
DIT UNIVERSITY
Dehradun

Detailed Course Structure of

B.Tech- Petroleum Engineering

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

### Year: 1st Semester: I

<table>
<thead>
<tr>
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Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

**Year: 2\textsuperscript{nd} Semester: III**

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**Year: 2\textsuperscript{nd} Semester: IV**

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**Total** 23

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**Year: 3rd**  
**Semester: V**

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**Total** 24

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<td>HS 391</td>
<td>Positive Psychology &amp; Living</td>
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**Year: 3rd**  
**Semester: VI**

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**Total** 27

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**Year: 4th** & **Semester: VII**

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**Year:** 4<sup>th</sup>  
**Semester:** VIII

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<td>CBM and Gas Hydrates</td>
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<td>PE 452</td>
<td>Oil and Gas Marketing and Resource Management</td>
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<tr>
<td>PE 453</td>
<td>Oil and Gas Field Development</td>
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## Department Elective 6

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<th>Course Code</th>
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<tr>
<td>PE 456</td>
<td>Well Control</td>
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<tr>
<td>PE457</td>
<td>Directional Drilling</td>
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## Department Elective 7

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<tr>
<td>PE 458</td>
<td>Petroleum Law and Policies</td>
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<td>PE 459</td>
<td>Natural Gas Engineering</td>
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<td>PE 460</td>
<td>Well Integrity and abandonment</td>
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<td>PE 461</td>
<td>Refinery Utilities and Energy Optimization</td>
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## Humanities Elective 4

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<tbody>
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<td>Indian Culture &amp; Tradition</td>
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<td>HS483</td>
<td>Indian Philosophy</td>
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<td>HS491</td>
<td>Industrial Sociology</td>
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<td>HS485</td>
<td>Sustainable Development</td>
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## Open Elective- 2

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<td>IT359</td>
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<td>EC386</td>
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<td>EE485</td>
<td>Basic Instrumentation &amp; Process Control</td>
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Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018
### Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<th>Year</th>
<th>Semester</th>
<th>Max Credit</th>
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<tbody>
<tr>
<td>ME382</td>
<td>Ergonomics and Value Engineering</td>
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<td>ME366</td>
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<td>ME452</td>
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#### Summary of the Credit

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#### Category wise classification of the Credit

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<thead>
<tr>
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<tr>
<td>DC</td>
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<td>DE</td>
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<tr>
<td>HE</td>
<td>8</td>
<td>4</td>
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<tr>
<td>IP/THESIS</td>
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<td>OE</td>
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<td>2</td>
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<tr>
<td>PRJT</td>
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<td>VAT</td>
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<td>Grand Total</td>
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<td>59</td>
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</table>

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018
Course Outline:

Course Objective:
To develop the LSRW skills of students for effective communication, to equip the students for business environment, to prepare the students understand and present themselves effectively

Course Pre/Co- requisite (if any):

UNIT 1: Communication

UNIT 2: Listening & Speaking Skills
Listening Comprehension: identifying General and Specific information, Note taking and drawing inferences. Introduction to Phonetics: Articulation of consonants and vowel sounds.

UNIT 3: Reading Skills & Technical Writing Skills

UNIT 4: Business Letter Writing
Business Letter Writing, Job Application Letter & Resume, Interview Skills, Impression Management, Swot Analysis (Identifying Strength & Weakness), EQ and Its Dimensions

Learning Outcome
At the end of the course, the student will be able to:
CO1. Communicate smoothly
CO2. Write formal documents
CO3. Present themselves effectively

Text book [TB]:

Reference Books [RB]:

List of Experiments:
1. Neutralization of Mother Tongue Influence through manner of articulation, Introduction to Speech Sounds – Practicing Vowel and Consonant sounds
2. Listening (Biographies through software) & Presentation of Biographies
3. Listening & Role Play on Situational/Telephonic Conversation (through software)
4. Picture presentation
5. Public Speaking
6. Group Discussion
7. Case Studies
8. SWOT analysis
9. Interview
10. Final evaluation

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>MA101</th>
<th>Subject Title</th>
<th>Engineering Mathematics-I</th>
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<tbody>
<tr>
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<td>Credit</td>
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</table>

**Course Outline:**

**Course Objective:**

To introduce the fundamentals in Differential, Integral and Vector Calculus, use of tools for solving engineering problems.

**Course Pre/Co-requisite (if any):**

**UNIT 1: Limit, Continuity and Differentiability**
Review of Limit, Continuity and Differentiability; Indeterminate forms, L’ Hospital’s rule, Rolle’s Theorem, Mean Value theorem and its applications, Successive Differentiation, Leibnitz’s Theorem, Taylor’s and Maclaurin’s Series, Maxima and Minima, Asymptotes, Curvature, Evolutes, Involutes, Sketching of curves.

**UNIT 2: Multivariable calculus (Differentiation)**
Limit, Continuity, Partial Derivatives, Euler’s Theorem, Total Derivatives, Taylor’s series, Maxima and Minima, Method of Lagrange’s multipliers.

**UNIT 3: Multiple Integral**
Review of indefinite and definite integrals and its application to evaluate surface area and volume of revolutions, Beta and Gamma functions and their properties, Double integral, Change of order of integration, Change of variables, triple integral, Dirichlet’s integral and their applications.

**UNIT 4: Vector Calculus**

**Learning Outcome**

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

CO1. Learn techniques in calculus, multivariate analysis and linear algebra.

CO2. Equip the students with standard concepts and tools for tackling advanced level of mathematics and applications.

CO3. Familiarity with fundamental tools of Differential, Integral and Vector Calculus.

**Text book [TB]:**


**Reference Books [RB]:**


<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject Title</th>
<th>Basic Electrical Engineering</th>
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<tbody>
<tr>
<td>EE103</td>
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<tr>
<td>LTP</td>
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<td>Subject Category</td>
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<td>Year</td>
</tr>
</tbody>
</table>

Course Outline:

Course Objective:

- To apprise students about electric charge, current, voltage and various circuit laws involved in analysis.
- To get acquainted with the basic idea of Generation, Transmission and Distribution of Electrical energy.
- To provide the basic knowledge of operation and working of different types of electrical equipment and their applications.

Course Pre/Co-requisite (if any):

UNIT 1: D.C. Network Theory
Review of basic circuit theory concepts, Mesh and Nodal analysis, Superposition theorem, Thevenin’s theorem, Norton’s theorem, Maximum power transfer theorem, Star – delta transformation, Magnetic Circuits.

UNIT 2: A.C. Circuits & Measuring Instruments
Three Phase A.C.: Star – delta connections, Relation between line and phase quantities, three phase power and its measurement, What is 3 phase 4 wire and 3 phase 3 wire system.
Measuring Instruments: Construction and principle of voltage and current measuring instruments.

UNIT 3: Power System & Transformers
Single line diagram of simple power system.

UNIT 4: D.C. & Synchronous Machines
D.C. Machines: Construction and working principle of d.c. generator and d.c. motor, Types of d.c. machines, E.M.F. equation, Torque equation, characteristics, Losses and efficiency, Need of starter in d.c. motors.
Synchronous Machines: Construction and Principle of operation of Alternator and Synchronous Motor.

UNIT 5: Induction Motors
Three Phase Induction Motors: Principle of operation of 3-Ø induction motor, Types of 3-Ø induction motor, Need of starters in 3-Ø induction motors, Slip – torque characteristics

Learning Outcome

At the end of the course, the student will be able to:
CO1. Students will be familiar about electrical charge, current, voltage and various basic electric circuit laws.
CO2. Acquaint students about DC circuit analysis and methods
CO3. Advanced approach for solving series parallel network of resistors by star delta transformation.
CO4. Acknowledge students with the use of transformers and its working.
CO5. To build an ability amongst students regarding the functioning of DC machines and its characteristics.
CO6. Students will recognize the need for synchronous machine in our electrical systems, its basic functioning and various advantages over other types of machines.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

Text book [TB]:

Reference Books [RB]:

List of Experiments:
1. Verification of Network Theorems.
2. Study of diode characteristics. Study of phenomenon of resonance in RLC series circuit.
3. Measurement of power in a three phase circuit by two wattmeter method.
5. Determination of parameters and losses in a single phase transformer by OC and SC test.
7. Study of characteristic of AC Motor.
8. DC generator characteristics.
9. Speed control of dc shunt motor.
10. Study running and reversing of a three phase induction motor.
11. Study of a single phase energy meter.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>PY102</th>
<th>Subject Title</th>
<th>Introduction to Mechanics</th>
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<td>3-1-2</td>
<td>Credit</td>
<td>UC 5 1st Semester 1/II</td>
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COURSE OBJECTIVE: To teach students the effects of electric charges at rest and in motion. Both positive and negative charges produce force field which is called “electric field”. Moving charges produce current, which gives rise to another force field called “magnetic field”. The electromagnetic theory studies the behavior of the electric and magnetic fields.

Unit 1: Electrostatics in vacuum

Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace’s and Poisson’s equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal conduction; Practical examples like Faraday’s cage and coffee-ring effect; Boundary conditions of electric field and electrostatic potential; method of images; energy of a charge distribution and its expression in terms of electric field.

Unit 2: Electrostatics in a linear dielectric medium

Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field.

Unit 3: Magnetostatics

Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes’ theorem; the equation for the vector potential and its solution for given current densities.

