

TEXT BOOKS:

1. Physical Chemistry, by P.W. Atkins
2. Engineering Chemistry by P.C.Jain & M.Jain; Dhanpat Rai Publishing Company (P) Ltd., New Delhi.
3. Fundamentals of Molecular Spectroscopy, by C.N. Banwell
4. Organic Chemistry: Structure and Function by K.P.C. Volhardt and N.E.Schore, 5th Edition.
5. University Chemistry, by B.M. Mahan, Pearson IV Edition.
6. Engineering Chemistry (NPTEL Web-book), by B.L. Tembe, Kamaluddin and M.S. Krishnan

ME203ES: ENGINEERING MECHANICS

B.Tech. I Year II Sem.	**L**	**T/P/D**	**C**
	3	**1/0/0**	**4**

Course Objectives: The objectives of this course are to

- Explain the resolution of a system of forces, compute their resultant and solve problems using equations of equilibrium
- Perform analysis of bodies lying on rough surfaces.
- Locate the centroid of a body and compute the area moment of inertia and mass moment of inertia of standard and composite sections
- Explain kinetics and kinematics of particles, projectiles, curvilinear motion, centroidal motion and plane motion of rigid bodies.
- Explain the concepts of work-energy method and its applications to translation, rotation and plane motion and the concept of vibrations

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

- Determine resultant of forces acting on a body and analyse equilibrium of a body subjected to a system of forces.
- Solve problem of bodies subjected to friction.
- Find the location of centroid and calculate moment of inertia of a given section.
- Understand the kinetics and kinematics of a body undergoing rectilinear, curvilinear, rotatory motion and rigid body motion.
- Solve problems using work energy equations for translation, fixed axis rotation and plane motion and solve problems of vibration.

UNIT-I:

Introduction to Engineering Mechanics - Force Systems: Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy

UNIT-II:

Friction: Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;

Centroid and Centre of Gravity -Centroid of Lines, Areas and Volumes from first principle, centroid of composite sections; Centre of Gravity and its implications. – Theorem of Pappus

UNIT-III:

Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Product of Inertia, Parallel Axis Theorem, Perpendicular Axis Theorem

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:

Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique).

UNIT-V:

Kinetics of Rigid Bodies -Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work Energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation

TEXT BOOKS:

1. Shames and Rao (2006), Engineering Mechanics, Pearson Education
2. Reddy Vijay Kumar K. and J. Suresh Kumar (2010), Singer's Engineering Mechanics – Statics & Dynamics

REFERENCE BOOKS:

1. Timoshenko S.P and Young D.H., "Engineering Mechanics", McGraw Hill International Edition, 1983.
2. Andrew Pytel, Jaan Kiusalaas, "Engineering Mechanics", Cengage Learning, 2014.
3. Beer F.P & Johnston E.R Jr. Vector, "Mechanics for Engineers", TMH, 2004.
4. Hibbeler R.C & Ashok Gupta, "Engineering Mechanics", Pearson Education, 2010.
5. Tayal A.K., "Engineering Mechanics – Statics & Dynamics", Umesh Publications, 2011.
6. Basudeb Bhattacharyya, "Engineering Mechanics", Oxford University Press, 2008.
7. Meriam. J. L., "Engineering Mechanics", Volume-II Dynamics, John Wiley & Sons, 2008.

ME105ES/ME205ES: ENGINEERING WORKSHOP

B.Tech. I Year II Sem.	**L**	**T/P/D**	**C**
	1	**0/3/0**	**2.5**

Pre-requisites: Practical skill

Course Objectives:

- To Study of different hand operated power tools, uses and their demonstration.
- To gain a good basic working knowledge required for the production of various engineering products.
- To provide hands on experience about use of different engineering materials, tools, equipments and processes those are common in the engineering field.
- To develop a right attitude, team working, precision and safety at work place.
- It explains the construction, function, use and application of different working tools, equipment and machines.
- To study commonly used carpentry joints.
- To have practical exposure to various welding and joining processes.
- Identify and use marking out tools, hand tools, measuring equipment and to work to prescribed tolerances.

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

- Study and practice on machine tools and their operations
- Practice on manufacturing of components using workshop trades including pluming, fitting, carpentry, foundry, house wiring and welding.
- Identify and apply suitable tools for different trades of Engineering processes including drilling, material removing, measuring, chiseling.
- Apply basic electrical engineering knowledge for house wiring practice.

1. TRADES FOR EXERCISES:

At least two exercises from each trade:

I. Carpentry – (T-Lap Joint, Dovetail Joint, Mortise & Tenon Joint)
II. Fitting – (V-Fit, Dovetail Fit & Semi-circular fit)
III. Tin-Smithy – (Square Tin, Rectangular Tray & Conical Funnel)
IV. Foundry – (Preparation of Green Sand Mould using Single Piece and Split Pattern)
V. Welding Practice – (Arc Welding & Gas Welding)
VI. House-wiring – (Parallel & Series, Two-way Switch and Tube Light)
VII. Black Smithy – (Round to Square, Fan Hook and S-Hook)

2. TRADES FOR DEMONSTRATION & EXPOSURE:

Plumbing, Machine Shop, Metal Cutting (Water Plasma), Power tools in construction and Wood Working

TEXT BOOKS:

1. Workshop Practice /B. L. Juneja / Cengage
2. Workshop Manual / K. Venugopal / Anuradha.

REFERENCE BOOKS:

1. Work shop Manual - P. Kannaiah/ K. L. Narayana/ SciTech
2. Workshop Manual / Venkat Reddy/ BSP

EN105HS/EN205HS: ENGLISH

B.Tech. I Year II Sem.	**L**	**T/P/D**	**C**
	2	**0/0/0**	**2**

INTRODUCTION

In view of the growing importance of English as a tool for global communication and the consequent emphasis on training students to acquire language skills, the syllabus of English has been designed to develop linguistic, communicative and critical thinking competencies of Engineering students.

In English classes, the focus should be on the skills development in the areas of vocabulary, grammar, reading and writing. For this, the teachers should use the prescribed text for detailed study. The students should be encouraged to read the texts leading to reading comprehension and different passages may be given for practice in the class. The time should be utilized for working out the exercises given after each excerpt, and also for supplementing the exercises with authentic materials of a similar kind, for example, newspaper articles, advertisements, promotional material etc. *The focus in this syllabus is on skill development, fostering ideas and practice of language skills in various contexts and cultures.*

Learning Objectives: The course will help to

- Improve the language proficiency of students in English with an emphasis on Vocabulary, Grammar, Reading and Writing skills.
- Equip students to study academic subjects more effectively and critically using the theoretical and practical components of English syllabus.
- Develop study skills and communication skills in formal and informal situations.

Course Outcomes: Students should be able to

- Use English Language effectively in spoken and written forms.
- Comprehend the given texts and respond appropriately.
- Communicate confidently in various contexts and different cultures.
- Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

UNIT –I

'The Raman Effect' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary Building: The Concept of Word Formation --The Use of Prefixes and Suffixes.

Grammar: Identifying Common Errors in Writing with Reference to Articles and Prepositions.

Reading: Reading and Its Importance- Techniques for Effective Reading.

Basic Writing Skills: Sentence Structures -Use of Phrases and Clauses in Sentences- Importance of Proper Punctuation- Techniques for writing precisely – **Paragraph writing** – Types, Structures and Features of a Paragraph - Creating Coherence-Organizing Principles of Paragraphs in Documents.

UNIT –II

'Ancient Architecture in India' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Synonyms and Antonyms.

Grammar: Identifying Common Errors in Writing with Reference to Noun-pronoun Agreement and Subject-verb Agreement.

Reading: Improving Comprehension Skills – Techniques for Good Comprehension

Writing: Format of a Formal Letter-**Writing Formal Letters** E.g.., Letter of Complaint, Letter of Requisition, Job Application with Resume.

UNIT –III

'Blue Jeans' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Acquaintance with Prefixes and Suffixes from Foreign Languages in English to form Derivatives-Words from Foreign Languages and their Use in English.

Grammar: Identifying Common Errors in Writing with Reference to Misplaced Modifiers and Tenses.

Reading: Sub-skills of Reading- Skimming and Scanning

Writing: Nature and Style of Sensible Writing- **Defining- Describing** Objects, Places and Events – **Classifying**- Providing Examples or Evidence

UNIT –IV

'What Should You Be Eating' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Standard Abbreviations in English

Grammar: Redundancies and Clichés in Oral and Written Communication.

Reading: Comprehension**-** Intensive Reading and Extensive Reading

Writing: Writing Practices--Writing Introduction and Conclusion - Essay Writing-Précis Writing.

UNIT –V

'How a Chinese Billionaire Built Her Fortune' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Technical Vocabulary and their usage

Grammar: Common Errors in English

Reading: Reading Comprehension-Exercises for Practice

Writing: **Technical Reports**- Introduction – Characteristics of a Report – Categories of Reports

Formats- Structure of Reports (Manuscript Format) -Types of Reports - Writing a Report.

TEXT BOOK:

1. Sudarshana, N.P. and Savitha, C. (2018). English for Engineers. Cambridge University Press.

REFERENCE BOOKS:

1. Swan, M. (2016). Practical English Usage. Oxford University Press.
2. Kumar, S and Lata, P. (2018). Communication Skills. Oxford University Press.
3. Wood, F.T. (2007). Remedial English Grammar. Macmillan.
4. Zinsser, William. (2001). On Writing Well. Harper Resource Book.
5. Hamp-Lyons, L. (2006). Study Writing. Cambridge University Press.
6. Exercises in Spoken English. Parts I –III. CIEFL, Hyderabad. Oxford University Press.

CH106BS/CH206BS: ENGINEERING CHEMISTRY LAB

B.Tech. I Year II Sem.

L	T/P/D	C
0	0/3/0	1.5

Course Objectives: The course consists of experiments related to the principles of chemistry required for engineering student. The student will learn:

- Estimation of hardness and chloride content in water to check its suitability for drinking purpose.
- To determine the rate constant of reactions from concentrations as an function of time.
- The measurement of physical properties like adsorption and viscosity.
- To synthesize the drug molecules and check the purity of organic molecules by thin layer chromatographic (TLC) technique.

Course Outcomes: The experiments will make the student gain skills on:

- Determination of parameters like hardness and chloride content in water.
- Estimation of rate constant of a reaction from concentration – time relationships.
- Determination of physical properties like adsorption and viscosity.
- Calculation of R_f values of some organic molecules by TLC technique.

List of Experiments:

1. Determination of total hardness of water by complexometric method using EDTA
2. Determination of chloride content of water by Argentometry
3. Estimation of an HCl by Conductometric titrations
4. Estimation of Acetic acid by Conductometric titrations
5. Estimation of HCl by Potentiometric titrations
6. Estimation of Fe^{2+} by Potentiometry using $KMnO_4$
7. Determination of rate constant of acid catalysed hydrolysis of methyl acetate
8. Synthesis of Aspirin and Paracetamol
9. Thin layer chromatography calculation of R_f values. eg ortho and para nitro phenols
10. Determination of acid value of coconut oil
11. Verification of freundlich adsorption isotherm-adsorption of acetic acid on charcoal
12. Determination of viscosity of castor oil and ground nut oil by using Ostwald's viscometer.
13. Determination of partition coefficient of acetic acid between n-butanol and water.
14. Determination of surface tension of a give liquid using stalagmometer.

REFERENCE BOOKS:

1. Senior practical physical chemistry, B.D. Khosla, A. Gulati and V. Garg (R. Chand & Co., Delhi)
2. An introduction to practical chemistry, K.K. Sharma and D. S. Sharma (Vikas publishing, N. Delhi)
3. Vogel's text book of practical organic chemistry 5^{th} edition
4. Text book on Experiments and calculations in Engineering chemistry – S.S. Dara

EN107HS/EN207HS: ENGLISH LANGUAGE AND COMMUNICATION SKILLS LAB

B.Tech. I Year II Sem.	L	T/P/D	C
	0	0/2/0	1

The **Language Lab** focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations both in formal and informal contexts.

Course Objectives:

- To facilitate computer-assisted multi-media instruction enabling individualized and independent language learning
- To sensitize students to the nuances of English speech sounds, word accent, intonation and rhythm
- To bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking
- To improve the fluency of students in spoken English and neutralize their mother tongue influence
- To train students to use language appropriately for public speaking and interviews

Learning Outcomes: Students will be able to attain

- Better understanding of nuances of English language through audio- visual experience and group activities
- Neutralization of accent for intelligibility
- Speaking skills with clarity and confidence which in turn enhances their employability skills

Syllabus

English Language and Communication Skills Lab (ELCS) shall have two parts:

a. **Computer Assisted Language Learning (CALL) Lab**
b. **Interactive Communication Skills (ICS) Lab**

Listening Skills

Objectives

1. To enable students develop their listening skills so that they may appreciate its role in the LSRW skills approach to language and improve their pronunciation
2. To equip students with necessary training in listening so that they can comprehend the speech of people of different backgrounds and regions

Students should be given practice in listening to the sounds of the language, to be able to recognize them and find the distinction between different sounds, to be able to mark stress and recognize and use the right intonation in sentences.

- Listening for general content
- Listening to fill up information
- Intensive listening
- Listening for specific information

Speaking Skills

Objectives

1. To involve students in speaking activities in various contexts
2. To enable students express themselves fluently and appropriately in social and professional contexts

- Oral practice: Just A Minute (JAM) Sessions

- Describing objects/situations/people
- Role play – Individual/Group activities

- **The following course content is prescribed for the English Language and Communication Skills Lab based on Unit-6 of AICTE Model Curriculum 2018 for B.Tech First English. As the syllabus is very limited, it is required to prepare teaching/learning materials by the teachers collectively in the form of handouts based on the needs of the students in their respective colleges for effective teaching/learning and timesaving in the Lab)**

Exercise – I
CALL Lab:
Understand: Listening Skill- Its importance – Purpose- Process- Types- Barriers of Listening.
Practice: Introduction to Phonetics – Speech Sounds – Vowels and Consonants.
ICS Lab:
Understand: Communication at Work Place- Spoken vs. Written language.
Practice: Ice-Breaking Activity and JAM Session- Situational Dialogues – Greetings – Taking Leave – Introducing Oneself and Others.

Exercise – II
CALL Lab:
Understand: Structure of Syllables – Word Stress and Rhythm– Weak Forms and Strong Forms in Context.
Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms in Context.
ICS Lab:
Understand: Features of Good Conversation – Non-verbal Communication.
Practice: Situational Dialogues – Role-Play- Expressions in Various Situations –Making Requests and Seeking Permissions - Telephone Etiquette.

Exercise - III
CALL Lab:
Understand: Intonation-Errors in Pronunciation-the Influence of Mother Tongue (MTI).
Practice: Common Indian Variants in Pronunciation – Differences in British and American Pronunciation.
ICS Lab:
Understand: How to make Formal Presentations.
Practice: Formal Presentations.

Exercise – IV
CALL Lab:
Understand: Listening for General Details.
Practice: Listening Comprehension Tests.
ICS Lab:
Understand: Public Speaking – Exposure to Structured Talks.
Practice: Making a Short Speech – Extempore.

Exercise – V
CALL Lab:
Understand: Listening for Specific Details.
Practice: Listening Comprehension Tests.
ICS Lab:
Understand: Interview Skills.
Practice: Mock Interviews.

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Minimum Requirement of infrastructural facilities for ELCS Lab:

1. **Computer Assisted Language Learning (CALL) Lab:**

The Computer Assisted Language Learning Lab has to accommodate 40 students with 40 systems, with one Master Console, LAN facility and English language learning software for self- study by students.

System Requirement (Hardware component):

Computer network with LAN facility (minimum 40 systems with multimedia) with the following specifications:

i) Computers with Suitable Configuration
ii) High Fidelity Headphones

2. **Interactive Communication Skills (ICS) Lab:**

The Interactive Communication Skills Lab: A Spacious room with movable chairs and audio-visual aids with a Public-Address System, a LCD and a projector etc.

MA301BS: PROBABILITY AND STATISTICS & COMPLEX VARIABLES

B.Tech. II Year I Sem.	L	T/P/D	C
	3	1/0/0	4

Pre-requisites: Mathematical Knowledge at pre-university level

Course Objectives: To learn

- The ideas of probability and random variables and various discrete and continuous probability distributions and their properties.
- The basic ideas of statistics including measures of central tendency, correlation and regression.
- The statistical methods of studying data samples.
- Differentiation and integration of complex valued functions.
- Evaluation of integrals using Cauchy's integral formula and Cauchy's residue theorem.
- Expansion of complex functions using Taylor's and Laurent's series.

Course outcomes: After learning the contents of this paper the student must be able to

- Formulate and solve problems involving random variables and apply statistical methods for analysing experimental data.
- Analyse the complex function with reference to their analyticity, integration using Cauchy's integral and residue theorems.
- Taylor's and Laurent's series expansions of complex function.

UNIT - I: Basic Probability **8 L**

Probability spaces, conditional probability, independent events, and Bayes' theorem.
Random variables: Discrete and continuous random variables, Expectation of Random Variables, Moments, Variance of random variables

UNIT - II: Probability distributions **10 L**

Binomial, Poisson, evaluation of statistical parameters for these distributions, Poisson approximation to the binomial distribution
Continuous random variables and their properties, distribution functions and density functions, Normal and exponential, evaluation of statistical parameters for these distributions

UNIT - III: Testing of Hypothesis **10 L**

Test of significance: Basic of testing of Hypothesis. Null and alternate Hypothesis, types of errors, level of significance, critical region.
Large sample test for single proportion, difference of proportions, single mean, difference of means; small sample tests: Test for single mean, difference of means and test for ratio of variances

UNIT - IV: Complex Variables (Differentiation) **10 L**

Limit, Continuity and Differentiation of Complex functions, Analyticity, Cauchy-Riemann equations (without proof), finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties.