Unit-4: Magnetostatics in a linear magnetic medium

Magnetization and associated bound currents; auxiliary magnetic field \( \vec{H} \); Boundary conditions on \( \vec{H} \) and \( \vec{H} \). Solving for magnetic field due to simple magnets like a bar magnet; magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.

Unit-5: Faraday’s law

Faraday’s law in terms of EMF produced by changing magnetic flux; equivalence of Faraday’s law and motional EMF; Lenz’s law; Electromagnetic breaking and its applications; Differential form of Faraday’s law expressing curl of electric field in terms of time-derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi-static approximation; energy stored in a magnetic field.

Unit-6: Displacement current, Magnetic field due to time-dependent electric field and Maxwell’s equations

Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity equation; displace current and magnetic field arising from time-dependent electric field; calculating magnetic field due to changing electric fields in quasi-static approximation. Maxwell’s equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Poynting vector with examples. Qualitative discussion of momentum in electromagnetic fields.

Unit- 7: Electromagnetic waves (8L)

The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave; energy carried by electromagnetic waves and examples. Momentum carried by electromagnetic waves and resultant pressure. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

COURSE OUTCOME:
At the end of the course, the student can:
CO1. To know Newton’s laws of motion, potentials, conservation of energy, momentum and angular momentum, and be able to apply them to projectiles, circular motion, and gravity
CO2. Demonstrate an understanding of intermediate mechanics topics such as co-ordinate transformations, oscillatory motion, gravitation etc.
CO3. Demonstrate rigid body and rotational dynamics using the concept of angular velocity and momentum.
CO4. Understand the concept of non-inertial frames of reference, coriolis and centripetal accelerations and their applications.

TEXT BOOKS

REFERENCE BOOKS

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<th>LIST OF EXPERIMENTS (ANY TEN)</th>
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<tr>
<td>1</td>
<td>Identification of various electronic components.</td>
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<tr>
<td>2</td>
<td>Use of multimeter for testing diodes, LEDs, transistors and measurements of resistance, capacitance, inductance, dc voltage, dc current, ac voltage, ac current and frequency of ac mains.</td>
</tr>
<tr>
<td>3</td>
<td>Charging and discharging of capacitor through resistance and determination of time constant.</td>
</tr>
<tr>
<td>4</td>
<td>To determine the specific resistance of a given wire using Carey Foster’s bridge.</td>
</tr>
<tr>
<td>5</td>
<td>To verify Stefan’s law by electrical method.</td>
</tr>
<tr>
<td>6</td>
<td>To study the variation of magnetic field with distance along the axis of a current carrying coil and determination of radius of the coil.</td>
</tr>
<tr>
<td>7</td>
<td>To calibrate the given voltmeter using potentiometer.</td>
</tr>
<tr>
<td>8</td>
<td>To calibrate the given ammeter using potentiometer.</td>
</tr>
<tr>
<td>9</td>
<td>To determine the band gap of a semiconductor p-n junction.</td>
</tr>
<tr>
<td>10</td>
<td>To determine the resistance of a sample using four probe method.</td>
</tr>
<tr>
<td>11</td>
<td>To determine the band gap of semiconductor using four probe method.</td>
</tr>
<tr>
<td>12</td>
<td>To determine a unknown resistance using Wheatstone bridge.</td>
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<table>
<thead>
<tr>
<th>Subject Code</th>
<th>PY103</th>
<th>Subject Title</th>
<th>Waves and Optics and Introduction to Quantum Mechanics</th>
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**COURSE OBJECTIVE:** The objective of this course is to develop a fundamental basis of waves, optical phenomenon, concepts of quantum mechanics and semiconductor physics which the engineering students can apply to their respective area of specialization.

**Unit 1: Waves**

Mechanical and electrical simple harmonic oscillators, damped harmonic oscillator, forced mechanical and electrical oscillators, impedance, steady state motion of forced damped harmonic oscillator

**Unit 2: Non-dispersive transverse and longitudinal waves**

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 equation for them, acoustics waves

**Unit 3: Light and Optics**

Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster’s angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them.

**Unit 4: Wave Optics**

Huygens’ principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young’s double slit experiment, Newton’s rings, Michelson interferometer, Mach Zehnder interferometer. Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power

**Unit 5: Lasers**

Einstein’s theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers (ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity

**Unit 6: Introduction to Quantum Mechanics**

Wave nature of Particles, Time-dependent and time-independent Schrodinger equation for wave function, Born interpretation, probability current, Expectation values, Free-particle wave function and wave-packets, Uncertainty principle.

**Unit 7: Solution of Wave Equation**

Solution of stationary-state Schrodinger equation for one dimensional problems—particle in a box, particle in attractive delta-function potential, square-well potential, linear harmonic oscillator. Scattering from a potential barrier and tunneling; related examples like alpha decay, field-ionization and scanning tunneling microscope, tunneling in semiconductor structures. Three-dimensional problems: particle in three dimensional box and related examples.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018
Unit- 8: Introduction to Solids and Semiconductors

Free electron theory of metals, Fermi level, density of states in 1, 2 and 3 dimensions, Bloch’s theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands. Types of electronic materials: metals, semiconductors, and insulators. Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction

TEXT BOOKS

REFERENCE BOOKS

COURSE OUTCOME:
At the end of the course, the student will be able to:
CO1. To acquire skills allowing the student to identify and apply formulas of optics and wave physics using course literature.
CO2. To be able to identify and illustrate physical concepts and terminology used in optics and to be able to explain them in appropriate detail.
CO3. To be able to make approximate judgments about optical and other wave phenomena when necessary.
CO4. To acquire skills allowing the student to organize and plan simpler laboratory course experiments and to prepare an associated oral and written report.
CO5. To have basic knowledge of Quantum Mechanics and Semiconductors.

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<tr>
<th>SR.NO.</th>
<th>LIST OF EXPERIMENTS</th>
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<tbody>
<tr>
<td>1</td>
<td>(a) To determine wavelength of sodium light using Newton’s Rings.</td>
</tr>
<tr>
<td></td>
<td>(b) To determine the refractive index of a liquid using Newton’s Rings.</td>
</tr>
<tr>
<td>2</td>
<td>To determine wavelength of sodium light using Fresnel’s Biprism.</td>
</tr>
<tr>
<td>3</td>
<td>(a) To determine wavelength of prominent lines of mercury using plane diffraction grating.</td>
</tr>
<tr>
<td></td>
<td>(b) To determine the dispersive power of a plane transmission diffraction grating.</td>
</tr>
<tr>
<td>4</td>
<td>To determine the specific rotation of cane sugar solution using bi-quartz polarimeter</td>
</tr>
<tr>
<td>5</td>
<td>To study the diffraction pattern of Single slit and hence determine the slit width.</td>
</tr>
<tr>
<td>6</td>
<td>(a) To verify cosine square law (Malus Law) for plane polarized light.</td>
</tr>
<tr>
<td></td>
<td>(b) To study the nature of polarization using a quarter wave plate.</td>
</tr>
<tr>
<td>7</td>
<td>To study the variation of refractive index of the material of the prism with wavelength and to verify Cauchy’s dispersion formula</td>
</tr>
<tr>
<td>8</td>
<td>(a) To study photoelectric effect and determine the value of Planck’s constant.</td>
</tr>
<tr>
<td></td>
<td>(b) To verify inverse square law using photocell.</td>
</tr>
<tr>
<td>9</td>
<td>To determine the frequency of AC mains using sonometer.</td>
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<tr>
<td>10</td>
<td>To determine the frequency of AC mains or of an electric vibrator by Melde’s experiment</td>
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<tr>
<td>11</td>
<td>To measure the numerical aperture (NA) of an optical fiber.</td>
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<td>PY104</td>
<td>Introduction to Electromagnetic Theory</td>
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Course Outline:

Course Objective:
To teach students the effects of electric charges at rest and in motion. Both positive and negative charges produce force field which is called “electric field”. Moving charges produce current, which gives rise to another force field called “magnetic field”. The electromagnetic theory studies the behavior of the electric and magnetic fields.

Course Pre/Co-requisite (if any):

UNIT 1: Electrostatics in vacuum
Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace’s and Poisson’s equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal conduction; Practical examples like Faraday’s cage and coffee-ring effect; Boundary conditions of electric field and electrostatic potential; method of images; energy of a charge distribution and its expression in terms of electric field.

UNIT 2: Electrostatics in a linear dielectric medium
Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field.

UNIT 3: Magnetostatics
Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes’ theorem; the equation for the vector potential and its solution for given current densities.

UNIT 4: Magnetostatics in a linear magnetic medium
Magnetization and associated bound currents; auxiliary magnetic field $\mathbf{H}$; Boundary conditions on $\mathbf{B}$ and $\mathbf{H}$. Solving for magnetic field due to simple magnets like a bar magnet; magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.

UNIT 5: Faraday’s law
Faraday’s law in terms of EMF produced by changing magnetic flux; equivalence of Faraday’s law and motional EMF; Lenz’s law; Electromagnetic breaking and its applications; Differential form of Faraday’s law expressing curl of electric field in terms of time-derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi-static approximation; energy stored in a magnetic field.

UNIT 6: Displacement current, Magnetic field due to time-dependent electric field and Maxwell’s equations
Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity equation; displace current and magnetic field arising from time-dependent electric field; calculating magnetic field due to changing electric fields in quasi-static approximation. Maxwell’s equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Poynting vector with examples. Qualitative discussion of momentum in electromagnetic fields.

UNIT 7: Electromagnetic waves
The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave; energy carried by electromagnetic waves and examples. Momentum carried by electromagnetic waves and resultant pressure. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018
Learning Outcome
At the end of the course, the student will be able to:
CO1. The use of Coulomb's law and Gauss' law for the electrostatic force
CO2. The relationship between electrostatic field and electrostatic potential
CO3. The use of the Lorentz force law for the magnetic force
CO4. The use of Ampere's law to calculate magnetic fields
CO5. The use of Faraday's law in induction problems
CO6. The basic laws that underlie the properties of electric circuit elements

Text book [TB]:

Reference Books [RB]:

List of Experiments:
1. To compare capacitances using De'Sauty's bridge.
2. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
3. To verify the Thevenin and Norton theorems.
4. To verify the Superposition, and Maximum power transfer theorems
5. To determine self-inductance of a coil by Anderson's bridge.
6. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
7. To study the response curve of a parallel LCR circuit and determine its (a) Antiresonant frequency and (b) Quality factor Q.
8. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer

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<tr>
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<th>Subject Title</th>
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Course Outline:

Course Objective:
The objectives of this course are to enable students to acquire and use engineering graphics skills as a means of accurately and clearly communicating ideas, information and instructions for technical communication.

Course Pre/Co- requisite (if any):

Detailed Syllabus

UNIT 1: Introduction to Engineering Graphics
Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Involutes; Scales Plain, Diagonal

UNIT 2: Projection of Points and Planes
Orthographic Projections covering, Principles of Orthographic Projections, Projections of Points and lines inclined to both planes; Projections of planes inclined Planes

UNIT 3: Projection of Solids
Projections of solids in simple position, projections of solids with axes inclined to one reference plane and parallel to other. Projections of solids with axes inclined to both of the reference plane

UNIT 4: Section of Solids and Development of Surfaces
Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone, Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone

UNIT 5: Isometric Projection and Auto CAD
Isometric Projections, Freehand Sketching, Simple and compound Solids, Conversion of Isometric Views to Orthographic Views (simple machine components according to first angle projection method), Basic AutoCAD commands & its applications

Learning Outcome
At the end of the course, the student will be able to:
CO1: Be able to use Engineering Drawing Skills as a means of accurately and clearly communicating ideas, information and instructions.
CO2: Acquire requisite knowledge, techniques and attitude for advanced study of engineering drawing.
CO3: Comprehend and draw a simple engineering drawing primarily in first angle Orthographic projections.
CO4: To create section views of simple engineering objects
CO5: To understand basic AutoCAD commands and appreciate the need of AutoCAD over Manual Drafting.

Text book [TB]:

Reference Books [RB]:
5. (Corresponding set of) CAD Software Theory and User Manuals

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

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Course Outline:

Course Objective:

The objective of the course is to introduce the fundamentals in Matrices and Linear Algebra, Solving Ordinary Differential Equations, Convergence of an Infinite Series, Laplace Transform and Fourier Series relevant to engineering applications.

Course Pre/Co-requisite (if any):

UNIT 1: Linear Algebra

UNIT 2: Differential Equations
Methods of solving differential equations of first order and first degree, Bernoulli equation, Wronskian, Solutions of linear differential equations of higher order with constant coefficients, Cauchy-Euler linear differential equation, Solution of second order linear differential equation with variable coefficients, Method of variation of parameters. Solution of simultaneous linear differential equations of first order.

UNIT 3: Infinite Series
Introduction to sequences and series, Convergence and divergence, Series of positive terms, Comparison test, Cauchy’s integral test, D’Alembert’s ratio test, Cauchy’s root test, Raabe’s test, Logarithmic test, Alternating series, Leibnitz test.

UNIT 4: Fourier Series
Periodic functions, Fourier series of Periodic functions, Euler’s formulae, Functions having arbitrary period, Change of intervals, Even and odd functions, Half range sine and cosine series

UNIT 5: Laplace Transform

Learning Outcome

At the end of the course, the student will be able to:
CO1. Equip the students to deal with advanced level of mathematics and applications.
CO2. Familiarity with fundamental tools of Matrices and Linear Algebra, Ordinary Differential Equations, Infinite Series, Laplace Transforms and Fourier Series.
CO3. Use of tools to solve engineering applications.

Text book [TB]:


Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

Reference Books [RB]:

Course Outline:

**Course Objective:**
The objectives of this course are to provide a summary on water chemistry, water treatment, green chemistry and synthetic chemistry. The course intends to provide an overview of the working principles, mechanism of reactions and application of the building blocks like batteries, fuel cells, polymers and an overview of surface coatings in order to protect the metal.

**Course Pre/Co-requisite (if any):**

**UNIT 1: Water Treatment and Analysis**

**UNIT 2: Electrochemistry & Corrosion**
Electrochemical cell, Electrode potential & EMF of a Galvanic cell, Nernst Equation, Migration of ions, Transport number, Determination of Transport number by Hittorf’s method, Conductometric titrations, Types of electrode: Calomel and glass electrode, Liquid junction potential.

**UNIT 3: Polymers & Biomolecules**
Introduction; Classification of Polymers; Functionality; Mechanism of Polymerization; Plastics; Individual Polymers; LDPE, HDPE, PVC, Polystyrene, Bakelite, Teflon, PMMA, PET, Nylon-6, Rubbers (BUNA-S and BUNA-N); Specialty Polymers (Conducting Polymers, Silicones and Polycarbonates), Structural and functional attributes of cell and cell organelles; Biomolecules (Proteins, Carbohydrates, Lipids, Enzymes, Nucleic acids).

**UNIT 4: Fuels, Battery& Lubrication**
Classification of fuels, Calorific value, Cetane number, Octane number, Comparison of solid, liquid and gaseous fuel, properties of fuel, Biofuels, Power alcohol and synthetic petrol, Battery, Metal-air battery, Lithium and nickel battery. Introduction of Lubricants, Functions of Lubricants, Classification of lubricants, Mechanisms of Lubrication, Properties of Lubricants.

**UNIT 5: Green Chemistry & Nano Chemistry**
Emergence of green chemistry, Twelve principle of green chemistry, use of alternative feedstock (biofuels), Use of innocuous reagents, use of alternative solvents, design of safer chemicals, designing alternative reaction methodology, minimizing energy consumption. Introduction to Nano chemistry, properties of Nano materials, preparation of nanomaterial, self-assembly, Different Nano materials, Applications of Nano materials.

**Learning Outcome**
At the end of the course, the student will be able to:
CO1: To understand about the treatment of water, sewage water and hardness related calculation
CO2: An overview of surface coatings in order to protect the metal.

CO3: An ability to identify and formulate polymers and have a knowledge of various polymers like polythene, PVC, PS, Teflon, Bakelite, Nylon which have engineering applications. To gain acquaintance regarding biomolecules and their application in Engineering. To gain acquaintance regarding biomolecules and their application in Engineering.

CO4: An overview of the working principles, mechanism of reactions and application of the building blocks like batteries, fuel cells,

CO5: An ability to handle various instruments like spectroscope, flame photometer etc. Have a knowledge of synthesizing Nano materials and their applications in industry. Know the properties of Fuels and Lubricants. Have a scope in the area of Material Chemistry.

Text book [TB]:

Reference books [RB]:
5. Basic Biotechnology by S Ignacimuthu. Tata Mcgraw-Hills

List of Experiments:
1. Determination of alkalinity in the given water sample.
2. Estimation of temporary and permanent hardness in water sample using EDTA as standard solution.
3. To determine the percentage of available chlorine in bleaching powder.
4. To determine the chloride content in the given water sample by Mohr’s method.
5. Determination of iron content in the given ore by using External indicator.
6. To determine the Dissolved Oxygen in a given water sample.
7. To determine the strength of unknown acid pH-metrically.
8. To analyze the coal sample by proximate analysis.
9. To determine the Flash and Fire point of a fuel sample.
10. To determine the Viscosity of a lubricant by redwood viscometer.
11. To determine the rate constant and order of reaction.
12. To determine the strength of a given solution conductometrically.

<table>
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<th>Subject Title</th>
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<td>ME105</td>
<td>Engineering Mechanics</td>
<td>1st</td>
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### Course Outline:

**Course Objective:**

The objectives of this course is to learn basics concepts of engineering mechanics and increase the ability to solve problems involving forces, loads and moments and to know their applications in allied subjects

**Course Pre/Co- requisite (if any):**

**Detailed Syllabus**

**UNIT 1: Introduction to Engineering Mechanics**

Basic idealizations - Particle, Continuum and Rigid body; Newton's laws of Force and its characteristics, types of forces-Gravity, Lateral and its distribution on surfaces, Classification of force systems, Principle of physical independence, superposition, transmissibility of forces, Introduction to SI units.

Couple, Moment of a couple Characteristics of couple, Moment of a force, Equivalent force - couple system; Numerical problems on moment of forces and couples, on equivalent force - couple system.

**UNIT 2: Equilibrium of forces**

Equilibrium of forces - Definition of Equilibrant; Conditions of static equilibrium for different force systems, Lami's theorem; Numerical problems on equilibrium of coplanar – concurrent and non-concurrent force systems.

Application- Static Friction in rigid bodies in contact, Types of friction, Laws of static friction, Limiting friction, Angle of friction, angle of repose; Impeding motion on horizontal and inclined planes; Numerical Problems on single and two blocks on inclined planes, ladder and wedge friction.