UNIT - V: Complex Variables (Integration) **10 L**

Line integral, Cauchy's theorem, Cauchy's Integral formula, Zeros of analytic functions, Singularities, Taylor's series, Laurent's series; Residues, Cauchy Residue theorem, Conformal mappings, Mobius transformations and their properties.

TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2010.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, keying Ye, Probability and statistics for engineers and scientists, 9th Edition, Pearson Publications.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.

REFERENCE BOOKS:

1. Fundamentals of Mathematical Statistics, Khanna Publications, S. C. Gupta and V. K. Kapoor.
2. Miller and Freund's, Probability and Statistics for Engineers, 8th Edition, Pearson Educations
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

PE302PC: CHEMICAL PROCESS CALCULATIONS

B.Tech. II Year I Sem.	L	T/P/D	C
	3	1/0/0	4

Prerequisites: Engineering Mathematics, Engineering Physics, Engineering Chemistry

Course Objective: To introduce calculations for both material and energy balances for different industrial processes. It is prerequisite for several other courses in the curriculum, including courses like process dynamics, heat transfer and thermodynamics.

Course Outcome: The student would be in a position to have knowledge of chemical engineering calculations, which is a pre-requisite for several other courses in the syllabus.

UNIT - I

Stoichiometric & Composition relations: Stoichiometric relation, basis of calculations, methods of expressing compositions of mixtures and solutions, density and specific gravity, Baume and API gravity scales.

Behavior of Ideal gases: Kinetic theory of gases, application of ideal gas law, gaseous mixtures, gases in chemical reactions.

UNIT - II

Vapour pressure: Liquefaction and liquid state, vaporization, boiling point, effect of temperature on vapour pressure, Antoine equation, vapour pressure plots, estimation of critical properties, vapour pressure of immiscible liquids and ideal solutions, Raoult's law, Non-volatile solutes.

Humidity and Saturation: Partial saturation, Humidity- Absolute Humidity, Vaporization process, Molal humidity, Relative and percentage saturation, dew point, humid heat, wet bulb and dry bulb temperatures, use of humidity charts, adiabatic vaporization.

UNIT - III

Material balances: Tie substance, Yield, conversion, limiting reactant, excess reactant, processes involving reactions, Material balances with the help of Stoichiometric equations, Material balances involving drying, dissolution, & crystallization. Material balance calculations for processes involving recycle, bypass and purge.

UNIT - IV

Thermo physics: 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 non-polar liquids enthalpy and its evaluation.

Thermo chemistry: Calculation and applications of heat of reaction, combustion, formation and neutralization, Kirchhoff's equation, enthalpy concentration change, calculation of theoretical and actual flame temperatures.

UNIT - V

Combustion Calculations: Introduction, 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.

TEXT BOOK:

1. Chemical process principles, Part -I, Material and Energy Balance, Hougen O A, Watson K.M. and Ragatz R.A. 2nd Edition, John Wiley and Sons, New York, 1963.

REFERENCE BOOKS:

1. Basic principles and calculations in chemical engineering by D.H. Himmelblau, 7th Ed. PHI, 2013
2. Stoichiometry by B.I. Bhatt and S.M. Vora (3rd Ed.) Tata McGraw Hill publishing company, Ltd. New Delhi (1996)

PE303PC: GENERAL GEOLOGY

B.Tech. II Year I Sem.	L	T/P/D	C
	3	0/0/0	3

Prerequisites: None

Course Objective: To expose the students to different geological environments, which relate to petroleum industry

Course Outcome: The student would understand the basics of geology, viz: formation of earth, layers of earth, different types of rocks, formation of sedimentary basins and the micro fossils and their relationship to oil and gas.

UNIT - I

Dimensions of earth, structure, composition and origin of earth-envelops of the Earth- crust, mantle, core. Internal dynamic process- Plate tectonics- continental drift, Earthquake and volcanoes. External dynamic process- weathering, erosion and deposition.

UNIT - II

Fundamental concepts in Geomorphology-geomorphic processes distribution of landforms-drainage patterns –development, Landforms in relation to rocks types, paleochannels, buried channels.

UNIT - III

Geological work of rivers, wind, Ocean and glaciers and the landforms created by them.

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UNIT - IV

Origin of igneous, sedimentary and metamorphic rocks. Sedimentary structures-petrographic character of conglomerate, sandstone, shale, limestones.

Introduction to sedimentary basins and deltaic systems. Topographic maps, thematic maps, Topographic and thematic profiles.

UNIT - V

Palaeontology: Introduction to Palaeontology, Fossils and Fossilization.

Micropaleontology - Palynology: Distribution of microfossils-Foraminifera, Radiolaria, Conodonts, Ostracodes, Diatoms. Importance of micro fossils in oil exploration.

TEXT BOOK:

1. Engineering Geology, F. G. Bell, 2nd Edition, Butterworth Heimann, 2007.

REFERENCE BOOKS:

1. Text book of Geology, P.K Mukharjee, The World Press Pvt Ltd., Calcutta, 2005.
2. Rutleys Elements of Mineralogy, 27 Ed., N.H.Read, Allen & Unwin Australia 1988.

PE304PC: SURVEYING AND OFFSHORE STRUCTURES

B.Tech. II Year I Sem.	L	T/P/D	C
	3	0/0/0	3

Prerequisites: None

Course Objectives: The students will be trained to:

- Demonstrate the principles of surveying for the measurement of distance and angles.
- Explain the concepts of levelling and contouring.
- Introduce the concepts of advanced surveying and implementation in shoreline surveying.
- Demonstrate the principles of sea surveying.
- Introduce the concepts of wave and current data collection.
- Explain various stages of fixed offshore structure in view of the operation.
- Introduce the concept and types of compliant structures.
- Demonstrate the basic terminology and floatation principles of floating structures.

Course Outcomes: After successful completion of the course, the student can understand:

- The basic principles and significance of measurement of distance and direction.
- Horizontal and vertical angles.
- Principles, importance and measurement of angles using Theodolite.
- Concepts and terminology in contour mapping.
- Measurement and to plotting the contour maps.
- Basics of total station and GPS.
- Shore line survey and basics of acoustics, application in the field.
- Basics of sea surveying and bathymetry, importance of bathymetry survey, seismic survey, positioning and wave and current data collection and significance of data collection.
- Types and functions of fixed offshore structures, methodology of fabrication transportation, installation and operation of fixed offshore structures, Significance and types of compliant structures.
- The basic principles of floatation and stability of floating structures.
- Stability criteria of neutrally and positively buoyant structures.

UNIT – I

Distance and Direction: Objectives, Principles and classifications of Surveying, chain, tape, Electronic distance measurements, Meridians Azimuths and Barings, declination, computation of angle.

Theodolite: Theodolite, description, uses and adjustments – temporary, measurement of horizontal and vertical angles. Principles of Electronic Theodolite.

UNIT - II

Levelling and Contouring: Concept and Terminology, Temporary- method of levelling. Characteristics and Uses of contours- methods of conducting contour surveys and their plotting.

UNIT - III

Introduction to Advanced Surveying: Total Station and Global positioning system and Differential GPS. **Hydrographic surveying**: Introduction- Shoreline Surveys- Sounding Methods (Bathymetry).

UNIT – IV

Subsea surveying and Geomatics, introduction to the principles of subsea surveying and geomatics is including bathymetry and seismic survey, positioning systems (surface positioning, visual positioning techniques) distance from shore & water depth, generation of surface waves in oceans, wave data collection, and current data collection.

UNIT – V

Functions of offshore structures, fixed offshore structures, types of fixed structures, fabrication, transportation, installation and operation of offshore structures, construction of offshore concrete structures, definition of compliant structures, types of complaint structures.

Floating structures, basic hydrostatics, Centre of gravity, center of buoyancy, displacement, law of floatation, draft, keel, Simpson's rule for areas and centroids, second moments of area, moments of inertia, mass moment of inertia, calculation of metacentric height, stability of floating structures, definition of neutrally and positively buoyant structures.

TEXT BOOKS FOR UNITS I - III:

1. Surveying (Vol – 1, 2); Higher Surveying, Punmia, B.C., Ashok Kumar Jain and Arun Kumar Jain, Vol 3, Laxmi Publications, 2005.
2. Surveying (Vol – 1 & 2), Duggal S K, Tata McGraw Hill, 2004.
3. Text book of Surveying, Venkataramaiah, C., Universities Press, 1996.

TEXT BOOKS FOR UNITS IV - V:

1. Handbook of Offshore Engineering, Subrata K. Chakrabarti, Volume 1, Elsevier, 2005.
2. Ship Stability for Masters and Mates, Barrass, C. B. and D. R. Derret, 7th Edition, Butterworth-Heinemann, 2012.
3. Construction of Marine and Offshore Structure, Gerwick, Jr., C., 3rd Edition, CRC Press, 2007.

SM305MS: BUSINESS ECONOMICS AND FINANCIAL ANALYSIS

B.Tech. II Year I Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Prerequisites: None

Course Objective: To learn the basic Business types, impact of the Economy on Business and Firms specifically. To analyze the Business from the Financial Perspective.

Course Outcome: The students will understand the various Forms of Business and the impact of economic variables on the Business. The Demand, Supply, Production, Cost, Market Structure, Pricing aspects are learnt. The Students can study the firm's financial position by analysing the Financial Statements of a Company.

UNIT – I

Introduction to Business and Economics:

Business: Structure of Business Firm, Theory of Firm, Types of Business Entities, Limited Liability Companies, Sources of Capital for a Company, Non-Conventional Sources of Finance.

Economics: Significance of Economics, Micro and Macro Economic Concepts, Concepts and Importance of National Income, Inflation, Money Supply in Inflation, Business Cycle, Features and Phases of Business Cycle. Nature and Scope of Business Economics, Role of Business Economist, Multidisciplinary nature of Business Economics.

UNIT - II

Demand and Supply Analysis:

Elasticity of Demand: Elasticity, Types of Elasticity, Law of Demand, Measurement and Significance of Elasticity of Demand, Factors affecting Elasticity of Demand, Elasticity of Demand in decision making, Demand Forecasting: Characteristics of Good Demand Forecasting, Steps in Demand Forecasting, Methods of Demand Forecasting.

Supply Analysis: Determinants of Supply, Supply Function & Law of Supply.

UNIT - III

Production, Cost, Market Structures & Pricing:

Production Analysis: Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Different Types of Production Functions.

Cost analysis: Types of Costs, Short run and Long run Cost Functions.

Market Structures: Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly, Monopolistic Competition.

Pricing: Types of Pricing, Product Life Cycle based Pricing, Break Even Analysis, Cost Volume Profit Analysis.

UNIT - IV

Financial Accounting: Accounting concepts and Conventions, Accounting Equation, Double-Entry system of Accounting, Rules for maintaining Books of Accounts, Journal, Posting to Ledger, Preparation of Trial Balance, Elements of Financial Statements, Preparation of Final Accounts.

UNIT - V

Financial Analysis through Ratios: Concept of Ratio Analysis, Liquidity Ratios, Turnover Ratios, Profitability Ratios, Proprietary Ratios, Solvency, Leverage Ratios (simple problems).

Introduction to Fund Flow and Cash Flow Analysis (simple problems).

TEXT BOOKS:

1. D.D. Chaturvedi, S.L. Gupta, Business Economics - Theory and Applications, International Book House Pvt. Ltd. 2013.
2. Dhanesh K Khatri, Financial Accounting, Tata McGraw Hill, 2011.
3. Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury, Managerial Economics, 2e, Tata McGraw Hill Education Pvt. Ltd. 2012.

REFERENCES:

1. Paresh Shah, Financial Accounting for Management 2e, Oxford Press, 2015.
2. S.N. Maheshwari, Sunil K Maheshwari, Sharad K Maheshwari, Financial Accounting, 5e, Vikas Publications, 2013.

PE306PC: GEOLOGY LAB

B.Tech. II Year I Sem.	L	T/P/D	C
	0	0/2/0	1

Prerequisites: Basic knowledge of Geology

Course Objectives:

- The students should be in a position to
- read, understand and interpret the supplied maps
- understand the steps to be followed for completing any field job successfully

Course Outcomes: The student will be in a position to

- read, understand and interpret different maps like Toposheet, Structural Geology maps, Stratigraphic maps, geological cross-sections, Isopach maps, Structural Contour maps etc.
- understand how to locate own / outcrop positions on Toposheet and how to take traverse
- understand geological formations and measure dip and strike reading correctly in the filed
- calculate true dip, true thickness, Oil Water Contact (OWC) from given maps
- explain different sediment depositional environments from stratigraphic columns

List of Experiments:

1. Study of physical properties of minerals in hand specimen
2. Study of common rocks with reference to their common structures, mineral composition and uses.
3. Identification of minerals under microscopes
4. Identification of rocks under microscopes
5. Location of observed outcrops on the Toposheet. Geological mapping and Traversing.
6. Measurement of the strike and dip in the field
7. Interpretation of Topographic Maps
8. Interpretation of Geological Maps: (1) Attitude, (2) Cross-sections, (3) Unconformable beds, (4) Folded beds, (5) Faults and geological intrusions (dykes and sills)
9. Interpretation of isopach maps
10. Interpretation of litho stratigraphic columns and litho stratigraphic correlation
11. Interpretation of structural contour map and location of Oil Water Contact (OWC)
12. Interpretation of isopach map and depositional model.
13. Estimation of Thickness, Distance, and Depth of subsurface Ore Bodies

PE307PC: BASIC ENGINEERING (MECHANICAL + ELECTRICAL) LAB

B.Tech. II Year I Sem.	L	T/P/D	C
	0	0/4/0	2

Section A: Mechanical Engineering Laboratory:

Course Objective: 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.

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

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 I.C .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.

Section B: Electrical Engineering Laboratory

Course Objectives: This course imparts knowledge to the students to:

- Learn the estimation of efficiency of a DC machine as motor & generator.
- Learn the estimation of efficiency of transformer at different load conditions & power factors.
- Study the performance of a 3-Phase induction motor by conducting direct test.
- Pre-determine the regulation of an alternator by Synchronous impedance method.
- Understand the speed control of a DC shunts motor.
- Study the performance of a DC shunts motor by conducting direct test.

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

- Estimate the efficiency of a DC machine as motor & generator.
- Estimate the efficiency of transformer at different load conditions & power factors.
- Understand the performance of a 3-Phase induction motor by conducting direct test.
- Pre-determine the regulation of an alternator by Synchronous impedance method.
- Control the speed of a DC shunt motor by Field flux control method & Armature Voltage control method.
- Understand the performance characteristics of a DC shunt motor by conducting direct test.

List of Experiments:

1. Swinburne's test on D.C. Shunt machine. (Predetermination of efficiency of a given D.C. Shunt machine working as motor and generator).
2. OC and SC tests on single phase transformer (Predetermination of efficiency and regulation at given power factors)
3. Brake test on 3-phase Induction motor (Determination of performance characteristics)
4. Regulation of alternator by Synchronous impedance method.
5. Speed control of D.C. Shunt motor by
   a) Armature Voltage control b) Field flux control method
6. Brake test on D.C Shunt Motor

PE308PC: SURVEYING LAB FOR PETROLEUM ENGINEERS

B.Tech. II Year I Sem.	L	T/P/D	C
	0	0/2/0	1

Prerequisites: Basic knowledge of Civil Engineering and Survey

Course Objectives:

- To have the ability for applying knowledge of mathematics, science, and engineering to understand the measurement techniques and equipment used in land surveying
- To gain an appreciation of the need for lifelong learning through the discussion of recent changes in survey procedures and equipment
- To have the ability for using techniques, skills, and modern engineering tools necessary for engineering practice
- To build the ability for working as a member of a team
- To understand the importance of professional licensure to protect the public in the practice of land surveying.

Course Outcomes: After the completion of the said lab, the students will

- appreciate the need for accurate and thorough note taking in field work to serve as a legal record
- gain the ability to use modern survey equipment to measure angles and distances
- gain a basic understanding of the principles and operation of the Global Positioning System
- gain the ability to measure differences in elevation, draw and utilize contour plots, and calculate volumes for earthwork
- improve ability to function as a member of a survey party in completing the assigned field work
- Appreciate the need for licensed surveyors to establish positioning information for property and structures.

List of Experiments:

1. Study of linear measuring instruments and chain surveying.
2. Study of theodolite and traversing with theodolite,
3. Study of levels and ordinary levelling with tilting level, Profile levelling,
4. Study of total station and measurement with total station.
5. Study of Global Positioning System (GPS) and measurement with GPS.
6. Determination of distance between two inaccessible points with compass.
7. Surveying of a given area by prismatic compass (closed traverse) and plotting after adjustment
8. Radiation method and Intersection method by plane table survey.
9. Two-point problems in plane table survey.
10. Three-point problems in plane table survey.
11. Traversing by plane table survey.
12. Fly levelling (differential levelling)

***MC309/*MC409: CONSTITUTION OF INDIA**

B.Tech. II Year I Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**0**

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement; however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

PE401ES: ELEMENTS OF MECHANICAL ENGINEERING

B. Tech. II Year II Sem.	L	T/P/D	C
	3	0/0/0	3

Prerequisites: None

Course Objective: To give an insight to students about the behaviour of materials under external forces. The concept of stress, strain, elasticity etc. as applied to various structures under loading are included.