**UNIT 3: Analysis of Plane truss and Beam**

Support Reaction in beams: Types of beams, Types of Loads and Supports, statically determinate beams, Numerical problems on support reactions for statically determinate beams with Point load (Normal and inclined) and uniformly distributed and uniformly varying loads and Moments.

Plane Truss: Perfect and imperfect truss Assumptions and Analysis of Plane Truss by Method of joints and Method of section.

**UNIT 4: Center of Gravity and Centroids**

Introduction to the concept, Centroids of line and area, Centroids of basic geometrical figures, computing Centroids for– T, L, I, and full/quadrant circular sections.

**UNIT 5: Kinetics of Particle**

Newton’s law of motion; Motion of bodies in Rectangular coordinates; D’Alembert’s Principle.

### Learning Outcome

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

- **CO1.** Identify principles of mechanics to be used for solving real life engineering problems.
- **CO2.** Apply basic Engineering concepts based on force, shape and dimension for selection of material
- **CO3.** Comprehend the action of Forces, Moments and other loads on systems of rigid bodies.
- **CO4.** Compute the reactive forces and the effects that develop as a result of the external loads.
- **CO5.** Express the relationship between the motions of bodies.

### Text book [TB]:


### Reference Books [RB]:

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

1. Hibler and Gupta (2010), Engineering Mechanics (Statics, Dynamics) by Pearson Education

List of Experiments:
1. Study of different types of beam.
2. Calculation and Verification of forces in truss elements.
3. Calculation and verification of equilibrium condition on beam model.
4. Calculation to find the redundant force in a truss.
5. Mechanical advantage over pulley arrangement.
6. Determining the coefficient of friction.
7. Optional Tensile Strength
8. Optional Hardness Measurement

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Course Outline:

Course Objective:
Ability to prepare simple objects using machines and machine tools to make students aware of fundamental operations of manufacturing an engineering component, enhance visualization and motivate them to innovate

Course Pre/Co-requisite (if any):

UNIT 1: Machine Shop
To make a machined-component using lathe with mild steel round bar or hexagonal bar Comprising of common turning operations with reference to drawing given in the manual. Any one of the following jobs
Jobs: Hex Bolt, Axle for cycle wheel, Jig Bush, a typical turning specimen.

UNIT 2: Sheet metal Shop
To make a sheet metal component with galvanized iron sheet as per the drawing provided in the manual having spot welding joint. Any one of the following jobs
Jobs: Square tray, Scoop, Funnel

UNIT 3: Fitting Shop
To make a joint using fitting tools with mild steel flats, round bars or square bars as per the drawing provided in the manual.

UNIT 4: Welding Shop - Arc Welding
To prepare a welding joint with mild steel flat using Manual Metal Arc welding machine according to the drawing provided in the manual. Any one of the following jobs
Jobs: Lap joint, Butt joint, Fillet/Corner joint

UNIT 5: Gas & Spot Welding
To observe the demonstration of making a Lap joint/Butt joint with mild steel sheet using oxyacetlylene flame as per the drawing provided in the manual. To perform the spot welding operation on G.I. sheet

UNIT 6: Carpenter Shop
To make a wooden joint with soft wood as per the drawing provided in the manual. Any one of the following jobs
Jobs: T-Lap joint, Dove tail joint, Mortise & Tendon joint, Bridle joint.

UNIT 7: Foundry Shop
Introduction to foundry process like melting of metals, mould making, casting process and use of patterns to prepare of a component and significance of foundry.
Demo of mould preparation

Minor Project:
To make a minor project by the students in batches comprising the operations performed in different shops

Learning Outcome
At the end of the course, the student will be able to:
CO1: Have Capability to identify hand tools and instruments for machining and other workshop practices.
CO2: Obtain basic skills in the trades of fitting, carpentry, welding and machining
CO3: Acquire measuring skills, using standard workshop instruments & tools.
CO4: Gain eye hand co-ordination, enhance psycho motor skills and attitude.

Text book [TB]:
Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018


Reference Books [RB]:


Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

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**Course Outline:**

**Course Objective:**

The objective of the course is to make the students to understand the key hardware components in a modern computer system and as to how the software is mapped to the hardware. The student shall also be able to learn make the computer programs using C language by exploring the various features of C.

**Course Pre/Co- requisite (if any):**

**Detailed Syllabus**

**UNIT 1: Introduction to Computer, Programming & algorithms**
Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)
Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples, From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code

**UNIT 2: Arithmetic Expression, and Conditional statements, Loops**
Expression:
Arithmetic, Logical, Relational expressions and precedence.
Loops & Branching: Writing and evaluation of conditionals and consequent branching, Iteration and loops.

**UNIT 3: Arrays & Functions**
Arrays: Arrays (1-D, 2-D), Character arrays and Strings.
Functions: functions (including using built in libraries), Parameter passing in functions, call by value, passing arrays to functions: idea of call by reference.
Searching & Sorting: Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

**UNIT 4: Fuels, Battery & Lubrication**
Recursion:
Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc.
Structure:
Structures, Defining structures and Array of Structures.

**UNIT 5: Pointers & File handling**
File handling: different modes of opening a file in C, reading, writing from files.

**Learning Outcome**
At the end of the course, the student will be able to:
CO1. To formulate simple algorithms for arithmetic and logical problems.
CO2. To implement conditional branching, iteration and recursion.
CO3. To decompose a problem into functions and synthesize a complete program using divide and conquer approach.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

CO4. To use arrays, pointers and structures to formulate algorithms and programs.

CO5. To apply programming to solve matrix addition and multiplication problems and searching and sorting problems

Text book [TB]:


List of Experiments:

1. Familiarization with programming environment.
2. Programming for Simple computational problems using arithmetic expressions.
3. Programming for Problems involving if-then-else structures.
4. Programming for Iterative problems e.g., sum of series.
5. Programming for 1-D Array manipulation.
7. Programming for Simple functions
10. Programming for File operations
11. Programming for solving Numerical methods problems

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018
Course Objective:
1. To impart basic knowledge about the environment and its allied problems and to develop an attitude of concern for the environment.
2. Further the course structure will create the awareness about environmental problems among students and motivate the students to participate in environment protection and environment improvement programs.
3. The course aims to develop skills to help the concerned individuals in identifying and solving environmental problems.

Detailed Syllabus

UNIT 1 - Basics of Environment and Natural Resources:

UNIT 2 - Ecosystems:

UNIT 3 - Biodiversity and its conservation:

UNIT 4 - Environmental Pollutions:

UNIT 5 - Social Issues and Environment:

Field work: 03 Hrs

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

1. Visit to a local area to document environmental asset: river/forest/grassland/hill/mountain
2. Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
4. Study of a common ecosystem-pond, river, hill slopes, etc.

Learning Outcome

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

1. Demonstrate depleting nature of Environmental Resources and Ecosystem concepts.
2. Able to identify the structure and functioning of natural ecosystems.
4. Adapt to 3R (Reuse, Recovery, Recycle). Identify the causes and control measures related to Pollutions.
5. Illustrate and analyse various Case Studies related to Environmental issues and Env. Legislation.

Text book [TB]:

2. Kaushik A & Kaushik C P; Perspectives in Environmental Studies; New Age International Publ.; 2007.
3. S. Deswal & A. Deswal; A Basic Course in Environmental Studies; Dhanpat Rai & Co; 2015.

Reference books [RB]:


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<td>LTP 2 0 0 Credit 0</td>
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**Course Objective:**
1. To familiarize the students with the features of the Indian Constitution
2. To provide a knowledge of their constitutional rights

**Detailed Syllabus:**

**UNIT 1: Introduction**
6L

**UNIT 2: Union Government and its Administration**
5L
Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, Institutional Functioning: Prime Minister, Parliament and Judiciary, Power Structure in India: Caste, class and patriarchy.

**UNIT 3: State Government and its Administration**
5L

**UNIT 4: Local Administration**
6L

**UNIT 5: Election Commission**
5L
Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

**Learning Outcome**
1. Enable the students to protect their rights
2. The students will be engaged in the political system of India.
3. To know the structures of government bodies.
4. To know the roles and responsibilities of regulatory bodies.
5. To understand the functions and importance of election commission.

**Textbook [TB]:**

**Reference Books [RB]:**

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

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**Course Objective:**
1. To acquaint students with the fundamental concepts of probability and statistics and to develop an understanding of the role of statistics in engineering.
2. Also to introduce numerical techniques to solve the real world applications.

**Detailed Syllabus**

**UNIT 1 - Discrete Random variables and Distributions:**
7L
Introduction-Random variables- Discrete Random variable-Distribution function- Expectation-Moment Generating function-Moments and properties. Discrete distributions: Binomial, Poisson and Geometric distributions and their fitting to data

**UNIT 2 - Continuous Random variable and distributions:**
7L
Introduction-Continuous Random variable-Distribution function- Expectation-Moment Generating function-Moments and properties. Continuous distribution: Uniform, Exponential and Normal distributions, Normal approximation to Binomial distribution -Weibull, Gamma distribution

**UNIT 3 - Sampling Theory:**
7L
Introduction - Population and samples- Sampling distribution of means (σ known)-Central limit theorem-t-distribution- Sampling distribution of means (σ unknown)- Sampling distribution of variances -χ² and F-distributions- Point estimation- Maximum error of estimate - Interval estimation

**UNIT 4 - Tests of Hypothesis:**
6L
Introduction –Hypothesis-Null and Alternative Hypothesis- Type I and Type II errors –Level of significance - One tail and two-tail tests- Tests concerning one mean and proportion, two means- Proportions and their differences- ANOVA for one-way and two-way classified data

**UNIT 5 - Curve fitting and Correlation:**
6L
Introduction - Fitting a straight line –Second degree curve-exponential curve-power curve by method of least squares-Goodness of fit. Correlation and Regression – Properties

**UNIT 6 - Statistical Quality Control Methods**
6L
Introduction - Methods for preparing control charts - Problems using x-bar, p, R charts and attribute charts

**Learning Outcome**
At the end of the Course, Student will be able to:
1. Examine, analyze, and compare various Probability distributions for both discrete and continuous random variables.
2. Describe and compute confidence intervals for the mean of a population.
3. Describe and compute confidence intervals for the proportion and the variance of a population and test the hypothesis concerning mean, proportion and variance and perform ANOVA test.
4. Fit a curve to the numerical data.

**Text book [TB]:**
1. Jay I.devore; Probability and Statistics for Engineering and the Sciences; Cengage; 2009.
2. William Menden Hall, Robert J. Bever and Barbara Bever; Introduction to probability and statistics; Cengage learning; 2009.

*Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018*

3. Sheldon, M. Ross; Introduction to probability and statistics Engineers and the Scientists; Academic Foundation; 2011.

Reference books [RB]:
2. Johannes Ledolter and Robert V.Hogg; Applied statistics for Engineers and Physical Scientists; Pearson; 2010.

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<th>Subject Code</th>
<th>PE201</th>
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Course Objective:
The objective is to provide a concise introduction to various branches of Applied Geology with special emphasis on Petroleum exploration. Instead of delving deep into various branches an effort is made to give a fair idea of various topics.

1. The student will learn about Igneous and Metamorphic rock types and their formation, classification of Sedimentary rocks, properties and the textures and structures.
2. The student will learn the principles and methods of Paleontology and the significance of microfossils in correlation of Petroliferous strata with emphasis on their application to the exploitation of Oil and Gas.
3. The students will learn the principles of Structural geology, folds, faults, joints and unconformities in relation to Petroleum reservoir and traps.
4. The student will learn about the various types of environments, namely Non-marine, Marine, and mixed environments, basin formation and analysis. Introduction to Sequence stratigraphy with respect to exploration of Hydrocarbons.

The students will able to analyze different types of source rock, reservoir rock, cap rock, trap, seals etc with respect to Hydrocarbon generation, accumulation and entrapment.

Detailed Syllabus

UNIT 1- Rock types, structure and their classification and properties  8L

UNIT 2
Introduction to paleontology, Process of fossilization, trace fossils and their uses, idea of Macrofossils and Microfossils. Introduction to micropaleontology, significance of microfossils in correlation of petroliferous strata.

UNIT 3
Measurements of Linear and Planar Structures; Primary and secondary structures; Geometric classification of: Folds, faults, joints, and unconformities; Field recognition of Fold and Faults.

UNIT 4

UNIT 5

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018
List of Experiments

1. Identification of Mineral Hand Specimen
   (i) Quartz  (ii) Gypsum  (iii) Beryl  (iv) Garnet  (v) Serpentine  (vi) Dolomite  (vii) Talc  (viii) Pyroxene  (ix) Kyanite  (x) Orthoclase Feldspar  (xi) Plagioclase  (xii) Muscovite  (xiii) Biotite  (xiv) Calcite
2. Identification of Igneous rock in Hand Specimen
   (i) Garnet (ii) Basalt  (iii) Rhyolite  (iv) Dolerite  (v) Diorite
3. Identification of sedimentary rocks in Hand Specimen
   (i) Sandstone  (ii) Arkose  (iii) Limestone  (iv) Shale  (v) Mudstone
4. Identification of metamorphic rocks in Hand Specimen
   (i) Quartzite  (ii) Marble  (iii) Schist  (iv) Gneiss  (v) Slate
5. Identification of Mineral in thin section
   (i) Quartz  (ii) Feldspar  (iii) Muscovite  (iv) Biotite  (v) Hornblende  (vi) Pyroxene  (vii) Olivine  (viii) Pyrite  (ix) Garnet
6. Measurement of dip and strike
7. Understanding of concept of contour map
8. Understanding of structural map

Learning Outcome

1. Having successfully completed this course, the student will demonstrate a better understanding of various topics of Applied Geology and get a better perspective of Petroleum exploration and concepts leading to a clearer understanding of Petroleum Engineering.
2. The outcome creates ability to apply the principles of exploration, evaluation, development, and recovery of hydrocarbons, and other fluids in various subsurface reservoirs.
3. Creates knowledge base which imparts the ability to work for Clients world over who are at the forefront of efforts in the areas of exploration and exploitation of Hydrocarbons to meet the world’s ever-increasing demand for energy.
4. Develop skills for solving basic Petroleum related problems.
5. Develop into successful, socially and ethically responsible careers in the petroleum industry.

Text book [TB]:

3. Leverson; Geology of Petroleum; Elsevier; 2006.

Reference books [RB]:


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Course Objective:
1. Objective of this course is to disseminate knowledge about the principles of fluid mechanics. Fluid mechanics has wide application in different domains of physics.

Detailed Syllabus

UNIT 1
Newtonian and non-Newtonian fluids. In compressible and compressible flow. Two-phase flow. Friction factor estimation. Straight pipe bends, elbows, converging diverging section

UNIT 2
Fluid pressure measurement. Piezometers, Manometers, Flow of fluid in pipes and flat surfaces

UNIT 3
One and two dimensional flow equations. Bernoulli's equation, application, venturimeter, orifice meter. Equivalent length. Slurry transport

UNIT 4
Pumps: Types, reciprocating and rotary pumps, construction details, performance characteristics. Single & multistage operation. Turbine pumps: multistage turbine pumps

UNIT 5
Compressors: Types, Rotary and centrifugal. Single stage and multi stage. Construction details and performance characteristics

List of Experiments
1. To determine the coefficient of discharge Cd, velocity Cv, and contraction Cc of various types of orifices
2. Determine of discharge coefficients of: V-notch, Rectangular notch
3. To determine the minor head loss coefficient for different pipe fittings.
4. To study the variation of friction factor f. For turbulent flow in rough and smooth commercial pipes
5. To obtain the Reynolds number in different flow conditions.
6. To calibrate Venturimeter and to study the variation of coefficient of discharge with the Reynolds number.
7. To calibrate an orifice meter and to study the variation of coefficient of discharge with the Reynolds number.
8. To verify the Bernoulli’s theorem experimentally.
9. To determine Meta centric height of a floating body
10. To determine the efficiency of centrifugal pump

Learning Outcome
1. A good understanding of this subject will help students to develop better understanding of fluid behavior, fluid flow through the pipes, flow through porous media, various fluid properties and their relation, various types of pumping equipment petroleum industry.
2. It will develop ability to understand subjects like computational fluid dynamics along with better employment opportunity.
3. The student will understand stress strain relationship in fluids, classify their behavior and force analysis in static system.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

4. To determine and analyse the performance aspects of fluid machinery specially for turbine, centrifugal pump and reciprocating pumps.
5. Be able to describe function of flow metering devices and apply bernoulli’s equation to determine the performance of flow metering devices.

Text book [TB]:
1. R.K. Bansal; Fluid Mechanics; Laxmi Publication; 2005.
2. P.N Modi and Dr S.M Seth; Hydraulics and fluid mechanics including hydraulics machines; Standard Book House; 1960.

Reference books [RB]:
2. Cengel and Cimbala; Fluid mechanics; McGraw Hills; 2017.

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>PE203</th>
<th>Subject Title</th>
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</table>

Course Objective:
1. Be able to understand the basic thermodynamic terminology and scope, thermodynamic laws and their applicability and limitations.
2. To understand the various thermodynamics correlation and able to calculate the changes in U, H, S and G for ideal gases and also for non-ideal gases.
3. To understand the concept of partial molar properties, phase equilibria, fugacity, phase rule.
4. Understand the working principle and performance of refrigerators and heat pumps

Detailed Syllabus

UNIT 1
Compression/ expansion of ideal and non-ideal gases. Horse power calculations. Single, double and multi-stage operation 8L

UNIT 2
Thermodynamics of Gases and Liquid Hydrocarbons: Force energy, work function, Mollier diagram, perfect and imperfect gaseous mixtures. Equation of state, Law of corresponding states, Joule-Thompson effect, Arrhenius equation, Activation energy, Fugacity and fugacity coefficient, Lewis fugacity rules. Third law of thermodynamics 6L

UNIT 3
Solution Thermodynamics: Vapour-liquid equilibria, partial molar properties, chemical potential, Raoults Law and Henrys Law. Ideal and non-ideal solutions, activity and activity coefficients. 8L

UNIT 4
Gibbs – Duhem equation, Gibb’s adsorption equation. Phase rule: Single, two and multicomponent system. Phase behavior, Phase equilibria calculations. Ternary and pseudo-ternary phase diagrams 9L

UNIT 5
Fluid flow thermodynamics: multiphase flow in vertical, inclined and horizontal conduits. Pressure traverse and calculation. Thermodynamics of multiphase multi-component system. 8L

Learning Outcome
1. Students gain knowledge about thermodynamics laws and their limitations. Also students understand the various equation of state and their significance
2. Students understand the concept of partial molar properties, phase equilibria, ideal and non-ideal solution, fugacity, phase rule and calculations
3. Students learn about various thermodynamics correlation and also learn about how to calculate thermodynamics properties
4. Select an appropriate equation of state for representing the P-V-T behavior of gases and/or liquids.
5. Students gain knowledge about types of compressor, their uses, working principle and performance of refrigerators and heat pump

Text book [TB]:
1. K V Narayanan; A textbook of Chemical Engineering Thermodynamics; PHI Learning; 2013.
2. Y V C Rao; A textbook of Chemical Engineering Thermodynamics; Universities Press India; 2012.