Course Outcome: The student would be exposed to basic mechanical engineering machinery.

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. Theory of simple bending, simple bending formula, Distribution of Flexural and Shear stress in Beam section – Shear stress formula – Shear stress distribution for some standard sections.

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

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

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.

Gear trains: classification of gears, gear trains velocity ratio, simple, compound –reverted and epicyclic gear trains.

TEXT BOOKS:

1. "Strength of Materials and Mechanics of Structures", B.C. Punmia, Standard Publications and distributions, 9 th ed. (units I – III)
2. Thermal Engineering, Ballaney, P.L., Khanna Publishers, 2003 (Units IV.
3. Theory of Machines, S.S. Rattan, Tata McGraw Hill (Units V).

PE402PC: CHEMICAL ENGINEERING FLUID MECHANICS

B.Tech. II Year II Sem.	L	T/P/D	C
	3	1/0/0	4

Prerequisites: Engineering Mathematics, Engineering Physics

Course Objective: To introduce the concepts, principles, laws, observations and models of fluids at rest and in motion and also to provide the basis for understanding the fluid behavior, engineering design and control of fluid systems.

Course Outcomes: The student would be able to get knowledge related to compressible & incompressible fluids and also transportation of fluids.

UNIT - I

Unit operations and unit processes, unit systems, basic concepts, 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, Basic equation of fluid flow –Mass balance in a flowing fluid; continuity equation, differential momentum balance; equations of motion, Macroscopic momentum balances, Bernoulli equation, pump work in Bernoulli equation.

UNIT - II

Incompressible 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, Dimensional analysis including Buckingham π Theorem and Rayleigh's method.

UNIT - III

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

UNIT - IV

Flow past immersed bodies, Drag and Drag coefficient, friction in flow through beds of solids, Kozeny-Carman, Blake-Plummer and Ergun equations, and motion of particles through fluids.

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

UNIT - V

Transportation and Metering of fluids- Pipes, fittings and valves, Fluid- moving machinery, Fans, blowers, and compressors.

Measurement of flowing fluids- variable head meters- Orifice meter, Venturi meter, Pitot tube; Area meters- Rota meter.

TEXT BOOKS:

1. Unit Operations of Chemical Engineering by W.L. McCabe, J.C. Smith & Peter Harriot, McGraw-Hill, 7th ed, 2007
2. Chemical Engineering Fluid Mechanics by Ron Darby, 2nd Edition, CRC press, Taylor & Francis group, 2001

REFERENCE BOOKS:

1. Transport processes and unit operations by Christie J. Geankoplis, PHI
2. Principles of Unit Operations, Foust *et al*, 2nd ed., John Wiley, 1999
3. Chemical Engineering, Vol-I, Coulson and Richardson, Pergamon Press

PE403PC: PETROLEUM GEOLOGY

B.Tech. II Year II Sem.	**L**	**T/P/D**	**C**
	3	**1/0/0**	**4**

Prerequisites: General Geology

Course Objective: To expose the students to different source, reservoir and cap rocks, hydrocarbon migration and generation of oil and gas from sediments.

Course Outcome: The students will learn different source, reservoir and cap rocks, concepts of porosity, permeability and their relation to hydrocarbon migration and entrapment. Temperature-pressure conditions for the generation of oil and gas from organic rich sediments.

UNIT - I

Source Rocks: Definition of source rock. Organic rich sediments as source rocks. Nature and type of source rocks - Claystone / shale. The process of diagenesis, catagenesis and metagenesis in the formation of source rocks. Evaluation of petroleum source rock potential. Limestone as source rocks. Subsurface pressure temperature conditions for the generation of oil and gas from the source sediments. Oil window.

UNIT - II

Reservoir Rocks: 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.

Reservoir pore space - porosity – primary and secondary porosity, Effective porosity, fracture porosity - permeability – effective and relative permeability Relationship between porosity, permeability and texture. Cap rocks: Definition and characteristics of 'cap Rocks'.

UNIT - III

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 - IV

Entrapment of Hydrocarbons: Entrapment and accumulation of hydrocarbons - Classification and types of traps: Structural, stratigraphic and combination type of traps - Traps associated with salt domes.

UNIT - V

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, Cambay basin and Mumbai off-shore

TEXT BOOK:

1. Levorsen, A.I. Geology of Petroleum, 1967, 2nd Edn., CBS, New Delhi.

REFERENCE BOOKS:

1. Richard, C. Selley, 1998. Elements of Petroleum Geology, Academic Press, London
2. Sedimentary basins of India- ONGC bulletin.

PE404PC: PETROLEUM EXPLORATION METHODS

B.Tech. II Year II Sem.	**L**	**T/P/D**	**C**
	3	**1/0/0**	**4**

Prerequisites: Basic knowledge of Geology and Petroleum Geology

Course Objectives: The syllabus for Petroleum Exploration should be aimed at the student to have a broad knowledge of exploration history in India. The student 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.

Course Outcomes: The outcome this is to give insight for the student to have a broad-based understanding of the seismic exploration, viz its acquisition methods, processing and interpretation, as they have already had geology in 2nd year course. The knowledge of these methods will go a long way along with the other paper i.e, logging methods for them to opt for upstream industry jobs if they so desire.

UNIT - I
Introduction: Overview of petroleum exploration in India, Introduction to Geophysical/Geological methods used in Petroleum Exploration.

UNIT - II
Sediment logical and biostratigraphic approaches in hydrocarbon exploration.

UNIT - III
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. 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.

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 & stacking- 2D, 3D, & 4D seismic surveys- Field procedures & principles- Time corrections applied to seismic data- Data processing - Introduction to 2D & 3D data acquisition & interpretation of reflection data for identification of drillable structures.
Well seismic shooting for velocity determination and Vertical Seismic Profiling (VSP).

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, EBD Educational Pvt Ltd., 1993.
3. 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.

PE405PC: PROCESS HEAT TRANSFER

B.Tech. II Year II Sem.	L	T/P/D	C
	3	0/0/0	3

Prerequisites: Engineering Mathematics, Engineering Physics

Course Objective: The objective of this course is to understand the principles of heat transfer (conduction, convection and radiation) and also principles and working of heat transfer equipments.

Course Outcome: The student would be in a position to design of heat transfer equipments which are used in the process industry.

UNIT - I

Introduction: Nature of heat flow, conduction, convection, natural and forced convection, radiation.

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.

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 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 and analogy between transfer of momentum and heat, heat transfer to liquid metals, heating and cooling of fluids in forced convection outside tubes.

UNIT - IV

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

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

Radiation: Introduction, properties and definitions, black body radiation, real surfaces and the gray body, absorption of radiation by opaque solids, radiation between surfaces, radiation shielding, radiation to semi-transparent materials, 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: Evaporators, performance of tubular evaporators, capacity and economy, multiple effect evaporators, methods of feeding, vapor recompression.

TEXT BOOK:

1. Unit Operations of Chemical Engineering by W.L. McCabe, J.C. Smith & Peter Harriot, McGraw-Hill, 7th ed, 2007

REFERENCE BOOKS:

1. Process Heat Transfer, D. Q. Kern, Tata McGraw-Hill, New Delhi, 1997.
2. Heat Transfer, 4th ed., J.P. Holman, McGraw-Hill, New York, 1976.

PE406ES: MATHEMATICAL METHODS FOR PETROLEUM ENGINEERING

B.Tech. II Year II Sem.	**L**	**T/P/D**	**C**
	0	**0/2/0**	**1**

Prerequisites: Mathematical Methods

Course Objectives: The Lab emphasizes on writing MATLAB code, execution and doing what if analysis of the variations in the parameters for the given problems.

Course Outcomes: The Students will be able to

- apply mathematical methods to Petroleum Engineering Problems.
- write code in MATLAB.

List of problems:

1. Determination of Molar volume and Compressibility from Redlich-Kwong Equation
2. Calculation of flow rate in a pipeline
3. Correlation of the physical properties
4. Compressibility factor variation from vanderwaals equation
5. Isothermal compression of gas using Redlich-Kwong Equation of state
6. Thermodynamic properties of steam from Redlich-Kwong Equation
7. Solution of Stiff Ordinary Differential Equations
8. Iterative Solution of ODE boundary value problem
9. Shooting method for solving two-point boundary value problems
10. Expediting the solution of systems of nonlinear algebraic equations
11. Solving differential algebraic equations –DAEs
12. Method of lines for Partial Differential Equations
13. Estimating model parameters involving ODEs using fermentation data

TEXTBOOK:

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

PE407PC: CHEMICAL ENGINEERING FLUID MECHANICS LAB

B.Tech. II Year II Sem.	L	T/P/D	C
	0	0/2/0	1

Prerequisites: Basic knowledge of Fluid Mechanics

Course Objectives: The lab provides knowledge on various flow patterns, flow measuring devices and pumps.

Course Outcomes: Student will be able to understand the concept of fluid flow phenomena, different flow regimes, flow measuring devices like venturi, orifice and rotameter.

List of Experiments

1. Identification of laminar and turbulent flows
   Major equipment - Reynolds apparatus
2. Measurement of point velocities
   Major equipment - Pitot tube setup
3. Verification of Bernoulli's equation
   Major equipment – Bernoulli's Apparatus
4. Calibration of Rotameter
   Major equipment – Rotameter Assembly
5. Variation of Orifice coefficient with Reynolds Number
   Major equipment - Orifice meter Assembly
6. Determination of Venturi coefficient
   Major equipment – Venturi meter Assembly
7. Friction losses in Fluid flow in pipes
   Major equipment - Pipe Assembly with provision for Pressure measurement
8. Pressure drop in a packed bed for different fluid velocities
   Major equipment - Packed bed with Pressure drop measurement
9. Pressure drop and void fraction in a fluidized bed
   Major equipment - Fluidized bed with Pressure drop measurement
10. Studying the coefficient of contraction for a given open orifice
    Major equipment - Open Orifice Assembly
11. Studies of performance characteristics of a Reciprocating Pump
12. Studying the Characteristics of a centrifugal pump
    Major equipment - Centrifugal Pump

PE408PC: PROCESS HEAT TRANSFER LAB

B.Tech. II Year II Sem.	L	T/P/D	C
	0	0/2/0	1

Prerequisites: Basic knowledge of Process Heat Transfer

Course Objectives: This lab will provide practical knowledge on various heat transfer process and equipment like heat exchangers and evaporators

Course Outcomes: The student will be able to understand the thermal conductivity measurement, heat transfer coefficient, calculation in natural and forced convection and some of the radiation aspects.

List of Experiments

1. Determination of total thermal resistance and thermal conductivity of composite wall.
   Major equipment - Composite wall Assembly
2. Determination of thermal conductivity of a metal rod.
   Major equipment - Thermal Conductivity apparatus
3. Determination of natural convective heat transfer coefficient for a vertical tube.
   Major equipment - Natural convection heat transfer apparatus
4. Determination of critical heat flux point for pool boiling of water.
   Major equipment- Pool boiling apparatus
5. Determination of forced convective heat transfer coefficient for air flowing through a pipe
   Major equipment – Forced convection heat transfer apparatus
6. Determination of overall heat transfer coefficient in double pipe heat exchanger.
   Major equipment - Double pipe heat exchanger apparatus
7. Determination of heat transfer coefficient for a helical coil in an agitated vessel.
   Major equipment – Helical coil in a agitated vessel.
8. Study of the temperature distribution along the length of a pin-fin under natural and forced convection conditions.
   Major equipment - Pin fin apparatus
9. Estimation of un-steady state film heat transfer coefficient between the medium in which the body is cooled.
   Major equipment - Heat transfer coefficient determination apparatus
10. Determination of Stefan – Boltzmann constant.
    Major equipment - Stefan Boltzmann apparatus
11. Determination of emissivity of a given plate at various temperatures.
    Major equipment - Emissivity determination apparatus
12. Determination of overall heat transfer coefficient in 1-2 heat exchanger.
    Major equipment - 1-2 heat exchanger

***MC409/*MC309: GENDER SENSITIZATION LAB**
(An Activity-based Course)

B.Tech. II Year II Sem.	**L**	**T/P/D**	**C**
	0	**0/2/0**	**0**

COURSE DESCRIPTION
This course offers an introduction to Gender Studies, an interdisciplinary field that asks critical questions about the meanings of sex and gender in society. The primary goal of this course is to familiarize students with key issues, questions and debates in Gender Studies, both historical and contemporary. It draws on multiple disciplines – such as literature, history, economics, psychology, sociology, philosophy, political science, anthropology and media studies – to examine cultural assumptions about sex, gender, and sexuality.

This course integrates analysis of current events through student presentations, aiming to increase awareness of contemporary and historical experiences of women, and of the multiple ways that sex and gender interact with race, class, caste, nationality and other social identities. This course also seeks to build an understanding and initiate and strengthen programmes combating gender-based violence and discrimination. The course also features several exercises and reflective activities designed to examine the concepts of gender, gender-based violence, sexuality, and rights. It will further explore the impact of gender-based violence on education, health and development.

Objectives of the Course
- To develop students' sensibility with regard to issues of gender in contemporary India.
- To provide a critical perspective on the socialization of men and women.
- To introduce students to information about some key biological aspects of genders.
- To expose the students to debates on the politics and economics of work.
- To help students reflect critically on gender violence.
- To expose students to more egalitarian interactions between men and women.

Learning Outcomes
- Students will have developed a better understanding of important issues related to gender in contemporary India.
- Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature and film.
- Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.
- Students will acquire insight into the gendered division of labour and its relation to politics and economics.
- Men and women students and professionals will be better equipped to work and live together as equals.
- Students will develop a sense of appreciation of women in all walks of life.
- Through providing accounts of studies and movements as well as the new laws that provide protection and relief to women, the textbook will empower students to understand and respond to gender violence.

UNIT- I: UNDERSTANDING GENDER

Introduction: Definition of Gender-Basic Gender Concepts and Terminology-Exploring Attitudes towards Gender-Construction of Gender-Socialization: Making Women, Making Men
- Preparing for Womanhood. Growing up Male. First lessons in Caste.

UNIT – II: GENDER ROLES AND RELATIONS

Two or Many? -Struggles with Discrimination-Gender Roles and Relations-Types of Gender Roles-Gender Roles and Relationships Matrix-Missing Women-Sex Selection and Its Consequences-Declining Sex Ratio. Demographic Consequences-Gender Spectrum: Beyond the Binary

UNIT – III: GENDER AND LABOUR

Division and Valuation of Labour-Housework: The Invisible Labor- "My Mother doesn't Work." "Share the Load."-Work: Its Politics and Economics -Fact and Fiction. Unrecognized and Unaccounted work. -Gender Development Issues-Gender, Governance and Sustainable Development-Gender and Human Rights-Gender and Mainstreaming

UNIT – IV: GENDER - BASED VIOLENCE

The Concept of Violence- Types of Gender-based Violence-Gender-based Violence from a Human Rights Perspective-Sexual Harassment: Say No!-Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading: "*Chupulu".*

Domestic Violence: Speaking OutIs Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Thinking about Sexual Violence Blaming the Victim-"I Fought for my Life…."

UNIT – V: GENDER AND CULTURE

Gender and Film-Gender and Electronic Media-Gender and Advertisement-Gender and Popular Literature- Gender Development Issues-Gender Issues-Gender Sensitive Language-Gender and Popular Literature - Just Relationships: Being Together as Equals

Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers. Rosa Parks-The Brave Heart.

Note: **Since it is Interdisciplinary Course, Resource Persons can be drawn from the fields of English Literature or Sociology or Political Science or any other qualified faculty who has expertise in this field from engineering departments.**

- ***Classes will consist of a combination of activities: dialogue-based lectures, discussions, collaborative learning activities, group work and in-class assignments. Apart from the above prescribed book, Teachers can make use of any authentic materials related to the topics given in the syllabus on "Gender".***

☞ **ESSENTIAL READING**: The Textbook, "*Towards a World of Equals: A Bilingual Textbook on Gender" written* by A.Suneetha, Uma Bhrugubanda, DuggiralaVasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu **published by Telugu Akademi, Telangana Government in 2015.**

ASSESSMENT AND GRADING:

- Discussion & Classroom Participation: 20%
- Project/Assignment: 30%
- End Term Exam: 50%

PE501PC: INSTRUMENTATION AND PROCESS CONTROL

B.Tech. III Year I Sem.	**L**	**T/P/D**	**C**
	3	**1/0/0**	**4**

Prerequisites: Chemical Engineering Fluid Mechanics and Process Heat Transfer

Course Objectives: The subject is designed to understand the fundamentals and principles of Process Control and instrumentation It also provides the details of performance characteristics and applications of various instruments used in petroleum industry.

Course Outcomes: The student would be able to understand Process modeling fundamentals, idealized dynamic behavior, transfer functions, control system context like evaluate stability, frequency response, and other characteristics relevant to process control.

UNIT - I

Elements of instruments, static and dynamic characteristics, mercury in glass thermometer, bimetallic thermometer, pressure spring thermometer, static accuracy. Thermo electricity: Industrial thermocouples, thermocouple wires, thermo couple wells

Composition analysis, spectroscopic analysis by absorption, emission, mass and color measurement by spectrometers, gas analysis by thermal conductivity, analysis of moisture, gas chromatography, refractometer

UNIT - II

Measurement of Pressure and vacuum: liquid column manometers, measuring elements for gauge pressure and vacuum, indicating elements for pressure gauges, measurement of absolute pressure, measuring pressure in corrosive liquids

Measurement of head and level: Head, density and specific gravity, direct measurement of liquid level, pressure measurement in open vessels, level measurements in pressure vessels..

velocity meters, quantity meters, viscosity measurements. Recording instruments, indicating and signalling instruments, transmission of instrument readings, control center, instrumentation diagram

UNIT - III

Introduction to process control: Response of First order systems, Transfer Function of mercury thermometer, Transient response to step, impulse, sinusoidal forcing function, physical examples of first order systems, liquid level, mixing process, RC circuit, response of first order systems in series: Noninteracting and interacting systems

UNIT - IV

Response of Second order system to step, impulse and sinusoidal forcing function. Transportation lag .

The control system: Servo and Regulatory control problems, Development of Block diagram, Controllers and final control elements, Ideal transfer functions of P, PI, PD and PID Controllers. closed loop transfer functions, Stability: Stability analysis by Routh's Criterion

UNIT - V

Root locus: concept of root locus, plotting the root locus diagram.

Introduction to frequency response: substitution rule, Bode diagrams for First order, first order systems in series, second order system and for controllers and transportation lag. Bode stability criterion. Gain margin and phase margin, Z-N controller settings

TEXT BOOKS:

1. Industrial instrumentation by Donald P. Eckman, Wiley eastern, 1950.

2. Donald R. Coughanowr, Process Systems Analysis and Control, 2nd edition McGraw-Hill,1991

REFERENCE BOOKS:

1. Principles of industrial instrumentation by Patra Nabis, TMH.
2. Chemical Process Control Stephanoupoulous, G., Prentice Hall, India New Delhi. 1990.

PE502PC: DRILLING TECHNOLOGY

B.Tech. III Year I Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Prerequisites: Elements of Mechanical Engineering, Chemical Engineering Fluid Mechanics

Course Objectives:

- To understand various aspects involved in drilling a well including completion.
- To understand the plan of drilling a well, the process of drilling and various equipment used for drilling and design of the drill string.
- To know the drilling fluid importance and its properties and hydraulics.
- To understand different types of casings lowered in a well, the requirement of cementation in a well and cement slurry design.
- To understand different tools used for directional drilling and various techniques, fishing, stuck pipe and well control concepts.

Course Outcomes: The students will be able to

- apply the drilling concepts of a well from planning to rig mobilization to the location
- apply the concept of a drill string design for drilling
- decide the suitable drilling fluids during drilling
- do Casing and Cementation design
- carry out Directional drilling
- manage rouble shoot well control, stuck pipe and fishing problems
- to select the proper drilling equipment.

UNIT - I

Overview of drilling: Drilling plan- GTO -Types of drilling, Rotary bit technology- Drilling string basics. Drilling fluid properties- Drilling fluid hydraulics calculations- Bit Hydraulics- Optimization- Swab & Surge-pressures- Mud hydraulics analysis report- Lost circulation.
Disposing of the drilling fluids waste and drill cuttings waste.

UNIT - II

Hydrostatic pressure, Pore pressure, Causes of abnormal pore pressure, abnormal pore pressure evaluation- Mud logging methods - Measurement while drilling & logging while drilling data-Direct measurements of pore pressure. Formation integrity tests – Fracture gradient determination – Theory of wellbore – FIT procedural Guidelines – Predicting fracture gradient HPHT well design.

UNIT - III

Wellbore stability–Determination of the magnitude and direction of the in situ stress Determination of rock properties, Failure criteria – Stress distribution around a wellbore Procedure for determining safe mud weights to prevent hole collapse Preventing borehole instability Gas behavior in a well – Kick tolerance How to calculate kick tolerance – Influence of FG on kick tolerance – Kick tolerance while drilling – Kick tolerance graph – Modifying the calculate kick tolerance – Use of kick tolerance to calculate wellbore pressures.

UNIT - IV

Casing Functions of casing – Types of casing – Casing properties Casing specifications – Casing connections – Factors influencing casing design – Collapse criterion – Burst criterion – Combination strings – Tension criterion Compression loads – Biaxial effects – Triaxial analysis – Triaxial load capacity diagram Casing seat selection method.

Cementation: Introduction cement slurries-Typical field calculations- Cementing nomenclature-Cement additives – Cementation of liners.

UNIT - V

Directional drilling: Applications- Well planning- Down-hole motors- Deflection tools and techniques-Face orientation- Direction control with rotary assemblies- Navigation drilling systems.

Horizontal wells: Well profile design considerations – Torque and drag – Horizontal borehole stability – Extended reach well design – Multilateral wells.

Stuck pipe, well control: Kicks- Kick control- Pressure control theory- BOP-Special kick problems and procedures to free the pipes and Fishing operations. Types of fishing tools, Case studies of blow out control.

TEXT BOOKS:

1. Petroleum Engineering: Drilling and Well Completion, Carl Gatlin, Prentice-Hall, Inc., 1960.
2. Drilling Engineering, J.J. Azar and G. Robello Samuel, Pennwell Books, 2007.
3. Working Guide to Drilling Equipment and Operations, William Lyons, Gulf Publishing, 2009.

REFERENCE BOOKS:

1. Oil Well Drilling Engineering: Principles and Practice, H. Rabia, Graham & Trotman, 1985.
2. Drilling Engineering: A Complete Well Planning Approach, Neal Adams, Tommie Charrier Pennwell, 1985.
3. Practical Well Planning and Drilling Manual, Steve Devereux, Pennwell, 1998.
4. Primer of Oil Well Service, Workover and Completion, Petroleum Extension Service, University of Texas at Austin, 1997.
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, Hussain Rabia, Entrac Consulting, 2002.
8. Drilling Fluids Processing Handbook, ASME Shale Shaker Committee, Gulf Professional Publishing, 2005
9. Fundamentals of Drilling Engineering, Robert F. Mitchell, Stefan Z. Miska, Society of Petroleum Engineers, 2011

PE503PC: THERMODYNAMICS FOR PETROLEUM ENGINEERS

B.Tech. III Year I Sem.	L	T/P/D	C
	3	0/0/0	3

Prerequisites: Engineering Mathematics, Engineering Physics

Course Objective: This course is to understand the laws of thermodynamics and their application in the analysis of chemical and engineering problems and to calculate thermodynamics properties of fluids and fluid mixtures using equation of state.

Course Outcome: Student should be able to identify a system and apply the laws of thermodynamics and should be able to estimate thermodynamic properties of substances in gas or liquid state

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.

The second law of thermodynamics-1**:** Statements of the second law, heat engines, thermodynamic temperature scales, thermodynamic temperature and the ideal-gas scale.

UNIT - III

The second law of thermodynamics-2: Entropy, Entropy changes of an ideal gas, mathematical statement of the second law, the third law of thermodynamics. Mollier diagram and steam tables.

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; calculation of ideal work and last work. Examples on hydrocarbons and natural gas.

UNIT - IV

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.

UNIT - V

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. Correlations for petroleum fluids.

TEXT BOOK:

1. Introduction to Chemical Engineering Thermodynamics, J.M. Smith, H.C. Van Ness and M.M. Abbott, 7th ed. McGraw Hill, 2005.

REFERENCE BOOKS:

1. Characterization and Properties of Petroleum Fractions. M. R. Riaze, ASTM, USA, 2005.
2. Equation of state and PVT analysis. Tarek Ahmed, Gulf publishing company, Houston, 2007.

SM506MS: FUNDAMENTALS OF MANAGEMENT FOR ENGINEERS

B.Tech. III Year I Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Course Objective: To understand the Management Concepts, applications of Concepts in Practical aspects of business and development of Managerial Skills.

Course Outcome: The students understand the significance of Management in their Profession. The various Management Functions like Planning, Organizing, Staffing, Leading, Motivation and Control aspects are learnt in this course. The students can explore the Management Practices in their domain area.

UNIT - I

Introduction to Management: Definition, Nature and Scope, Functions, Managerial Roles, Levels of Management, Managerial Skills, Challenges of Management; Evolution of Management- Classical Approach- Scientific and Administrative Management; The Behavioral approach; The Quantitative approach; The Systems Approach; Contingency Approach, IT Approach.

UNIT - II

Planning and Decision Making: General Framework for Planning - Planning Process, Types of Plans, Management by Objectives; Development of Business Strategy. Decision making and Problem Solving - Programmed and Non-Programmed Decisions, Steps in Problem Solving and Decision Making; Bounded Rationality and Influences on Decision Making; Group Problem Solving and Decision Making, Creativity and Innovation in Managerial Work.

UNIT - III

Organization and HRM: Principles of Organization: Organizational Design & Organizational Structures; Departmentalization, Delegation; Empowerment, Centralization, Decentralization, Recentralization; Organizational Culture; Organizational Climate and Organizational Change.

Human Resource Management & Business Strategy: Talent Management, Talent Management Models and Strategic Human Resource Planning; Recruitment and Selection; Training and Development; Performance Appraisal.

UNIT - IV

Leading and Motivation: Leadership, Power and Authority, Leadership Styles; Behavioral Leadership, Situational Leadership, Leadership Skills, Leader as Mentor and Coach, Leadership during adversity and Crisis; Handling Employee and Customer Complaints, Team Leadership.

Motivation - Types of Motivation; Relationship between Motivation, Performance and Engagement, Content Motivational Theories - Needs Hierarchy Theory, Two Factor Theory, Theory X and Theory Y.

UNIT - V

Controlling: Control, Types and Strategies for Control, Steps in Control Process, Budgetary and Non-Budgetary Controls. Characteristics of Effective Controls, Establishing control systems, Control frequency and Methods.

TEXT BOOKS:

1. Management Essentials, Andrew DuBrin, 9e, Cengage Learning, 2012.
2. Fundamentals of Management, Stephen P. Robbins, Pearson Education, 2009.

REFERENCES:

1. Essentials of Management, Koontz Kleihrich, Tata Mc - Graw Hill.
2. Management Fundamentals, Robert N Lussier, 5e, Cengage Learning, 2013.
3. Industrial Engineering and Management: Including Production Management, T. R. Banga, S.C. Sharma, Khanna Publishers.

PE504PC: WELL LOGGING AND FORMATION EVALUATION

B.Tech. III Year I Sem.	L	T/P/D	C
	3	0/0/0	3

Prerequisites: General Geology and Petroleum Geology

Course Objectives:

- To know the logging terminology.
- To delineate hydrocarbons through direct and indirect means/methods.
- Determination 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.
- Determination of physical properties of the subsurface, strata like resistivity, porosity, thickness etc. through tools like latero, induction, density, neutron, etc.
- Hydrocarbon saturation estimation with the data acquired by the logging tools.
- Hydrocarbons reserves estimation in a particular block.
- Refinement of the log interpretation data with the help of advanced technology tools namely, Scanner, NMR, Modular formation tester etc.

Course Outcomes: From the well logs:

- Will be able to identify the lithology, depositional environment of subsurface strata.
- Will be able to calculate the porosity, permeability, thickness of different interesting layers in a well.
- Finally, the hydrocarbon saturation in different reservoir rocks can be calculated at the well site itself.

UNIT - I

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

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.

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.

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- Perforation technique- Free point locater and Plug setting-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).

Outcome: 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.

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.

PE505PC: HEALTH, SAFETY & ENVIRONMENT IN PETROLEUM INDUSTRY

B.Tech. III Year I Sem.

L	T/P/D	C
3	0/0/0	3

Course Objectives:

- To understand impact of petroleum industry operations on environment.
- To know the importance of safety, health and environment in Petroleum Industry.
- To learn fundamental requirements for the safety, health, and environmental management system

Course Outcome: The student is expected to be able to describe the basic components of safety, health, and environmental systems as defined by the Occupational Safety and Health Administration

UNIT - I

Introduction to environmental control in the petroleum industry: Overview of environmental issues- A new attitude.

Drilling and production operations: Drilling- Production- Air emissions.

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.

UNIT - III

Planning for environmental protection: Environmental audits- Waste management plans- Waste management actions- Certification of disposal processes- Contingency plans- Employee training.

Waste treatment methods: Treatment of water- Treatment of solids- Treatment of air emissions.

Waste disposal methods: Surface disposal- Subsurface disposal.

Remediation of contaminated sites: Site assessment- Remediation processes.

UNIT - IV

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.

UNIT - V

Toxicity, physiological, asphyxiation, respiratory, skin effect of petroleum hydrocarbons and their mixture- Sour gases with their threshold limits- Guidelines for occupational health monitoring in oil and gas industry. Corrosion in petroleum industry- Additives during acidizing, sand control and fracturing.

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. Guideline for Process Safety Fundamentals in General Plant Operations, Centre for Chemical Process Safety, AIChE, 1995.

PE506PC: INSTRUMENTATION AND PROCESS CONTROL LAB

B.Tech. III Year I Sem.	L	T/P/D	C
	0	0/2/0	1

Prerequisites: Basic knowledge of Instrumentation and Process Control

Course Objectives: Instrumentation and Process Control laboratory enables a "hands-on" environment that is important for developing students' understanding of theoretical ideas. Instrumentation and Process Control laboratory is equipped with different instruments like computer-based temperature measurement, level detection, pressure measurement, flow measurement etc. and different types of valves, and operations in process control loop. On different panels or rigs these are arranged in different control configurations to achieve specific control objectives.

Course Outcomes: By the end of the course, students should be able to:

- develop awareness of safety in the laboratory so that all laboratory work is carried out in a safe manner
- develop the ability to carry out experimental investigations of processes which include creating equipment diagrams and comprehensive safe operating procedures for various unit operations
- determine a specific set of experimental objectives
- develop the ability to work in a team and develop confidence through the application of previously acquired knowledge of unit operations, chemical reactions, process safety, and process control
- learn how to apply software tools typically used by process control professionals

List of Experiments:

1. Calibration and determination of time lag of various first and second order instruments Major equipment - First order instrument like Mercury-in-Glass thermometer and Overall second order instrument like Mercury-in-Glass thermometer in a thermal well
2. Experiments with single and two capacity systems with and without interaction Major equipment- Single tank system, Two-tank systems (Interacting and Non-Interacting)
3. Level control trainer
   Major equipment - Level control trainer set up with computer
4. Temperature control trainer
   Major equipment - Temperature control trainer with computer
5. Cascade control
   Major equipment - Cascade control apparatus with computer
6. Experiments on proportional, reset, rate mode of control etc.
   Major equipment – PID control apparatus
7. Control valve characteristics
   Major equipment – Control valve set up
8. Estimation of damping coefficient for U-tube manometer
   Major equipment - U-tube manometer
9. Calibration of Mercury in glass thermometer
10. Calibration of Thermocouple
11. Calibration of Pressure Gauge
12. Calibration of Rotameter

PE507PC: DRILLING FLUIDS LAB

B.Tech. III Year I Sem.	L	T/P/D	C
	0	0/2/0	1

Prerequisites: Drilling Technology

Course Objectives:

- To inform the students about the primary functions of drilling fluid
- To introduce the test procedures for controlling the properties of drilling fluid
- To introduce the common additives used to obtain the desirable properties under various drilling conditions
- To explain main factors governing the selection of drilling fluids
- To improve technical report writing skills

Course Outcome:

- The students will be able to design desired drilling fluid.
- They will be aware of weighing additives and viscofiers.
- They can control filter loss.
- They can maintain hydrostatic pressure to prevent the well and rig from getting damage.

List of Experiments:

1. Determination drilling fluid weight.
   Equipment: Mud Balance
2. Determination of mud viscosity.
   Equipment: Marsh Funnel
3. Determination of pH of mud.
   Equipment: pH meter and Hydrion pH dispensers
4. Determination of mud rheology (Viscosity, Gel strength, and Yield point).
   Equipment: Rheometer / Fann Viscometer
5. Determination of the loss of liquid from a mud.
   Equipment: Standard API Filter-press
6. Determination of a drilling mud cake and evaluate resistivity.
   Equipment: Fann Digital Resistivitymeter
7. Determination of the effect of adding bentonite on mud properties.
8. Drilling fluid contamination test (Salt, Gypsum & Cement contamination).
9. Determination of solid and liquid content and emulsion characteristics of drilling fluid.
   Equipment: Sand Content Set, Fann Emulsion and Electrical Stability Tester
10. Oil, water, solid and clay content determination.
    Equipment: Oil-Water Retort Kit
11. Determination 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. Determination of compressive strength of cement test moulds.
    Equipment: Compressive Strength Testing Machine / UTM

PE508PC: ENERGY AND ENVIRONMENTAL ENGINEERING LAB

B.Tech. III Year I Sem.	L	T/P/D	C
	0	0/2/0	1

Prerequisites: Environmental Engineering and Energy Engineering

Course Objectives:

- To estimate pH, TDS & Conductivity, Hardness, Turbidity, Fluoride of ground & surface water
- To analyse the air to understand the pollution level
- To understand different parameters of fuel cell and concept of energy audit

Course Outcome: The student will be able to understand various aspects of energy and environment which are very much essential in the industry

List of Experiments:

1. Estimation of chemical and physical parameters of Ground and Surface water:
   pH, TDS & Conductivity, Hardness, Turbidity, Fluoride, Color analysis. Pesticide Microbial analysis: e-coli/ total coli forms bacteria
2. Estimation of physical parameters of waste water: pH, TDS, Hardness, Turbidity, Alkalinity etc.
3. Estimation of chemical parameters of waste water: COD, BOD, TSS
4. Water and waste water treatment: Small RO system for treatment of ground water.
   Same above system with UF membrane for turbidity removal and water disinfection.
5. Analysis of Air: Estimation of SPM, RSPM, Sox, Nox, CO and ozone in atmospheric air to study air pollution.
6. Fuel cell Test Kit [Energy]: A small ½ watt to 1-watt fuel cell with water electrolysis kit (H_2 and O_2 Generation) plus small volt meter and ammeter for measuring fuel cell performance (Three experiments can be conducted using this kit).
7. One small transparent anaerobic/aerobic biological reactor with slurry pump and aerator for treatment of industrial effluents to reduce COD levels.
8. Energy auditing of your Department.