Reference books [RB]:
2. Cengel and Boles; Thermodynamics an Engineering Approach; McGraw Hills; 1998.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018
### Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

<table>
<thead>
<tr>
<th>Subject Code</th>
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<th>OIL AND GAS WELL DRILLING TECHNOLOGY AND WELL COMPLETION</th>
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**Course Objective:**
1. To understand oil well drilling and operations engineering.
2. To get familiarized with field equipment drilling and practices nature of difficulties actions to be taken.
3. To learn fundamental equations and calculations used in drilling engineering.

**Detailed Syllabus**

**UNIT 1**
8L
- Site selection.
- Rig selection.
- Choice of drilling methods.
- Rotary drilling rig components.
- Rocks bit types (Drag, Roller cutter and PDC), Rock failure mechanism of bits and operational characteristics.
- Optimization of bit hydraulics, hydraulic horse power calculation, Affect of bit type, formation properties, drilling fluid, bit weight and hydraulics on penetration rate.
- Drill string design and components, Weight on bit calculation, buckling neutral point and axial neutral point, affect of hydraulic forces on weight on bit.
- Formation drill-ability; factor affecting; load on bit, rotational rpm; drilling fluid characteristics

**UNIT 2**
8L
- Casing types and scheme, Casing performance properties: Burst, collapse and Biaxial effect, choice of material, tool and upsets.
- Stress condition in casing string; design factors. Casing head system. Casing setting depth selection

**UNIT 3**
8L
- Oil-well cement composition and additives and. Preparation of well bore for casing and cementing.
- Cement-slurry design for efficient mud displacement, API standards of slurry design and testing cementing, cementing equipment: cementing units, mixers and storage and handling system

**UNIT 4**
8L
- Quality evaluation: height of the cement, cement bonding with casing and formation.
- Drilling Log: Temperature log, Radioactive Tracer, stuck pipe log, Well bore problems: differential sticking, mechanical sticking, fishing and lost circulation

**UNIT 5**
7L
- Well orientation survey. Well deflection; direction determination and presentation

**Learning Outcome**
1. Understand drilling rig power system, hoisting system, rotary system, and circulation system.
2. Identify, formulate, and solve simple engineering problems related to drilling operations, drilling fluid, downhole problems etc.
3. Knowledge of well control equipment, directional drilling, importance of coring, fishing operations.
4. To be able to design simple casing and design cement slurry for cementation.
5. To work on laboratory equipment to measure drilling fluid properties, Rheology, Cement slurry properties etc.
6. Calculation of pressure losses in drill string and optimization of hydraulics.

**Text book [TB]:**
1. Neal J. Adams; Drilling Engineering-A complete well planning approach; PennWell publishing Company; 1985.
2. Carl Gatlin; Drilling Well Completions; PHI; 1965.

**Reference books [RB]:**
2. S.S. Rahman, G.V. Chilingarian; Casing design theory and practice; Elsevier; 1995.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

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<th>Subject Code</th>
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**Course Outline:** This is a module having basics of aptitude coupled with Soft Skills to help students set the tone for aptitude training to create readiness for campus placement and various competitive exams for Government & non-corporate set-ups. The various tools used in the classes will help them rediscover & reinvent themselves.

**Course Objective:**
1. Prepare students for becoming confident and corporate-culture fit
2. Get them equipped with the aptitude tools to handle workplace stressors and manage time properly
3. Help them improve their interpersonal skills

**Course Pre/Co- requisite (if any):** Basic understanding of elementary Mathematics and Logical reasoning and basic understanding of Soft Skills.

**Detailed Syllabus**

**UNIT 1: QUANTITATIVE APTITUDE**
05 hours
- Simplification: Duplex method for finding square; Vedic mathematics tricks for multiplication of 2, 3, 4 digit numbers; BODMAS application, Finding square roots and cube roots; Introduction to Surds and Indices.
- Ages: Problems based on ages solving with algebraic equations; Concept of hence time and past time.
- Averages: Basic Concepts; Weighted Average; Basic understanding of mean, median and mode; Application of average on ages, speed time distance and series.

**UNIT 2: VERBAL APTITUDE**
05 hours
- Sentences: Types of sentences, Parts of Speech- application based approach.
- Vocabulary: Understanding word structure, common roots, prefixes, suffixes, Mnemonic method.
- Speed Reading: Easy to medium passages-techniques and practical applications, Idioms and phrases.
- Activities: Words from Dictionary, Newspaper and other sources (theme based).

**UNIT 3: LOGICAL REASONING**
06 hours
- Clock and Calendar, Cubes – Structure of cube, cutting rules, cutting the painted cube into identical cubelets and Dice reasoning – rule detection, pattern completion, image analysis.
- Missing Number, Mathematical operation, Inequality, Number puzzles.

**UNIT 4: SELF-ANALYSIS & INTERPERSONAL SKILLS**
05 hours
- MBTI and other personality tests, strategies to develop interpersonal skills.
- **Suggested Activities & Games:** (i) I Am (ii) Flip (iii) A Letter to Yourself, (iv) Card Pieces, (v) Blindfold Game, (vi) Crazy Comic.

**UNIT 5: PRESENTATION SKILLS**
05 hours
- Principles of Effective Presentations, Do’s and Don’ts of Formal Presentations, How to prepare for a formal presentation, Presentation Exercises a) Welcome speech, c) Farewell Speech, d) Vote of thanks etc.
- **Suggested Activities & Games:** (i) Stand Up for Fillers, (ii) Mimes, (iii) Short Speech Challenge.

**Learning Outcome**

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018
1: Get to know more about their personality and gain people skills.
2: Be able to deliver presentations more confidently.
3: Will have a firm base ready for the upcoming years for the aptitude part.

Text book [TB]:

Reference books [RB]:

Humanities Electives I

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject Title</th>
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Course Objective

- To define the various types of education policies
- To understand the role in striving for social change.
- To overview on education and its implications on social changes to the students.

Unit 1

6 Hrs

General introduction to the place of learning in society. Learning, education and training. Changing meanings of education across time and society. A brief historical perspective on education in India.

Unit 2

6 Hrs

Social-political arithmetic as a spurious way of understanding education and social change. Structural functionalist perspectives and structural-conflict perspectives on education.

Unit 3

7 Hrs


Unit 4

7 Hrs


LEARNING OUTCOME:

- The students will understand how the education system assesses the importance of education in society.
- The students will be able to take a significant action in area of education to maintain social change.
- The student will be able to participate in the changes required in society.
- Education will be used as a tool to implement adequate changes in society.

TEXT BOOKS


REFERENCE BOOKS

- Gadgil, Madhav & Ramachandra Guha (1993), *This Fissured Land: An Ecological History of India*, OU Press.
- Dhanagare, D.N., *Themes and Perspectives in Indian Sociology*, Rawat

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018
**Course Objective**

- To understand the basic psychological processes and their applications in everyday life.

**Unit 1 Introduction**

Psychology as a science, perspective, origin and development of Psychology, Psychology in India, Methods: experimental and case study.

**Unit 2 Cognitive Processes-Perception**

Nature of perception, laws of perceptual organization, learning, conditioning observational learning, memory processing, information processing model, techniques for improving memory

**Unit 3 Motivation and Emotion**

Motives: Biogenic and Sociogenic; Emotion: Nature of Emotions, key Emotion

**Unit 4 Personality and Intelligence-Personality**

Nature and Theories; Intelligence: Nature and Theories

**Course Outcome:**

- The students will develop an understanding of the various psychological processes to maintain their daily activities
- The students will understand themselves better.
- The students will be better equipped for life.
- The Students will be able to demonstrate critical and creative thinking and scientific approach to understand human behaviour.

**Text Books:**


**REFERENCE BOOKS:**


Humanities Electives I

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<th>Subject Code</th>
<th>Subject Title</th>
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**Course Objective**

To increase the basic understanding of students towards science and technology, and basic implications of science & technology on social development.

**Unit 1**

Introduction of society, Sociological imagination, the two revolutions and their socio-economic technological and scientific implications; Social significance of science and technology, ideas beyond technology.

**Unit 2**

Perspectives on relations between science and technology; Sociological perspective on scientific knowledge: Karl Marx, Emile Durkheim and Karl Mannhen’s Sociology of knowledge; Merton’s approach to science and technology.

**Unit 3**

Ethos of science, Matthew effect in science, Thomas theorem and Mathew effect; Thomas Kunn’s notions paradigm and paradigm-based science, Scientific community and growth of scientific knowledge.

**Unit 4**

Science in India: science and technology policies in India, Scientific communities and their linkages, national and international Science, Ethics in science & engineering, environment and science and technology

**COURSE OUTCOME:**

- Enable students to examine the role of science and technology in social and economic development.
- The students will understand perspectives on relations between science and technology.
- The student will be able to understand the scientific temper & its social significance.
- The student will be able to understand and implement technological policies for the betterment of society.