List of Equipment:

pH meter, Colorimeter, TDS meter, Aerobic /Anaerobic reactor 25L capacity, BOD incubator, High accuracy analytical balance (5 digit), Desiccators, RO system with domestic 2''x12'' Membrane module, H_2S vial kit, Water analysis kit, UV-Vis spectrophotometer, High volume air sampler, Bomb calorimeter, Fuel cell test kit, Microscope.

*MC510: INTELLECTUAL PROPERTY RIGHTS

B.Tech. III Year I Sem.

L	T/P/D	C
3	0/0/0	0

UNIT – I

Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT – II

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

UNIT – III

Law of copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

UNIT – IV

Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

UNIT – V

New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits.

International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

TEXT BOOKS & REFERENCE BOOKS:

1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tata McGraw Hill Publishing company ltd.

PE601PC: PETROLEUM REFINERY ENGINEERING

B.Tech. III Year II Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Prerequisites: Engineering Chemistry, Chemical Process Calculations

Course Objectives:

- To understand the various feed stocks of refinery and petroleum products.
- To get acquainted with basic separation and conversion processes used in refining of crude oil.
- To get familiarized with challenges involved in refining from viewpoint of environment.

Course Outcome: The student would be in a position to have advanced knowledge of feed-stocks used in the refinery, various conversion processes used to produce various petroleum products.

UNIT - I

Introduction: Overall refinery operations & Indian scenario.

Refinery feed stocks: Crude oil classification-Composition and properties-Composition of petroleum crude suitable for asphalt manufacture – Crude distillation curves.

UNIT - II

Petroleum Products: Low boiling products – Gasoline – Gasoline specifications – Distillate fuels – Jet and turbine fuels – Automotive diesel fuels; Heating oils –Residual fuel oils; wax and asphalt-Product blending.

Crude distillation: Atmosphere topping unit – Vacuum distillation –Auxiliary equipment – Products of these two units.

UNIT - III

Thermal & catalytic processes: Visbreaking, Hydrovisbreaking, Thermal cracking – Catalytic cracking fluidized bed catalytic cracking and Hydrocracking - Feed stocks – Feed treating – Catalysts process variables – Yield Estimation-Latest developments in cracking processes.

Coking: Types of petroleum coke-Properties and uses process description of delayed coking - Flexicoking and fluid coking – Yields.

UNIT - IV

Hydroprocessing and residue processing: Composition of vacuum tower bottoms – Processing options – Hydroprocessing options – Moving bed hydro processes – Solvent extraction Hydrotreating catalysts – aromatics
reduction – Process variables.

Catalytic reforming and isomerization: Catalytic reforming processes –Feed preparation & catalysts – Yields-Isomerization Processes and yields.

UNIT- V

Alkylation and polymerization: Alkylation feed stocks – Products –Catalysts – Hydrofluoric Acid and sulphuric acid alkylation processes –Comparison of processes-Polymerization processes.

Supporting processes: Hydrogen production and purification – Gas processing unit - Acid gas removal – Sulphur recovery processes – Waste water treatment and control of atmospheric pollution.

TEXT BOOK:

1. Petroleum Refining: Technology and Economics, J.H. Gary and G. E. Handwerk, 4th Edition, Marcel Dekkar, Inc., New York, 2001.

REFERENCE BOOKS:

1. Petroleum Refinery Engineering, W. L. Nelson, 4th Edition, McGraw Hill, New York, 1958.
2. Modern Petroleum Refining processes, 5th Edition, B. K. Bhaskara Rao, Oxford and IBH Publishing Co. Pvt. Ltd., 2008.
3. Practical Advances in Petroleum Processing, Chang S. Hsu and Paul Robinson, Vol. 1 & 2, Springer, 2006.

PE602PC: PETROLEUM RESERVOIR ENGINEERING

B.Tech. III Year II Sem.	**L**	**T/P/D**	**C**
	3	**1/0/0**	**4**

Prerequisites: Chemical Engineering Fluid Mechanics, Petroleum Geology, Chemical Process Calculations

Course Objectives:

- Recognize the central role of reservoir engineers in describing, evaluating and managing the reservoir system and, therefore, strive to gain a sound understanding of scientific principles used in the basic activities of reservoir engineering.
- Emphasize the impact of reservoir fluid behavior on reservoir exploitation.
- Understand the mechanics of oil and gas production in reservoirs and be able to apply the basic quantitative tools of reservoir engineering to analyze and/or predict the behavior of the reservoir under potentially useful production schemes.

Course Outcome: The student would be able to understand mechanics of oil production (natural reservoir energies and expulsion of fluids), and basic performance characteristics of various reservoir types to interpret performance characteristic curves for each reservoir type.

UNIT- I

Some 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.
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- II

Material balance applied to oil reservoirs : general form – the material balance expressed as a linear equation – reservoir drive mechanism – solution gas drive – gascap drive – natural water drive – compaction drive under related pore compressibility phenomena.
Darcy's law and applications: Darcy's law and field potential – sign convention – units and units conversion – real gas potential – datum pressures – radial steady state flow and well stimulation– two phase flow – effective and relative permeabilities.

UNIT- III

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 fluids of small and constant compressibility.
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.

UNIT- IV

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 – Multi Rate Drawdown testing – the effects of partial well completion – after flow analysis.

UNIT- V

Gas well testing: Linearization and solution of the basic differential equation for the radial flow of a real gas – the Russel, Goodrich etal. solution technique – the Al Hussainy, Ramey Crowford solution techniques – non– Darcy flow – determination of the non-Darcy coefficient F – the constant terminal rate solution for the flow of a real gas – general theory of gas well testing – multi rate testing of gas wells – pressure build up testing of gas wells – pressure build up analysis in solution gas drive reservoirs.

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 Fetkovitch for finite acquifiers predicting the amount of mater influx – application of influx calculation techniques to steam soaking.

TEXT BOOK:

1. Fundamentals of Reservoir Engineering, L.P. Dake, Elsevier Science, 1978 (17th Impression 1998).

REFERENCE BOOKS:

1. Reservoir Engineering Handbook, Tarek Ahmed, 3rd 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.

PE603PC: PETROLEUM PRODUCTION ENGINEERING AND DESIGN

B.Tech. III Year II Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Prerequisites: Chemical Engineering Fluid Mechanics, Petroleum Reservoir Engineering

Course Objectives: The students are expected to get knowledge of

- Fundamental concepts in petroleum production engineering.
- Reservoir fluids, efficient flow to the surface without damaging the reservoir dynamics/drive mechanisms.
- Various surface equipment's for process oil and gas after flow from wells.
- Sick well identification and remedial stimulation operations.
- Application of suitable artificial lifts on reservoir energy depletion.
- Crisis management.

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

- Determine the well head pressure, down hole pressure and operating oil/ gas flow rates of the reservoir.
- Identify formation damage and find remedial methods to bring the well back into production.
- Screen, design and operate artificial lifts on reservoir pressure depletions.
- Handle in case of any crisis at drilling/production installations.
- Process oil and gas before supply to refinery/consumers.
- Contribute to reservoir management as production engineers to prolong the reservoir life with optimum production.

UNIT - I

Petroleum production system over all view- production from various types of reservoir based on drive mechanisms field development method, Properties of Oil GOR, density, viscosity, pour point, Properties of gas specific gravity, compressibility, molecular weight, calorific value formation value factor.

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, well deliverability nodal analysis, well decline analysis.

UNIT - III

Artificial lift methods-I: Sucker rod pumping system- selection of unit and types of unit. Load & power requirements, performance analysis dynagraph.

Other lift systems- electrical submersible pumps principle design & operation, hydraulic piston pumping, progressive cavity pumping, plunger lift, hydraulic jet pumping.

Artificial Lift Methods-II: Gas lift system 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, design installations.

UNIT - IV

Design of Equipment**:** Separators-Treaters-Producer Water Disposal Systems-Heat Exchangers-Pumping Systems- Compressors-Blowers-Turbines-Metering Systems and Pipeline Design.

UNIT- V

Production stimulation: Well problem identification- sick well analysis, 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.

Production optimization- self flowing wells, wells on gas lift, wells on sucker rod, separator, pipeline network, gas lift facilities, producing fields.

TEXT BOOKS:

1. Petroleum Production Engineering: A Computer Assisted Approach, Boyun Guo, William C. Lyons, Ali Ghalambor, Elesevier 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.

PE611PE: SURFACE PRODUCTION OPERATIONS (Professional Elective - I)

B.Tech. III Year II Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Course Objective: This course is aimed to give an understanding of the principles and basic practice of surface production operations. The objective is to provide with a working knowledge of the current methodologies used in design of oil and gas handling systems and surface facilities. Principles and rules of designing and selecting the main components of petroleum production systems will be discussed.

Course Outcome: The student would be able to perform engineering calculations related to production tubing design for single-phase and two-phase flow in oil and gas wells.

UNIT - I

The production facility: Various types of facilities

Process selection: Controlling the process-Operation of a control valve: Pressure control- Level control- Temperature control- Flow Control- Basic system configuration: Wellhead and manifold- Separation- initial separation pressure- Stage Separation, Selection of Stages, Process flow sheet- Oil treating and storage- Lease automatic custody transfer- Water treating – Compressors- Gas dehydration- Well testing- Gas lift- Offshore platform considerations.

UNIT - II

Two phase oil and gas separation: Functional sections of a gas-liquid separator- Inlet diverter section- Liquid collection section- Gravity settling section- Mist extractor section- Equipment description of different separators- Scrubbers- Slug catchers- Selection considerations- Vessel internals- Mist extractors.

Three phase oil and water separation: Equipment description- Horizontal separators- Derivation of equation- Free-water knockout- Flow splitter- Horizontal three-phase separator with a liquid “Boot”- Vertical separator

UNIT - III

Crude oil treating: Equipment description of various treaters and heaters- Indirect and fired heaters- Waste heat recovery- Heater sizing- Vertical heater-treaters- Coalescing media- Horizontal heater treaters- Electrostatic heater-treaters- Oil dehydrators- Emulsion treating theory- Age of the emulsion- Agitation- Emulsifying agents- Demulsifiers- Field optimization- Changing the demulsifier- Demulsifier troubleshooting- Emulsion treating methods- General considerations- Chemical addition- Amount of chemical- Bottle test considerations- Chemical selection.

UNIT - IV

Oil desalting systems: Oil desalting systems-Equipment description of desalters- Mixing equipment- Globe valves- Spray nozzles- Static mixers- Process description- Single stage desalting- Two stage desalting.

Crude stabilization: Introduction- Basic principles- Process schemes- Equipment description- Stabilizer tower- Trays and packing- Stabilizer reboiler- Cooler- Reflux system- Feed cooler- Heater and stabilizer as a gas-processing plant.

UNIT - V

Produced water treating systems: Disposal standards- offshore & onshore operations- Characteristics of produced water- Scale removal- Controlling scale using chemical inhibitors- Sand and other suspended solids- Dissolved gases- Oil in water emulsions- Dissolved oil concentrations- Dispersed oil- Toxicants- Gravity separation- Coalescence- Dispersion- Flotation- Filtration- Equipment

description-Skim tanks and vessels- Types of configurations- Pressure vs atmospheric vessels- Retention time and performance considerations.

TEXT BOOKS:

1. Surface Production Operations, Ken Arnold & Maurice Stewart, Vol. 1, 3rd edition, Gulf Professional Publishing, 2008.
2. Petroleum and Gas Field Processing, H. K. Abdel-Aal and Mohamed Aggour and M.A. Fahim, Marcel Dekkar Inc., 2003.

PE612PE: HORIZONTAL WELL TECHNOLOGY (Professional Elective – I)

B.Tech. III Year II Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Course Objectives: This course is designed to provide the broad background, necessary to understand and successfully apply the technology of horizontal wells at various elevations. The course provides various methods for predicting well performance based on expected production rate, drainage area, and fluid coning.

Course Outcome: The student would be able to understand recent well construction technologies and the reservoir characteristics required for designing horizontal wells and would study specialized drilling strategies like horizontal ones.

UNIT- I

Overview of horizontal well technology: Introduction- Limitations of horizontal wells- Horizontal well applications- Drilling techniques- Horizontal well length based upon drilling techniques and drainage area limitations- Completion techniques.

Reservoir engineering concepts: Skin factor- Skin damage for horizontal wells- Effective wellbore radius r'_w- Productivity index, *f*- Flow regimes- Influence of areal anisotropy.

UNIT- II

Steady-state solutions: Steady-state productivity of horizontal wells- Effective wellbore radius of a horizontal well- Productivity of slant wells- Comparison of slant well and horizontal well productivities- Formation damage in horizontal wells- Field histories.

Influence of well eccentricity: Introduction- Influence of well eccentricity- Drilling several wells- Horizontal wells at different elevations.

UNIT- III

Transient well testing: Introduction-Mathematical solutions and their practical implications- Generalized flow regimes- Pressure response- Detailed well testing flow regimes- Pressure directivities- Wellbore storage effects- Practical Considerations.

UNIT- IV

Pseudo-steady state flow: Shape factors of horizontal wells- Horizontal well pseudo-steady state productivity calculations- Inflow performance of partially open horizontal wells- Inflow performance relationship (IPR) for horizontal wells in solution gas-drive reservoirs- Predicting horizontal well performance in solution gas-drive reservoirs.

UNIT- V

Water and gas coning in horizontal wells: Critical rate definition- Water and gas coning in horizontal wells- Horizontal well breakthrough time in a bottom- Water drive reservoir- Breakthrough time for a horizontal well in a reservoir with gas cap or bottom water- Cone breakthrough time for horizontal wells in reservoir with both gas cap and bottom water- Critical rate for horizontal well in edge-water drive reservoir practical considerations- Field Histories.

TEXT BOOK:

1. Horizontal Well Technology, S. D. Joshi, PennWell Publishing Company, 1991.

REFERENCE BOOK:

1. Horizontal Wells: Formation Evaluation, Drilling and Production Including Heavy Oil Recovery, Roberto Aguilera, G. M. Cordell, G. W. Nicholl, J. S. Artindete, M. C. Nq., Gulf Publishing Co., 1991.

PE613PE: TRANSPORT PHENOMENA (Professional Elective – I)

B.Tech. III Year II Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Course Objective: To assimilate the transfer processes in a unified manner.

Course Outcome: Ability to analyse the processes involving simultaneous flow, heat and mass transfer, to design packed bed flows and fluidization processes, to calculate heat and mass transfer.

UNIT - I

Viscosity and the mechanisms of momentum transfer: Newton's law of viscosity (molecular momentum transport), generalization of Newton's law of viscosity, pressure and temperature dependence of viscosity, molecular theory of the viscosity of gases at low density, molecular theory of the viscosity of liquids.

Thermal conductivity and the mechanisms of energy transport: Fourier's law of heat conduction (molecular energy transport), temperature and pressure dependence of thermal conductivity, and theory of thermal conductivity of gases at low density.

Diffusivity and the mechanisms of mass transport: Fick's law of binary diffusion (molecular mass transport), temperature and pressure dependence of diffusivities, theory of diffusion in gases at low density.

UNIT - II

Shell momentum balances and velocity distributions in laminar flow: shell momentum balances and boundary conditions, flow of a falling film, flow through a circular tube, flow through annulus, flow of two adjacent immiscible fluids, creeping flow around a sphere.

UNIT - III

Shell energy balances and temperature distributions in solids and laminar flow: shell energy balances; boundary conditions, heat conduction with an electrical heat source, heat conduction with a nuclear heat source, heat conduction with a viscous heat source, heat conduction with a chemical heat source, heat conduction through composite walls, heat conduction in a cooling fin, forced convection, free convection.

UNIT - IV

Concentration distributions in solids and laminar flow: shell mass balances; boundary conditions, diffusion through a stagnant gas film, diffusion with a heterogeneous chemical reaction, diffusion with a homogeneous chemical reaction, diffusion into a falling liquid film (gas absorption), diffusion into a falling liquid film (solid dissolution), diffusion and chemical reaction inside a porous catalyst.

UNIT - V

The equations of change: Derivation of the equation of continuity in Rectangular and Polar coordinates, the equation of motion, the equation of energy, the equation of continuity of a component in multi component mixture (in rectangular coordinates only) the equations of change in terms of the substantial derivative. Use of equations of change to solve one dimensional steady state problems of momentum, heat and component transfer, Introduction to Turbulent flow and Time smoothing

TEXT BOOK:

1. Transport Phenomena - R Byron Bird, Warran E Steward and Edwin N Lightfoot, John Wiley & Sons, Inc. New York.

REFERENCE BOOKS:

1. Transport Phenomena - Robert S Brodkey and Harry C Hershey, Mc Graw Hill Book Company, New York Tokyo-Toronto.
2. Transport Phenomena for Engineers - Louis Theodore, International Text-book Company, London.
3. Transport Phenomena - W.J. Book and K. M. K. Multzall, John Wiley & Sons Ltd, London, New York;

PE604PC: WELL COMPLETION, TESTING AND SERVICING

B.Tech. III Year II Sem.