**TEXT BOOKS**


**REFERENCE BOOKS**


Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

Humanities Electives I

<table>
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<th>Subject Code</th>
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Course Objective
- To introduce the concepts pertaining to ethical and moral reasoning and action
- To develop self – awareness

Unit 1 Introduction
Definition of Ethics; Approaches to Ethics: Psychological, Philosophical, Social.

Unit 2 Psycho-social theories of moral development
View of Kohlberg, Morality and Ideology, Culture and Morality, Morality in everyday context

Unit 3
Ethical Concerns: Work Ethics and Work Values, Business Ethics, Human values in organizations, Self-Awareness: Self Concept: Johari Window, Self and Culture, Self-Knowledge, Self-Esteem

Unit 4

COURSE OUTCOME
- Students will develop an understanding of the ethical values and their application in daily activities
- Students will learn business ethics and work ethically in every sphere.
- Students will understand themselves better and develop healthy interpersonal relationships.
- Students will be able to develop themselves into wholesome personalities.

TEXT BOOKS

REFERENCE BOOKS

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

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<tr>
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Course Objective:
1. The student will learn the separation processes based on the concepts of stage-wise and differential mass transfer.
2. The students will learn the concept of fractionation of crude oil.
3. The students will able to understand different non-dimensional numbers that are used to describe the relative effects of various parameters governing mass transfer.
4. The students will learn about other separation processes like drying, absorption, adsorption, crystallization and the designing of such columns.

Detailed Syllabus

UNIT 1
Introduction: Classification of mass transfer operation, choice of separation method, Methods of conducting mass transfer operations, Design principles

UNIT 2

UNIT 3
Distillation: Vapour-liquid equilibrium and enthalpy concentration diagrams; Principles of distillation; Batch distillation with and without reflux; Steam distillation; Fractionating columns; Calculation of number of plates by McCabe-Thiele and Ponchon-Savarit methods; Feed plate location; Optimum reflux; Open steam; Bubble cap tray, sieve tray, valve tray and packed columns; Calculation of column diameter; Entrainment; Hold-up; Plate efficiency; Principles of azeotropic and extractive distillations.

UNIT 4
Solid Liquid Extraction: Single and multi stage extraction; Number of equilibrium stages. Liquid Liquid Extraction: Ternary liquid-liquid equilibrium; Batch and continuous liquid-liquid extraction; Stage calculation; Extraction with intermediate feed and reflux; Selectivity.

UNIT 5
Drying: Different modes of drying operations, Definitions of moisture contents, Types of batch and continuous dryers, Rate of batch drying, Time of drying, Mechanism of batch drying, Continuous drying, Design of continuous dryers.
Humidification: Fundamental concept of humidification, Dehumidification and water cooling, Wet bulb temperature. Classification and design of cooling towers.

List of Experiments:
1. To study the vapor liquid equilibrium curve for CCL4 and toluene mixture
2. To determine the diffusion coefficient of an organic vapor in air.
3. To study the characteristics of fluidized bed
4. To study the operation of Batch Distillation
5. To study the operation of sieve tray distillation column.
6. To study the performance of packed bed during absorption process.
7. To study the extraction of benzene from toluene using liquid-liquid extraction column.

Learning Outcome
Having successfully completed this course,

1. Student will be able to calculate heat transfer by conduction, convection and thermal radiation for practical situations.
2. Student will be able to calculate flux in a diffusion process and number of theoretical stages in a stage-wise mass transfer operations.
3. Able to determine the height requirements for a packed distillation tower; and the number of stages required for a stage-wise liquid-liquid extraction process.
4. Fundamental knowledge of downstream engineering, designing of columns, skills both in analysis and synthesis will be improved.
5. Operation of cooling tower will be clearly understood.

Text book [TB]:

Reference books [RB]:

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<tr>
<th>Subject Code</th>
<th>Subject Title</th>
<th>FORMATION EVALUATION</th>
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<td>PE212</td>
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**Course Objective:**
1. The aim of this module is for the student to understand the principles and practices of log analysis in order to evaluate the subsurface formations and hydrocarbon bearing reservoirs. Wire line log is the most universal, comprehensive and concise document on oil and gas wells.
2. Familiarity with the purposes and optimum applications of well logs is therefore essential in both exploration and production activities.

**Detailed Syllabus**

**UNIT 1-Introduction to well logging and logging environment**
- classification of logs, Downhole & surface logging equipment, Log presentation, repeatability and Calibration, logging environment and effect of temperature, pressure and depth;

**UNIT 2-Different coring methods and electro logs**

**UNIT 3-Acoustic log and CBL**
- Resistivity departure curves, Acoustic logs, ultrasonic wave velocity propagation through formation and relevant factors: Wave amplitude and relevant factors; Stuck pipe and related logs, Cement quality evaluation: Cement bond log, cement bonding with casing and formation.

**UNIT 4- Radioactive logs**

**UNIT 5- Various aspects of cross plots**
- Interpretation and analysis: prediction of formation pressure on the basis of log analysis. Formation types, thickness and sequence construction; fluid saturation determination. Standard interpretation methods. Cross-plotting methods; neutron-density, sonic density, clean and shaly sand interpretation.

**Learning Outcome**
Knowledge and understanding on completion of this module students should be able to demonstrate
1. Principles and practices of wire-line logs and their importance in formation and reservoir evaluation
2. How to identify reservoirs
3. To determine mineralogy, porosity and saturation in various lithologies
4. Examine various logging tools: advantages and limitations; read and comprehend different log responses; apply integrated log interpretation techniques in formation evaluation;
5. Differentiate between reservoir and non reservoir rocks
6. Develop optimum tools and logging programs
7. Solve formation evaluation problems and demonstrate results
8. Diagnose the effect of down hole conditions on tool response and log quality

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

Text book [TB]:
2. M.H. Rider; The geological interpretation of well logs; French Consulting Limited; 2011.

Reference books [RB]:
2. George Asquith, Charles Gibson; Basic Well Log Analysis For Geologists; 1982.

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<tr>
<th>Subject Code</th>
<th>Subject Title</th>
<th>DRILLING FLUIDS AND CEMENTS</th>
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<td>PE213</td>
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Course Objective:
1. Become familiar with the various types of drilling fluid and cements and their uses, additives used in drilling fluid and cements.
2. Become familiar with the functioning of mud circulation system and different types cementing equipment and their operations.

Detailed Syllabus

UNIT 1: 8L
Types of drilling fluid, components of drilling fluid system: bentonite types and hydration characteristics

UNIT 2: 8L
Fluid-loss characteristics and characteristics of Filter cake

UNIT 3: 8L
Oil-base and Saline mud system. Additives used to control drilling fluid system

UNIT 4: 8L
Oil-well cements; composition, cement slurry components

UNIT 5: 7L
Cement-slurry preparation and down-hole displacement processes and system

List of Experiments
1. To find out plastic viscosity, yield point and gel strength using Fann Viscometer
2. To find of sand content in drilling mud
3. To find out mud weight of drilling fluid using Mud Balance
4. To find out Funnel Viscosity of drilling mud using Marsh Funnel
5. To determine Filter Cake and Fluid loss in drilling mud
6. To determine Resistivity of drilling mud
7. To determine surface tension and interfacial tension using surface tensionmeter

Learning Outcome
1. The student should be able to design the proper drilling fluids required to drill petroleum and natural gas wells for a given lithology and be able to examine the main properties of the designed drilling fluids.
2. Student should know how to design and test cement slurry and hard set cement required to complete the drilled petroleum and natural gas wells.
3. Understand the factors affecting drilling fluid and cementing performance.
4. Become aware of recent development in drilling fluid and cements selection.
5. Drilling cost optimization and safety control.

Text book [TB]:
1. RyenCaenn and HCH Darley; Composition and Properties of Drilling and Completion Fluids; GPP; 2011.
2. ASME; Drilling fluids processing; Elsevier; 2005.

Reference books [RB]:
2. Smith.P.K; Cementing; SPE Pulications; 1976.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

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<tr>
<th>Subject Code</th>
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<td>PE214</td>
<td>PETROLEUM PRODUCTION OPERATION – I</td>
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Course Objective:
1. To get familiarized with basic subsurface and surface production operations and equipment.
2. To understand typical problems during completion and production of a well and learn possible remedial measures to improve wellbore productivity.
3. To understand multiphase flow and Inflow Performance Relationship.

Detailed Syllabus

**UNIT 1**

**UNIT 2**

**UNIT 3**

**UNIT 4**

**UNIT 5**

Learning Outcome
The course provides an understanding of:
1. Production operation carried out in oil and gas industry.
2. Functioning of different production equipment.
3. Self-flow mechanism and characteristics of well.
4. Selection of best fit artificial life for candidate well.
5. Identification of production problems and its remedial measures.

Text book [TB]:
1. Thomas O. Allen & Alan P. Roberts; Production Operations Vol.- 1 & Vol. 2; Oil and Gas consultants international; 1982.
2. D. Perrin; Well Completion and Servicing; Technip; 1999.

Reference books [RB]:

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Course Objective:
The students will be able to:
1. Calculations on PVT analysis of the specific reservoir of various sands.
2. Estimation the reserves of various sands of the reservoir from different well data.
3. Calculate the formation damage and recovery factor from different drives and can propose suitable stimulation operations to reverse the lease.

Detailed Syllabus

UNIT 1
Reservoir rock properties: Measurement of Porosity, Permeability and Capillary pressure, interfacial tension measurement; evaluation. Parallel and series bed systems. Fluid saturation, effective and relative permeability, wettability, evaluations and significance.