L	T/P/D	C
3	0/0/0	3

Prerequisites: Drilling Technology

Course Objectives:

- Knowledge of subsurface equipment below well head.
- Planning and designing of well completion after testing of the hydrocarbon zones available.
- Knowledge of subsurface circulating equipment and packers.
- Testing of multi zones in a well with DST/RFT with logging tools as well as surface testing equipment.

Course Outcomes: The student can

- Have the knowledge of various equipment used in & on wells.
- Have the knowledge of DST/RFT to know the initial potential of the wells.
- Plan and design the well completion depending of the casing policy and the number of objectives available in the well.
- Also plan for suitable safety valves in sub surface as well as on well head for the safe operation of the high pressure and high temperature wells.
- Also be a good work over engineer to repair and maintenance of a sick well.
- Be a good CTU (Coil Tubing unit) operator whenever rigs less operation are required to be taken up.

UNIT - I

Well completion: Types of wells- Completion functions- Types of completion.

UNIT - II

Mechanical aspects of well testing- Cased hole logging equipment and application and perforation methods and perforation equipment.

UNIT - III

Packers: Function- Application- Proper selection- Packer setting – Packer loads - water / gas shut off, horizon separation etc.

UNIT - IV

Completion equipment (SSD, SSSV, mandrels, locks etc.)- Data acquisition in wells- Fibre optics- Permanent gauges- Memory gauges- Intelligent completion equipment.

Tubing string design (dimension, materials and connections etc.) based on pressure, temperature, operating conditions- Media- Safety requirements.

UNIT - V

Drill Stem Testing: General Procedure and considerations- Test tool components and arrangement- Analysis of Test data.

HPHT and horizontal well completions- Workover equipment wireline- Scrubbing unit- Coil tubing completion and work over design and execution.

TEXT 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. Well Testing, John Lee, Society of Petroleum Engineers, 1982.

REFERENCE BOOKS:

1. Well Completion Design, Jonathan Bellarby, Elsevier, 2009.
2. Petroleum Engineering: Principles and Practice, J.S Archer & C.G. Wall, Graham & Trotman, Inc., 1986.
3. Advanced Well Completion Engineering, Wan Renpu, Gulf Professional Publishing, 2011.

PE605PC: PETROLEUM RESERVOIR ENGINEERING LAB

B.Tech. III Year II Sem.	L	T/P/D	C
	0	0/2/0	1

Prerequisites: Petroleum Geology, Reservoir Engineering

Course Objective: To make familiar students with reservoir fluid and rock properties such as Porosity, Permeability, Saturation, Wettability, Viscosity, Contact Angle, Surface Tension and Interfacial Tension

Course Outcome: The students should be in a position to

- predict the type of rock
- find out the amount of hydrocarbon in the reservoir
- determine the amount of recoverable hydrocarbon

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: Ring 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: Image System Set-up
8. Measurement of Air Permeability.
   Equipment: Constant Head Permeameter with the Hassler cell / Gas Permeameter
9. Absolute permeability measurement of water.
   Equipment: Darcy Apparatus / Liquid Permeameter
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

PE606PC: PETROLEUM PRODUCT TESTING LAB

B.Tech. III Year II Sem.	L	T/P/D	C
	0	0/2/0	1

Prerequisites: Petroleum Refinery Engineering

Course Objectives

- To aware of various petroleum products
- To know characteristics or properties of petroleum products
- To get acquainted with basic separation and conversion processes used in refining of crude oil

Course Outcome: Students will be able to understand which characteristics should be measured for the fuel while it is transporting, storing and usage.

List of Experiments:

1. Determination of Distillation characteristics of crude oil & its products.
2. Determination of Reid vapour pressure of crude oil & gasoline.
3. Determination of Viscosity of diesel and transformer oils.
4. Determination of Smoke point of kerosene.
5. Determination of Carbon residue of petroleum oils.
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 LPG/gasoline.
9. Determination of Aniline point of gasoline and diesel oil.
10. Determination of Softening point of bitumen.
11. Determination of Cloud & Pour points of petroleum products.
12. Detection of Corrosiveness of petroleum products.

EN608HS: ADVANCED COMMUNICATION SKILLS LAB

B.Tech. III Year II Sem. **L T/P/D C**
0 0/2/0 1

1. INTRODUCTION:

The introduction of the Advanced Communication Skills Lab is considered essential at 3rd year level. At this stage, the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalized context.

The proposed course should be a laboratory course to enable students to use 'good' English and perform the following:

- Gathering ideas and information to organize ideas relevantly and coherently.
- Engaging in debates.
- Participating in group discussions.
- Facing interviews.
- Writing project/research reports/technical reports.
- Making oral presentations.
- Writing formal letters.
- Transferring information from non-verbal to verbal texts and vice-versa.
- Taking part in social and professional communication.

2. OBJECTIVES:

This Lab focuses on using multi-media instruction for language development to meet the following targets:

- To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.
- Further, they would be required to communicate their ideas relevantly and coherently in writing.
- To prepare all the students for their placements.

3. SYLLABUS:

The following course content to conduct the activities is prescribed for the Advanced English Communication Skills (AECS) Lab:

1. **Activities on Fundamentals of Inter-personal Communication and Building Vocabulary** - Starting a conversation – responding appropriately and relevantly – using the right body language – Role Play in different situations & Discourse Skills- using visuals - Synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, study of word origin, business vocabulary, analogy, idioms and phrases, collocations & usage of vocabulary.
2. **Activities on Reading Comprehension** –General Vs Local comprehension, reading for facts, guessing meanings from context, scanning, skimming, inferring meaning, critical reading& effective googling.
3. **Activities on Writing Skills** – Structure and presentation of different types of writing – *letter writing/Resume writing/ e-correspondence/Technical report writing/* – planning for writing – improving one's writing.
4. **Activities on Presentation Skills** – Oral presentations (individual and group) through JAM sessions/seminars/**PPTs** and written presentations through posters/projects/reports/ e-mails/assignments etc.
5. **Activities on Group Discussion and Interview Skills** – Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation- Concept and process, pre-interview planning, opening

strategies, answering strategies, interview through tele-conference & video-conference and Mock Interviews.

4. MINIMUM REQUIREMENT:

The Advanced English Communication Skills (AECS) Laboratory shall have the following infrastructural facilities to accommodate at least 35 students in the lab:

- Spacious room with appropriate acoustics.
- Round Tables with movable chairs
- Audio-visual aids
- LCD Projector
- Public Address system
- P – IV Processor, Hard Disk – 80 GB, RAM–512 MB Minimum, Speed – 2.8 GHZ
- T. V, a digital stereo & Camcorder
- Headphones of High quality

5. SUGGESTED SOFTWARE:

The software consisting of the prescribed topics elaborated above should be procured and used.

- Oxford Advanced Learner's Compass, 7th Edition
- DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.
- Lingua TOEFL CBT Insider, by Dream tech
- TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)

TEXT BOOKS:

1. Effective Technical Communication by M Asharaf Rizvi. McGraw Hill Education (India) Pvt. Ltd. 2nd Edition
2. Academic Writing: A Handbook for International Students by Stephen Bailey, Routledge, 5th Edition.

REFERENCES:

1. Learn Correct English – A Book of Grammar, Usage and Composition by Shiv K. Kumar and Hemalatha Nagarajan. Pearson 2007
2. Professional Communication by Aruna Koneru, McGraw Hill Education (India) Pvt. Ltd, 2016.
3. Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
4. Technical Communication by Paul V. Anderson. 2007. Cengage Learning pvt. Ltd. New Delhi.
5. English Vocabulary in Use series, Cambridge University Press 2008.
6. Handbook for Technical Communication by David A. McMurrey & Joanne Buckley. 2012. Cengage Learning.
7. Communication Skills by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009.
8. Job Hunting by Colm Downes, Cambridge University Press 2008.
9. English for Technical Communication for Engineering Students, Aysha Vishwamohan, Tata Mc Graw-Hill 2009.

***MC609: ENVIRONMENTAL SCIENCE**

B.Tech. III Year II Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**0**

Course Objectives:

- Understanding the importance of ecological balance for sustainable development.
- Understanding the impacts of developmental activities and mitigation measures
- Understanding the environmental policies and regulations

Course Outcomes:

Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles and environmental regulations which in turn helps in sustainable development

UNIT - I

Ecosystems: Definition, Scope and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnification, ecosystem value, services and carrying capacity, Field visits.

UNIT - II

Natural Resources: Classification of Resources: Living and Non-Living resources, **water resources:** use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. **Mineral resources:** use and exploitation, environmental effects of extracting and using mineral resources, **Land resources:** Forest resources, **Energy resources:** growing energy needs, renewable and non renewable energy sources, use of alternate energy source, case studies.

UNIT - III

Biodiversity And Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act.

UNIT - IV

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, **Air Pollution:** Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. **Water pollution:** Sources and types of pollution, drinking water quality standards. **Soil Pollution:** Sources and types, Impacts of modern agriculture, degradation of soil. **Noise Pollution:** Sources and Health hazards, standards, **Solid waste:** Municipal Solid Waste management, composition and characteristics of e-Waste and its management. **Pollution control technologies:** Wastewater Treatment methods: Primary, secondary and Tertiary.

Overview of air pollution control technologies, Concepts of bioremediation. **Global Environmental Problems and Global Efforts: C**limate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol.

UNIT - V

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio-

economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP). **Towards Sustainable Future:** Concept of Sustainable Development, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

TEXT BOOKS:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2. Environmental Studies by R. Rajagopalan, Oxford University Press.

REFERENCE BOOKS:

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.

PE701PC: PETROLEUM ECONOMICS, POLICIES & LAWS

B.Tech. IV Year I Sem.	L	T/P/D	C
	3	0/0/0	3

Course Objectives:

- To emphasize the importance of time value of money in petroleum projects.
- To introduce the students to the theory and practices of Petroleum Economics to perform economic feasibility studies on prospective oil and gas properties.
- To understand the economic and decision analysis parameters in petroleum business.
- To understand the background of functioning of petroleum industry as an economic entity.
- To understand petroleum fiscal system within the context of India.

Course Outcomes: The students would understand the basic features and technical foundations of Petroleum Economics, Policies & Laws and bridge the gap between the theory and the real world through practical applications based on up-to-date oil and gas projects.

UNIT-I

Introduction to the oil industry: World supply and demand- Structure of the oil industry- Characteristics of crude oils and properties of petroleum products- Resources and development of natural gas.

Principles, methods & techniques of engineering economics: Time value in capital expenditures, Depreciation and depletion in oil projects- Financial measures and profitability analysis.

UNIT-II

Analysis of alternative selections and replacements- Risk, uncertainty and decision analysis- Break even and sensitivity analysis- Optimization Techniques.

Application and project evaluation: oil fields exploration and drilling operations-Oil fields estimation of oil reserves and evaluation of an oil property- Oil fields production operations- Oil transportation- Crude oil processing.

UNIT-III

Demand and marketing of petroleum products: The petroleum products in the principal consuming countries- The distribution of petroleum products- The marketing of petroleum products.

UNIT-IV

Natural gas: Natural gas supply in the world- Transportation- International Markets and prices.

Petrochemicals: General characteristics- economics of the two large basic units- The market for the principal finished products- Problems of today.

UNIT-V

Petroleum or Oil & Gas Rules and Regulations in India – The Oil fields Regulations and Development Act – New Exploration Licensing Policy (NELP) –Open Acreage Licensing Policy (OALP) - Functions of Directorate General of Hydrocarbons – Petroleum and Natural Gas Regulatory Board.

TEXT BOOKS:

1. Petroleum Economics and Engineering, H. K. Abdel-Aal, Bakr A. Bakr, M.A. Al-Sahlawi, 2nd Edition, Marcel Dekker Inc., 1992.
2. Petroleum Economics, Jean Masseron, 4th Edition, Editions TECHNIP, 1990.

(The instructor can download information required from internet to teach the topics in UNIT-V).

PE711PE: OPTIMIZATION OF UPSTREAM PROCESSES (PE – II)

B.Tech. IV Year I Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Course Objective:

- To develop understanding of the principles, techniques, standard tools of production optimization
- To formulate multi-objective optimization problem with constraints based on production requirements
- To gain exposure to application of optimization techniques for performance in case of multi-phase flow and also in case of wells per productivity perspective.

Course Outcome: The student would be equipped with the advance knowledge of various optimization techniques to be used in Petroleum Industry to enhance the production considering various constraints.

UNIT- I

Introduction: Production systems modeling and optimization – overview

Production system modeling: Production system – System Modeling – Nodal Analysis

Optimization objective and Constraints: Economics Objectives- Environmental Objectives – Technical Objectives – Constraints

UNIT- II

Properties of Reservoir Fluids: Fluid Properties- Pressure Temperature Phase Diagram- Equation of State – Oil models

Single Phase Flow in Wells and Pipelines: Governing Equations – Pressure Drop Analysis

UNIT- III

Multi-Phase Flow in Wells, Pipelines and Chokes: Flow Regimes – Slip and Hold-Up- Gradient Curves – Intake Pressure Curves for Describing Performance –Multi Phase flow through Chokes

Inflow Performance: Then importance of Inflow Performance-Governing Equations – Inflow Performance Relationship –Formation Damage and Skin –Multi Layer Inflow Performance.

UNIT- IV

Oil Well Productivity: Optimizing well Productivity- Oil Completions- Production Rate of a Vertical Well Operating at given Tubing Head Pressure- Production Rate of Vertical Well Operating through a Surface Choice- Summary of Analysis Methods.

UNIT- V

Field Development: Planning and Field Management- Short Term Optimization of Well Performance – Long Term Optimization of Well Performance – Productivity of Horizontal Wells

TEXT BOOK:

1. Modelling and Optimization of Oil and Gas Production Systems, JD Jansen & PK Currie, TU DELFT, 2004

REFERENCE BOOK:

1. Production Optimization using Nodal Analysis, Beggs H.D., Oil and Gas Consultants International Publications, Tulsa 1991

PE712PE: CHEMICAL REACTION ENGINEERING (PE – II)

B.Tech. IV Year I Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Course Objective: To provide a foundation on deriving rate expressions for series, parallel, reversible reactions and the knowledge about product distribution in multiple reactions, recycle reactors and auto catalytic reactions.

Course Outcome: This course provides necessary knowledge for selection of the chemical reactors for a particular process, design and simulation of existing reactor.

UNIT - I

Overview of chemical reaction engineering- classification of reactions, variables affecting the rate of reaction definition of reaction rate. Kinetics of homogenous reactions- concentration dependent term of rate equation, Temperature dependent term of rate equation, searching for a mechanism, predictability of reaction rate from theory.

Interpretation of batch reactor data- constant volume batch reactor:- Analysis of total pressure data obtained in a constant-volume system, the conversion, Integral method of analysis of data– general procedure, irreversible unimolecular type first order reactions, irreversible bimolecular type second order reactions, irreversible trimolecular type third order reactions, empirical reactions of nth order, zero-order reactions, overall order of irreversible reactions from the half-life, fractional life method, irreversible reactions in parallel, homogenous catalyzed reactions, autocatalytic reactions, irreversible reactions in series.

UNIT - II

Constant volume batch reactor– first order reversible reactions, second order reversible reactions, reversible reactions in general, reactions of shifting order, Differential method of analysis of data. Varying volume batch reactor–differential method of analysis, integral method of analysis, zero order, first order, second order, nth order reactions, temperature and reaction rate, the search for a rate equation.

UNIT - III

Introduction to reactor design- general discussion, symbols and relationship between C_A and X_A. Ideal reactors for a single reaction- Ideal batch reactor, Steady-state mixed flow reactor, Steady-state plug reactors.

Design for single reactions- Size comparison of single reactors, Multiple- reactor systems, Recycle reactor, Autocatalytic reactions.

UNIT - IV

Design for parallel reactions- introduction to multiple reactions, qualitative discussion about product distribution, quantitative treatment of product distribution and of reactor size.

Multiple reactions-Irreversible first order reactions in series, quantitative discussion about product distribution, quantitative treatment, plug flow or batch reactor, quantitative treatment, mixed flow reactor, first-order followed by zero-order reaction, zero order followed by first order reaction.

UNIT - V

Temperature and Pressure effects- single reactions- heats of reaction from thermodynamics, heats of reaction and temperature, equilibrium constants from thermodynamics, equilibrium conversion, general graphical design procedure, optimum temperature progression, heat effects, adiabatic operations, non-adiabatic operations, comments and extensions. Exothermic reactions in mixed flow reactors-A special problem, multiple reactions.

TEXT BOOK:

1. Chemical Reaction Engineering, 3rd ed., O. Levenspiel, John Wiely & Sons, 1999.

REFERENCE BOOKS:

1. Elements of Chemical Reaction Engineering, 2nd ed., H.S. Fogler, PHI Learning Pvt. Ltd., New Delhi, 2010.
2. Chemical Engineering Kinetics, 3rd ed., J.M. Smith, McGraw-Hill, New York, 1981.

PE713PE: OFFSHORE ENGINEERING (PE – II)

B.Tech. IV Year I Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Course Objective: This course covers general introduction to explain the essential features of core activities, Project Overview, Codes and Standards practice, Installations and Vessels, offshore structures.

Course Outcome: The students would acquire knowledge for designing offshore structures. They shall also understand, how the physical environment affects such designs and how the structures respond to the environmental actions.

UNIT- I

Overview of offshore structures: Introduction- Deepwater challenges- Functions of offshore structures- Offshore structure configurations- Bottom-Supported fixed structures- Compliant structures- Floating structures- Classification societies and industry standard groups.

Novel and small field offshore structures: Introduction- Overview of oil and gas field developments- Technical basis for developing novel offshore structures- Other considerations for developing novel offshore structures- Novel field development systems- Future field development options.

UNIT- II

Ocean environment: Introduction- Ocean water properties- Wave theory- Breaking waves- Internal waves- Sea spectrum- Sea states- Wave-driven current- Loop current- wind and wind spectrum- Offshore environment by location.

Loads and responses: Introduction- Gravity loads- Hydrostatic loads- Resistance loads- Current loads on structures- Steady and dynamic wind loads on structures- Wave loads on structures- Applicability of Morison force vs Diffraction force- Steady wave drift force- Slow-Drift wave forces- Varying wind load- Impulse loads- Response of structure- Applicability of response formula.

UNIT- III

Fixed offshore platform design: Field development and concept selection activities- Basic and detailed design of a fixed jacket-Tower-type offshore platform- Special topics.

Floating offshore platform design: Introduction- Floating platform types- Design of floaters- Floating production storage and offloading systems.

UNIT- IV

Semi submersibles- Tension leg platforms- Spar design- Hull structure- Construction and installation. Fundamental aspects of the design of FPSO.

UNIT - V

Drilling and production risers: Introduction- Drilling risers- Production risers- Vortex induced vibration of risers- VIV suppression devices- Riser clashing- Fatigue Analysis.

TEXT BOOK:

1. Handbook of Offshore Engineering, S. Chakrabarti, Volume 1 & 2, Elsevier, 2005.

PE721PE: SHALE GAS RESERVOIR ENGINEERING (PE – III)

B.Tech. IV Year I Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Course Objectives:

- To understand the global significance and distribution of shale gas reservoirs
- To gain knowledge in petro-physical properties, pore pressure prediction, performance analysis, production and testing of shale gas reservoirs.
- To study gas shale asset life cycle and environmental issues and challenges.

Course Outcomes:

- With the knowledge gained on the different aspects of shale gas reservoirs such as organic geo-chemistry, mineralogy, petrophysical properties, geomechanics, reservoir engineering, the students will be able to evaluate and map shale gas pockets in sedimentary basins. Further, they will be able to devise the production mechanisms to extract shale gas.
- Knowing the shale gas environmental issues and challenges such as high water demands and ground water contamination risks posed by hydro-fracturing fluids and waste, the students will be able to address these problems during the exploration of shale gas reservoirs.

UNIT - I

Gas Shale – Global significance, Distribution – Organic matter – Rich Shale Depositional environments – Geochemical assessment of unconventional shale gas resource system.

UNIT - II

Sequence stratigraphy of unconventional resource shales – Pore Geometry in gas shale reservoirs. Petro-physical evaluation of gas shale reservoirs.

UNIT - III

Pore pressure prediction of shale formations using well log data: Overpressure generating mechanisms – Overpressure estimation methods – Role of tectonic activity on shale pore pressure – Geo-mechanics of gas shales.

Performance analysis of unconventional shale reservoirs: Shale reservoir production – Flow rate decline analysis – Flow rate and pressure transient analysis – Reservoir modeling and simulation – Speciality short term tests – Enhanced oil recovery.

UNIT - IV

Resource estimation for shale gas reservoirs– Methodology – Reservoir evaluation of shale gas plays. Wettability of gas shale reservoirs: Wettability – Imbibition in gas shales – Factors influencing water imbibition in shales – Quantitative interpretation of imbibition at the field scale – initial water saturation in gas shales.

UNIT - VI

Gas shale challenges over the asset life cycle: Asset life cycle – Exploration phase – Appraisal phase – Development phase – Production phase – Rejuvenation phase.

Gas shale environmental issues and challenges: Overview – water use – the disposal and reuse of fracking waste water – Ground water contamination – Methane incisions – Other air emissions – social impacts on shale gas communities – Waste water injection – Earth quakes – Regulatory developments.

TEXT BOOK:

1. Fundamentals of Gas Shale Reservoirs, Edited by Reza Rezace, John Wiley & Sons, 2015.

REFERENCE BOOK:

1. Shale Oil and Gas Handbook: Theory, Technologies and Challenges, Sohrab Zendehboudi & A. Bahadori, Elsevier Science, 2016.

PE722PE: PETROLEUM RESERVOIR STIMULATION (PE – III)

B.Tech. IV Year I Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Course Objective: This subject discusses the various well stimulation treatments that are frequently used to stimulate old or poorly producing wells. It will cover the stimulation techniques as tools to help manage and optimize reservoir development. The course includes; acidizing and fracturing quality control, conducting the treatment, monitoring pressures, and other critical parameters, during and after the treatment.

Course Outcome: The student would be familiarized with the selection of stimulation techniques best suited for various formation types and situations, application of basic non-acid and acidizing concepts and also basic hydraulic fracturing concepts.

UNIT - I

Reservoir justification of stimulation treatments: Introduction- Fundamentals of pressure transient analysis- Well and reservoir analysis.

Elements of rock mechanics: Basic concepts- Pertinent rock properties and their measurement- In-Situ stress and its determination.

UNTI - II

Modeling of hydraulic fractures: Conservation laws, and constitutive equations- Fracture propagation models- Fluid-Flow modeling- Acid fracturing.

Fracturing fluid chemistry: Water-Base fluids- Oil-Base fluids- Multiphase fluids- Additives- Execution.

UNIT - III

Fracturing fluid proppant and characterization: Rheology- Shear and temperature effects on fluid properties- Foam fracturing fluids- Slurry rheology- Proppant transport- Fluid loss- Formation and fracture damage- Proppants.

Pre-Treatment data requirements: Types of data- Sources of data- Dynamic downhole testing.

Fracturing diagnosis using pressure analysis: Basic relations- Pressure during pumping- Analysis during closure- Combined analysis pumping and closure- Field procedures.

UNIT - IV

Considerations in fracture design: Size limitations- Considerations with predetermined size or volume- Benefits of high proppant concentrations- Effect of reservoir properties- Effects of perforations on fracture execution.

Fracture-Height predictions and post-treatment measurements: Linear fracture-mechanics modeling for fracture height- Fracture-height prediction procedures- Techniques to measure fracture height.

Matrix acidizing of sandstones: Criteria for fluid selection- Organization of the decision tree- Preflush and postflush- Acidizing sandstones with mud acid- Other acidizing formulations- Matrix acidizing design.

UNIT - V

Fluid placement and diversion in sandstone acidizing: Techniques of fluid placement- Diverting agents.

Matrix acidizing treatment evaluation: Derivation of bottom hole parameters from wellhead measurements- Monitoring skin evolution during treatment.

Principles of acid fracturing: Comparison of acid Fracturing Vs Fracturing with propping agent and nonreactive fluids- Factors controlling the effectiveness of acid fracturing treatments- Acid fluid loss- Acid spending during fluid injection- Treatment design.

TEXT BOOK:

1. Reservoir Stimulation, Michael. J. Economides, Kenneth G. Nolte, 2nd Edition, Prentice Hall, 1989.

REFERENCE BOOKS:

1. Oil Well Stimulation, Robert S. Schechter, Prentice Hall, 1992.
2. Modern Fracturing Enhancing Natural Gas Production, Michael J. Economides, Tony Martin, ET Publishing, 2007.

PE723PE: PETROLEUM RESERVOIR MODELLING AND SIMULATION (PE – III)

B.Tech. IV Year I Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Course Objectives:

- To understand the importance and the fundamental concepts of reservoir simulation.
- To use a reservoir simulation package to solve complex fluid flow problems.
- To conduct a reservoir simulation study.

Course Outcomes: The student would be able to

- Apply various techniques to solve differential equations.
- Use numerical reservoir simulation to solve complex fluid flow problems.
- Execute a reservoir simulation project and suggest development plans for the reservoir.

UNIT - I

Introduction: Milestones for the engineering approach-Importance of the engineering and mathematical approaches.

Single-phase fluid equations in multidimensional domain: Properties of single-phase fluid-Properties of porous media- Reservoir discretization- Basic engineering concepts- Multidimensional flow in Cartesian coordinates- Multidimensional flow in radial-cylindrical coordinates.

UNIT - II

Flow equation using CVFD terminology: Introduction- Flow equations using CVFD terminology- Flow equations in radial-cylindrical coordinates using CVFD terminology- Flow equation using CVFD terminology in any block ordering scheme.

UNIT - III

Simulation with a block-centered grid: Introduction- Reservoir discretization- Flow equation for boundary grid blocks- Treatment of boundary conditions- Calculation of transmissibilities- Symmetry and its use in solving practical problems.

Simulation with a point distributed grid: Introduction- Reservoir discretization- Flow equation for boundary grid points-Treatment of boundary conditions-Calculation of transmissibilities - Symmetry and its use in solving practical problems.

UNIT - IV

Well representation in simulators: Introduction- Single block wells- Multi block wells- Practical considerations dealing with modeling and well conditions.

Single-phase flow equations for various fluids: Pressure dependence of fluid and rock properties-General single-phase flow equation in multi dimensions.

UNIT - V

Linearization of flow equation: Introduction- Nonlinear terms in flow equations- Nonlinearity of flow equations for various fluids- Linearization of nonlinear terms- Linearized flow equations in time.

Methods of solution of linear equations: Direct solution methods- Iterative solution methods.

TEXT BOOK:

1. Petroleum Reservoir Simulation: A Basic Approach, Jamal H. Abou – Kasem, S. M. Fariuq Ali, M. Rafiq Islam, Gulf Publishing Company, 2006.

REFERENCE BOOKS:

1. Principles of Applied Reservoir Simulation, John R. Fanchi, Elsevier, 2005.
2. Practical Reservoir Simulation, M.R. Carlson, Penn Well, 2003.

3. Reservoir Simulation: Mathematical Techniques in Oil Recovery, Zhangxin Chen, Cambridge University Press, 2008.
4. Mathematics of Reservoir Simulation, Richard E. Ewing, Society for Industrial and Applied Mathematics (SIAM), 1983.

PE731PE: PIPELINE MAINTENANCE ENGINEERING (PE – IV)

B.Tech. IV Year I Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Course Objectives:

- To familiarize the students with the various elements and stages involved in transportation of oil and gas.
- To understand international standards and practices in piping design.
- To know various equipment and their operation in pipeline transportation.
- To understand modern trends in transportation of oil and gas

Course Outcome: The students would get an understanding of the key steps in a pipeline's lifecycle: design, construction, installation, asset management and maintenance.

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.

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.

UNIT-III

Gas compression and coolers: Types of compressors – Compressor drivers – Compressor station configuration – Thermodynamics of isothermal and adiabatic gas compression – Temperature change in adiabatic gas compression – Thermodynamics of polytropic gas compression – Gas compressors in series – Centrifugal compressor horsepower – Enthalpy / Entropy charts (Mollier diagram) – Centrifugal compressor performance curve – Influence of pipeline resistance on centrifugal compressor performance-Reciprocating compressors – Gas compression solved problems – Gas coolers – Air-cooled heat exchangers – Coolers heat transfer equations – 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 – Centrifugal pumps – Retrofitting for centrifugal pumps (Radial-flow) – Pump station control – Pump station piping design.

Transient flow in liquid and gas pipelines: Purpose of transient analysis – Theoretical fundamentals and transient solution technique – Applications – Computer applications.

Pipeline mechanical design: Codes and standards – Location classification – Pipeline design formula – Expansion and flexibility – Joint design for pipes of unequal wall thickness.

UNIT-V

Materials selection and quality management: Elements of design – Materials designation standards – Quality management.

Pipeline construction: Construction – Commissioning.

Pipeline protection, Instrumentation, pigging & Operations: Pipeline coating – Cathodic protection – Cathodic protection calculations for land pipelines – Internal corrosion – Flow meters and their calibration – Sensors – Pigs-Pipeline Operations and maintenance.

TEXT BOOKS:

1. Pipeline Design and Construction: A Practical Approach, M. Mahitpour, 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.

PE732PE: NATURAL GAS PROCESSING (PE – IV)

B.Tech. IV Year I Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Course Objectives:

- To enhance student's knowledge about natural gas produced in the reservoirs, surface handling and processing equipment
- To educate student about knowledge of natural gas, basic chemical properties and physical laws
- To update student with the understanding of operations of separators, heaters and glycol dehydrators.

Course Outcomes: The student would be able to describe the basic components of processing equipment and explain various gas plant operational procedures.

UNIT- I

Overview of natural gas Industry: Introduction- The world picture for natural gas- Natural Gas in India - Nonconventional gas reserves in India- Sources of natural gas- Natural gas compositions – Classification- Processing and principal products - Product specifications- Combustion characteristics- Overview of gas plant processing- Roles of gas plants - Plant processes.

Field operations and inlet receiving: Field operations- Gas hydrates Inlet receiving- Safety and environmental considerations.

UNIT- II

Gas treating: Introduction- Solvent absorption processes- Physical absorption- Adsorption- Cryogenic fractionation- Membranes- Nonregenerable hydrogen Sulfide scavengers- Biological processes- Safety and environmental considerations.

Gas dehydration: Introduction- Water content of hydrocarbons- Gas dehydration processes - Safety and environmental considerations.

UNIT- III

Hydrocarbon recovery: Introduction- Process components- Recovery processes - Safety and environmental considerations.

Nitrogen rejection: Introduction- Nitrogen rejection for gas upgrading- Nitrogen rejection for enhanced oil recovery- Safety and environmental considerations.

Trace component recovery or removal: Introduction-Helium-Mercury- (BTEX) Benzene, Toluene, Ethylbenzene, and Xylene.

UNIT- IV

Liquids processing: Introduction- Condensate processing- NGL processing- Safety and environmental considerations.

Sulfur recovery: Introduction- Properties of sulfur- Sulfur recovery - Sulfur storage- Safety and environmental considerations.

Transportation and storage: Introduction-Gas – Liquids.

UNIT- V

Liquefied Natural Gas: Gas treating before liquefaction- Liquefaction cycles- Storage of LNG- Transportation- Regasification and cold utilization of LNG- Economics - Plant efficiency - Safety and environmental considerations.

TEXT BOOK:

1. Fundamental of Natural Gas Processing, Arthur J. Kidnay, William R. Parrish, Taylor and Francis, 2006.

REFERENCE BOOKS:

1. Natural Gas: A Basic Handbook, James G. Speight, Gulf Publishing Company, 2007.
2. Gas Conditioning and Processing, John M. Campbell, Volume 2, 7th Edition, Campbell Petroleum Series, 1992.
3. Gas Conditioning and Processing, Robert N. Maddox, Volume 3, 3rd Edition, Campbell Petroleum Series, 1982.
4. Petroleum & Gas Field Processing, H. K. Abdel – Aal, Mohamed Aggour and M. A. Fahim, Marcel Dekker, Inc., 2003.
5. Engineering Data Book 12th Edition (Electronic), FPS Version, Volume I & II, Gas Processers Suppliers Association (GPSA), 2005.
6. Handbook of Natural Gas Transmission and Processing, Saeid Mokhatab, William A. Poe, James G. Speight, Gulf Professional Publishing, 2006.
7. Surface Production Operations, Ken Arnold, Maurice Stewart, Volume 2, 2nd Edition, Elsevier Science, 1989.
8. Field Handling of Natural Gas, J. Leecraft, 4th Edition, PETEX, 2007.
9. Plant Processing of Natural Gas, Doug Elliot, J.C. Kuo, Pervouz Nasir, 2nd Edition, PETEX, 2012.

PE733PE: PETROCHEMICAL ENGINEERING (PE – IV)

B.Tech. IV Year I Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Course Objectives: The course is designed to

- Impart knowledge to the students about the latest developments in petrochemical engineering.
- To understand the various feed stocks of petro-chemical and its products.
- To get acquainted with basic manufacturing processes of various petro-chemical products.

Course Outcome: The student would be in a position to have a knowledge of feed-stocks used in the petro-chemical engineering, various techniques used to produce various petrochemical products.

UNIT - I

Introduction: Petrochemical industry -Structures of petrochemical complexes-Feedstock for petrochemicals-Profile of petrochemicals and their end products-Indian Petrochemical industries - Profile of Indian petroleum and petrochemical Industry.

UNIT - II

Petrochemical Feed stocks -Naphtha cracking -Gas cracking and Gas reforming.
Chemicals from gas reforming: Methanol- Acetic acid- Ammonia and urea.
Production of ethylene & propylene: Separation of cracking products- Emerging technologies.

UNIT - III

Chemicals from C_2 and C_3 olefins: Ethylene oxide- MEG- Ethyl benzene-styrene. Acrylonitrile–butyraldehydes and butanols, 2-ethyl hexanol.
Polymers based on olefins: LDPE, HDPE & LLDPE and Polypropylene- and polystyrene.
C_4 based Chemicals and others: Butadiene–1-Butene–n-Butenes-Isobutylene–n-Butene–Octenes–1,4-Butanediol–Chloroprene–Isoprene- Maleic anhydride.

UNIT - IV

Aromatic production: Petroleum feedstock for aromatic hydrocarbons-Aromatic hydrocarbon production- catalytic reforming-Reactions in catalytic reforming-Reforming catalyst -Reforming process -Process variables in catalytic reforming-Pyrolysis gasoline as aromatics feedstock-Aromatic separation from reformate and pyrolysis gasoline- Emerging technologies for the production of BTX.

UNIT - V

Production of Chemicals based on aromatics: Phthalic anhydride–Linear alkyl benzene–Phenol—Nitrobenzene and aniline
Chemicals for Fibres: Cyclohexane– Caprolactam – Adipic acid –Adiponitrile–Hexamethylene diamene and Dimethyl terephthalete, Terephthalic acid –Polyester fibre (Polyethylene terephthalate)–Nylon 66–Nylon 6– Acrylic fibres.

TEXT BOOK:

1. Petrochemical Process Technology, ID Mall, Macmillan India Ltd., New Delhi. 2007.

REFERENCE BOOKS:

1. Chemistry of Petrochemical Processes, Sami Matar and Lewis F.Hatch, 2nd Edition, Gulf Publishing Company, Houston, 2000.
2. Fundamentals of Petroleum Chemical Technology, P Belov, Mir Publishers, 1970.
3. Petrochemical Processes, A. Chauvel and G.Lefebvre, Volume 1 & 2, Gulf Publishing Company, 1989.
4. Petrochemical Production Processes, N.Naderpour, SBS Publishers, 2009.
5. Petrochemicals, B. K. Bhaskara Rao, Oxford & IBH Publishing, 2002.

PE811PE: SUB-SEA ENGINEERING (PE – V)

B.Tech. IV Year II Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Course Objectives:

- To understand the Subsea Development operations.
- To learn the hydraulic / equipment / system design considerations.
- To learn about the Process Control and power supply consideration.
- To understand the reliability issues & design challenges involving Subsea systems.

Course Outcomes:

- Able to do flow assurance calculations and size the piping & distribution system.
- Deliver the Equipment & System design required for a given Subsea Project Requirement.
- Anticipate reliability issues such as hydrate, wax formation, corrosion etc. during design

UNIT - I

Overall View 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.

Installation & Vessels: Introduction – Typical Installation Vessels – Vessel requirements & selection – Installation Positioning & Analysis.

UNIT - III

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 - IV

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.

Heat Transfer & Thermal Insulation: Heat Transfer Fundamentals – U value – Steady State Heat Transfer – Transient Heat Transfer – Thermal management Strategy & Insulation.

UNIT - V

Hydrates: Introduction – Physics & Phase Behaviour – Hydrate Prevention – Hydrate Remediation – Hydrate Control Design Philosophies – Recovery of Thermodynamic Hydrate Inhibitors.

Wax & Asphaltenes: Introduction - Wax - Wax Management – Wax remediation – Asphaltenes – Asphaltenes Control Design Philosophies.

Subsea Corrosion & Scale: Introduction – Pipeline Internal Corrosion – Pipeline External Corrosion – Scales – Overview of Erosion & sand Management.

TEXT BOOKS:

1. Subsea Engineering Handbook, Yong Bai & Qiang Bai, Gulf Professional Publishing, New York, 2012.
2. Offshore Drilling and Completions Training Manual by Drill – Quip, Inc.
3. Manual on Subsea Technology by IOGPT, ONGC.

PE812PE: NATURAL GAS HYDRATES AND COAL BED METHANE (PE – V)

B.Tech. IV Year II Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Course Objectives: This course is designed to introduce a basic study of natural gas hydrates and coal bed methane and their properties. The student will be imparted the knowledge of:

- Overview of NGH and classification of NGH, Hydrate formation by using different methods, inhibiting hydrate formation, Different physical and chemical properties of NGH, Deacting with hydrates using heat and pressure,
- Overview of scenario of CBM, The geology of coal, Basic principles of sorption and isotherms and Reservoir characterization of CBM.

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

- Have good knowledge in dealing with NGH, Model different hydrate formation using both hand calculations and computer methods, understand different properties of NGH, Design line heaters foe effective transportation, have knowledge of different equilibriums of liquid water and solids with natural gas and Understand the challenges of NGH.
- Master the fundamentals of coal bed methane, construct different isotherms, evaluate different logs for CBM reservoirs and Make reservoir analysis.

UNIT - I

Introduction: Overview of natural gas hydrates**-** Natural gas- Water molecule- Hydrates- Water and natural gas- Free-Water- Heavy water- Units.

Hydrate types and formers: Type I hydrates- Type II hydrates- Size of the guest molecule- n-Butane- Other hydrocarbons and non-hydrocarbon molecules- Chemical properties of potential guests- Liquid hydrate formers- Type H hydrates- Hydrate forming conditions- Pressure-Temperature- Composition- Other hydrate formers- Mixtures- Examples.

Hydrate formation hand calculation methods: Gas gravity method- K-Factor method- Baillie-Wichert method- Comments on these methods- Examples.

UNIT - II

Hydrate formation computer methods: Phase equilibrium- Van der Waals and Platteeuw- Parrish and Prausnitz-Ng and Robinson methods- Calculations- Commercial software packages- Accuracy of these programs- Dehydration- Examples.

Inhibiting hydrate formation with chemicals: Freezing point depression- Hammer schmidt equation- Nielsen-Bucklin equation- New method- Brine solutions- Comment on the simple methods- Advanced calculation methods- Inhibitor vaporization- Comment on injection rates- Kinetic inhibitors- Examples.

Combating hydrates using heat and pressure: Use of heat- Heat loss from a buried pipeline- Line heater deign- Two-Phase heater transfer- Depressurization- Melting a plug with heat- Examples.

UNIT-III

Physical properties of hydrates: Molar mass - Density- Enthalpy of fusion- Heat capacity- Thermal conductivity- Mechanical properties- Volume of gas in hydrate- Ice versus hydrate- Examples.

Water content of natural gas: Equilibrium with liquid water- Equilibrium with solids- Examples.
Dehydration Prcesses : TEG and Molecular Sieves dehydration Processes.

UNIT - IV

Introduction: Overview of coal bed methane (CBM) in India – CBM vs Conventional Reservoirs.
Geological influences on coat formation of coals – Coal chemistry – Significance of rank – Cleat system and natural fracturing.

UNIT - V

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.

TEXT BOOKS:

1. Natural Gas Hydrates: A Guide for Engineers, John J. Carroll, Gulf Professional Publishers, 2003.
2. Coal Bed Methane: Principles and Practice, R. E. Rogers, 3rd Edition, Prentice Hall, 1994.

REFERENCE BOOKS:

1. Natural Gas Hydrates in Flow Assurance, E. Dendy Sloan, C. Koh, A. K. Sum, A. L. Ballard, J. Creek, M. Eaton, N. McMullen, T. Palermo, G. Shoup and L. Talley, Elsevier, 2010.
2. Clathrate Hydrates of Natural Gases, E. Dendy Sloan, Jr., C. Koh, 3rdEdition, CRC Press, 2007.
3. Coal Bed Methane, Robert A. Lamarre, American Association of Petroleum Geologists, 2008.

PE813PE: MEMBRANE TECHNOLOGY (PE – V)

B.Tech. IV Year II Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Course Objective: This course will give the basic principles of membrane separation processes.
Course Outcome: The student will understand the underlined principles and importance of ultrafiltration, reverse Osmosis, electrodialysis, nano-filtration, etc., in industrial waste water treatment.

UNIT - I

Introduction: Separation process, Introduction to membrane processes, definition of a membrane, classifications membrane processes.
Preparation of Synthetic membranes: Types of Membrane materials, preparation of Synthetic membranes, phase inversion membranes, preparation technique for immersion precipitation, and preparation technique for composite membranes.

UNIT - II

Characterization of membranes; Introduction, membrane characterization, characterization of porous membranes, characterization of non-porous membranes.
Transport in membranes: introduction, driving forces, non-equilibrium thermodynamics, transport through porous, non-porous, and ion exchange membranes.

UNIT - III

Membrane Processes: Introduction, osmosis, pressure driven membrane processes: Introduction, microfiltration, membranes for microfiltration, industrial applications, ultrafiltration: membranes for ultrafiltration, industrial applications, reverse Osmosis and nanofiltration: membranes for reverse osmosis and nanofiltration, industrial applications, Electrically Driven processes: Introduction, electrodialysis, Process parameters, membranes for electrodialysis, applications, Membrane electrolysis, Bioploar membranes, Fuel Cells

UNIT - IV

Concentration driven membrane processes: gas separation: gas separation in porous and non-porous membranes, membranes for gas separation, applications, pervaporation, membranes for pervaporation, applications, dialysis: membranes for dialysis, applications, liquid membranes: aspects, liquid membrane development, choice of the organic solvent and carrier, applications, introduction to membrane reactors,

UNIT - V

Polarization phenomenon and fouling: Introduction to concentration polarization, turbulence promoters, pressure drop, gel layer model, osmotic pressure model, boundary layer resistance model, concentration polarization in diffusive membrane separations and electro dialysis, membrane fouling, methods to reduce fouling, compaction. Module and process design: Introduction, plate and frame module, spiral wound module, tubular module, capillary module, hollow fiber module, comparison of module configurations.

TEXT BOOKS:

1. Membrane Separations, M.H.V. Mulder, Springer Publications, 2007
2. Rate-Controlled Separations, P. C. Wanket, Elsevier Applied Science, London,1994.

REFERENCE BOOKS:

1. Membrane Technology in the Chemical Industry, S.P. Nunes, K.V. Peinemann, Wiley-VCH
2. Membrane Processes in Separation and Purification, J.G.Crespo, K.W.Bodekes, Kluwer Academic Publications.
3. Membrane Separation Processes, K. Nath, PHI Pvt. Ltd., New Delhi,2008.

PE821PE: ENHANCED OIL RECOVERY TECHNIQUES (PE – VI)

B.Tech. IV Year II Sem.	L	T/P/D	C
	3	0/0/0	3

Course Objectives:

- Introduce the student to the theory and practices of improved oil recovery.
- Emphasize the potential of enhanced oil recovery methods in reservoir exploitation.

Course Outcomes:

- Understand the basic features and technical foundations of the most common EOR methods.
- Apply screening criteria to a given reservoir to select an optimum EOR method both technically and economically.
- Use rock, fluid and reservoir data to specify the process and operating parameters of an EOR method application.

UNIT - I

Introduction: Oil recovery processes.

Gas injection: Introduction- Predictive performance- Gas injection in carbonate reservoirs- Inert gas injection- Candidates for gas injection.

UNIT - II

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_2flood- Guidelines for selection of miscible CO_2 projects- Immiscible CO_2 flooding Conclusions.

Polymer flooding: Introduction- Polyacrylamides chemistry- Application of PAM/AA in enhanced oil recovery- Factors affecting flow in porous media- Field considerations- Site factors- Field operation.

UNIT - III

Alkaline flooding: Introduction- Types of caustic used- Entrapment of residue oil- Displacement mechanisms in alkaline flooding- Crude oil properties-Alkali consumption- pH of injected caustic- Effect of sodium ions and sodium chloride.

In-situ combustion technology: Introduction-Reservoir characteristics- Ignition- Ignition methods, Process In-situ Combustion- Use of In-situ Combustion- Current status of In-situ Combustion.

UNIT - IV

Use of surfactants in oil recovery: 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.

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 steamflood modeling, parametric studies in steam flooding- Economics of the steam flooding process.

UNIT - V

Microbial enhanced oil recovery: Microorganisms- Historical development of microbial enhancement of oil recovery- Laboratory experiments show the potential of microbial enhancement oil recovery- Field application of microbial enhancement of oil recovery-Microbes associated with oilfield problems.

Environmental factors associated with oil recovery: Introduction-Primary and secondary production-Chemical flooding-Micellar-polymer processes- Thermal processes- Gas flooding.

TEXT BOOKS:

1. Enhanced Oil Recovery: Processes and Operations, E. C. Donaldson, G. V. Chilingarian, T. F. Yew, Elsevier, 1998.
2. Enhanced Oil Recovery, Larry W. Lake, Prentice Hall, 1998.

REFERENCE BOOKS:

1. Basic Concepts in Enhanced Oil Recovery Processes, Marc Baviere, SCI, 1991.
2. Enhanced Oil Recovery: Proceedings of the Third European Symposium on Enhanced Oil Recovery, F. John Fayers, Elsevier, 1981.
3. Enhanced Oil Recovery, Marcel Latil, Editions Technip, 1980.
4. Fundamentals of Enhanced Oil Recovery, H. R. Van Pollew and Associates, Penn Well, 1980.
5. Enhanced Recovery of Residual and Heavy Oil, M. M. Schumacher, Noyes Data Corp., 1980.
6. Applied Enhanced Oil Recovery, Aural Carcoane, Prentice Hall, 1992.
7. Recent Advances in Enhanced Oil and Gas Recovery, Istvan Laktos, Academy Kiado, 2001.
8. Enhanced Oil Recovery, Don W. Greew, G. Paul Willfite, Society of Petroleum Engineers, 1998.
9. Enhanced Oil Recovery: Field Planning and Development Strategies, Vladmir Alvarado, Eduardo Marriglee, Gulf Professional Publishing, 2010.
10. Modern Chemical Enhanced Oil Recovery: Theory and Practice, Gulf Professional Publishing, 2011.
11. Enhanced Oil Recovery, Teknica, Teknica Petroleum Services Ltd., 2001.

PE822PE: MULTI-PHASE FLOW IN POROUS MEDIA (PE – VI)

B.Tech. IV Year II Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Course Objective: The objective of this course is to introduce the basic theory and computational techniques for modeling multiphase flow in sub-surface porous media, especially applied to petroleum reservoir simulation. The students will also study conceptual and mathematical models that represent simplified scenario of petroleum reservoir.

Course Outcome: The students would gain knowledge on core sample characterization and properties measurement. They would get a feeling for time-scales of porous media flow, fluid pressure and chemical diffusion. They would understand the natural variability of porous media and the scale-dependence of flow properties. They know about pattern formation in porous media flow and about key coarsening instabilities like thermal or chemical convection etc.

UNIT - I

Introduction: Phases and porous media: Grain and pore size distribution- the concept of saturation – the concept of pressure – surface tension considerations – concept of concentration.

UNIT - II

Mass conservation Equation: Micro scale mass conservation – Integral form of mass conservation – Integral Theorems- point form of mass conservation – The macro scale perspective – The averaging theorem – Macro Scale mass Conservation – Applications

UNIT - III

Flow Equations: Darcy's Experiments, fluid properties – Equation of state for fluids- Hydraulic potential – single phase fluid flow- Two phase immiscible flow- The Buckley- Livertt Analysis.

UNIT - IV

Mass Transport Equations: Velocity in the species transport equations – Closure relations for the dispersion vector– Chemical Reaction Rate - Initial and boundary conditions.

UNIT – V

Simulation:1-D simulation of Air-Water Flow- 1-D Simulation of DNAPL water flow – 2-D simulation of DNAPL Water flow – Simulation of multi-phase flow and transport – 2-D single phase flow and transport – 3-D single phase flow and Transport– 2-D Three phase flow

TEXT BOOK:

1. Essential of multiphase flow in porous media, George F. Pinder and William G. Gray, Wiley Interscience, 2008.

REFERENCE BOOK:

1. Multiphase flow in porous media, Kluwer Academic publisher, 1995

PE823PE: PETROLEUM MANAGEMENT, MARKETING & FINANCE (PE – VI)

B.Tech. IV Year II Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Course Objective: The objective of this course is to introduce the student about the nature and function of companies and other organizations involved in technical, financial, commercial and contractual activities in the world-wide upstream oil and gas industries. The nature of mid and downstream oil and gas activities will be briefly examined to set an overall context.

Course Outcome: The students are expected to be able to evaluate the primary uses of oil and gas and the significance of oil and gas within the global energy industry with the broad technical issues involved in the location and development of oil and gas reserves.

UNIT- I

The global oil and gas industry: Oil and gas industry background - Oil and gas reserves - Oil and gas in global economy - The major players - Oil and gas industry value chain- Upstream-mid stream and downstream- Fundamentals of petroleum industry - Industry evaluation and strategies - Nationalism and national oil companies - Role and value of oil and gas- Government and corporate interests- Evolution of national oil companies - Organization of petroleum exporting countries - Political environment related to petroleum industry.

UNIT- II

Access, leasing and exploration: Oil project life cycle - Oil and gas formation - Access and development rights - Historical precedent - The neutral zone concession - Oil leases- Reserves - Defining reserves - Lease auctions exploration and strategy - Partnership and firm-ins.

UNIT- III

Developing oil and gas projects: Project development and project opportunity- Joint development utilization- Project financial analysis- Project execution- Contractor relationships- Problems in project development.

UNIT- IV

Finance and financial performance: Business finance- Capital sourcing- Corporate finance- Public equity- Private equity- Venture capital- Debt- Project finance- Multilateral lending- State interest- Oil loans- Ruminations and valuations.

UNIT- V

Marketing of crude oil and petroleum products and transportation: Crude oil fundamentals- Price of crude- Crude oil prices in transactions- Marketing and sale of motor fuel- Aviations fuel- Lubricants- Asphalt and propane- Transportation-Fundamentals of transportation-Pipelines- Oil tankers- Downstream transportations.

TEXT BOOK:

1. The Global Oil & Gas Industry: Management, Strategy and Finance**,** Andrew Inkpen, Michael H. Moffett, Penn Well, 2011.