UNIT 2
Reservoir Fluid System: Volumetric and phase behavior of multi-component oil/gas system. Formation volume factor for oil and gas, viscosity, reservoir fluid sampling, PVT properties: measurement, estimation and application.

UNIT 3
Fluid flow through Porous media: Darcy’s law, single and multi-phase system, linear, radial and spherical flow, steady state flow. Flow through fracture, GOR and WOR equations.

UNIT 4
Reservoir pressure determination: Pressure measurement techniques, Bottom hole pressure gauges, determination of reservoir pressure, significance.

UNIT 5

List of Experiments
1. To determine the effective porosity.
2. To determine the water separatability of petro oil.
3. To determine the permeability of the given core sample.
4. To determine the permeability of the given core sample.
5. To study the properties of core sample.
6. To plug the core of desired size from the rock sample.

Learning Outcome
1. To know in the basic concepts like PVT analysis for oil.
2. To be able to identify and design reservoir flow models.
3. To understand Material balance equation for oil reservoir, Darcy’s law and applications.
4. To understand Reservoir pressure determination and estimation for stabilized flow conditions.
5. To make them suitable as reservoir engineers for petroleum industry.

Text book [TB]:
1. L.P. Dake; Fundamentals of Reservoir Engineering; Elsevier Science; 1978.

Reference books [RB]:
2. Rene Cosse; Basic Reservoir Engineering; Editions Technip; 1993.

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<td>Aptitude and Soft Skills II</td>
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**Course Outline:** This module is focused on providing students more hands-on practice on aptitude problems and prepare a stronger fundamental base for Aptitude and Soft Skills III and IV. Employability skills will help students improve their employability.

**Course Objective:**
1. Prepare a ground for the students to be ready in Quantitative, Logical Aptitude and Verbal Aptitude
2. Prepare them for becoming confident and corporate-culture fit as present-day workplace requires professionals who are not only well qualified and competent but also possess Soft Skills like interpersonal skills and good presentation skills

**Course Pre/Co-requisite (if any):** Basic understanding of simplification and calculation tricks, non-verbal pattern completion LR, covered in Aptitude and Soft Skills I.

**Detailed Syllabus**

**UNIT 1: QUANTITATIVE APTITUDE**
Basic algebraic equations (linear equations in one variable), polynomials and Algebraic Inequalities; logarithm.
Quadratic Equations (concept of determinant, real, non-real, rational and conjugate roots); Geometry and Mensuration; Heights and Distances.

**UNIT 2: VERBAL APTITUDE**
Figures of speech; Determiners.
Creative Writing: Essay, Report Writing, Article, Letters, E-mail, difference between formal and informal tone, appropriate use of transition words, creating a signature, understanding different situations and the responses they require (situation-based writing), Proper use of connectors.

**UNIT 3: LOGICAL REASONING**
Input Output – Sequential output tracing of logical operations applied on machine input, Ranking and Order- Test - Ordering of measurable attributes like height / weight / performances, etc.
Eligibility test, Logical sequences and series, Completion of incomplete pattern, Odd figures or Odd man out, Analogies, Coding Decoding basics.

**UNIT 4: LEADERSHIP & TEAM BUILDING SKILLS**
Importance, How to develop Leadership Skills? Best Leadership & Team Building Examples.
**Suggested Activities & Exercises:** (i) Leadership Pizza, (ii) Minefield, (iii) Leaders You Admire.

**UNIT 5: EMPLOYABILITY SKILLS & CV WRITING**

**Suggested Activities & Exercises:** (i) Relevant Videos on ‘Employability’, (ii) Group Discussions on Newspaper Articles, (iii) Sample correction, (iv) writing exercise.

**Learning Outcome**

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018
1: Develop Leadership & Team Building Skills.
2: Receive hands-on guidance to develop an effective CV.
3: The students would be able to understand the basic trends of questions asked in the aptitude part of placements.

**Text book [TB]:**

3. Verbal Aptitude: English is Easy - Chetanand Singh, BSC Publication-2018

**Reference books [RB]:**

   Soft Skills: No Excuses – Dr Wayne Dyer, Hay House Inc.

<table>
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<th>Subject Code</th>
<th>Subject Title</th>
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<td>4 DC 3rd Semester V</td>
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Course Objective:
1. To develop better understanding of Geophysical and Geochemical methods for exploitation of Oil and Gas.

Detailed Syllabus

UNIT 1
Surface Indication of oil/gas accumulation: Accumulation Parameters, Regional and local structures. Time of generation vis-à-vis accumulation, Statistical analysis and spatial variations; grid survey model and economics; Magnetic survey: survey instruments Geo-magnetic anomalies, field methods, Data correction and reduction. Anomaly interpretation. Response for different type of geological structures.

UNIT 2
Geochemical methods of prospecting: micro seepage detection, Direct and Indirect methods of geochemical analysis; Radiometrics, Microbiological, Helium method, Ph/Eh method, Soil-chemical survey, source-rock characterization; Hydro-geochemistry as exploration tool. Plate tectonics and hydrocarbon accumulation.

UNIT 3

UNIT 4
Geological exploration processes: Sequence of operation. Field development: Prognostication of reserve; Geophysical Exploration Methods and their significance.

UNIT 5
Electrical methods – Introduction to Resistivity method, Resistivity surveys, Equipment for measurement, electrode layout and field procedure. Data acquisition and interpretation.

List of Experiments
1. To determine the free-air correction by measuring the gravitational acceleration at different elevations.
2. To determine the Bouguer gravity anomaly due to the offset of sediments along the fault.
3. Resistivity Sounding
4. Electromagnetic methods: EM conductivity
5. Magnetic Surveying
6. To study the different experimental geochemical methods for oil & gas exploration.

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Learning Outcome
1. This subject will assist students to delineate the subsurface features for exploration of oil and gas.
2. The Geochemical methods will assist in hydrocarbon correlation, maturity and classification of reserves.
3. The good concepts of geophysics will assist students in building better concepts of well logging.
4. The sound knowledge of this course will make student competent for better understanding of petroleum operation.
5. The student will learn about the prospect of oil and gas in India and abroad.

Text book [TB]:

Reference books [RB]:
3. Philip Kearey, Michael Brooks, Ian Hills; An Introduction to Geophysical Exploration; Wiley; 2013.

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Course Objective:
1. The objective of this course is to familiarize the students with the problems encountered during production and their remedial measures, and provide the knowledge of separation and storage facilities.

**Detailed Syllabus**

**UNIT 1**
8L
Sick Well Analysis; Water and Gas Shut Off: Extraneous Gas and Water Entry into Wellbore; Source Identification, and Control Measures.

**UNIT 2**
8L
Formation Damage: Sources, Effects, Mechanisms and Remedial Measures of Formation Damage; Corrosion and Scale Formation: Causes, Effects, Prevention, and Control Measures; Wax and Asphaltene; Control; Well Subduing; Well Activation.

**UNIT 3**
8L
Well Servicing and Workover: Introduction, Problem Identification, Workover Operations, Workover Equipment; Safety Procedures; Rig Selection; Rigless Intervention: Snubbing Unit and Coiled Tubing Unit; Workover Fluid; Planning and Economics.

**UNIT 4**
7L

**UNIT 5**
8L

**Learning Outcome**
1. To be able to identify and mitigate the problems encountered during production operations.
2. To be able to select, operate and maintain the separators in functioning condition.
3. To be able to select and operate the suitable storage facility for produced hydrocarbon.
4. To be able to perform well intervention jobs to improve productivity.
5. To understand the precautions and safety measures for wellsite jobs.

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Text book [TB]:
1. Thomas O. Allen & Alan P. Roberts; Production Operations Vol.- 1 & Vol. 2; Oil and Gas consultants international; 1982.

Reference books [RB]:
1. D. Perrin; Well Completion and Servicing; Technip; 1999.

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<th>PE303</th>
<th>Subject Title</th>
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**Course Objective:**

1. To introduce students to the crucial role of piping engineer in turn key projects and to make students understand the approval drawings and execute the work adhering to procedures and standards.

**Detailed Syllabus**

**UNIT 1** 8L

**UNIT 2** 8L
Types Of Fittings and Valves, Pipe Bends Branch Connections, Reducers, Offset Calculation, Stub Ends And Types, Application Of Stub Ends, Fabricated Branch Connections, Welding Minimums For Stub In, Branch Reinforcements, Types Of Flange And Couplings, Dimensioning, Minimum Pipe Requirements, Screwed And Socket Weld Fittings – Drawing Representations, Dimensioning Exercises, Pipe Color Coding

**UNIT 3** 8L

**UNIT 4** 8L

**UNIT 5** 7L
Types of Corrosion, Prevention strategies – design and coatings, Inhibitors, design of corrosion resistance alloys, anodic protection, Biological aspects of corrosion

**Cathodic Protection** - Principles and classification, design aspects for cathodic protection, influencing factors and monitoring,

**List of Experiments/Drawing Sheet:**

1. Drawing of Piping Components, Piping Fittings, Types of Flanges Types of Valves, Speciality Items.
3. Design of piping layout, pump piping, compressor piping system.
7. Drawing and design of on/offshore pipeline.
8. Detail Drawing of Piping & Instrumentation diagram with all the accessories.
9. PIPE STRESS ANALYSIS using CAESAR II software.

**Software Designing:**

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1. AutoCAD: Drawing Creation (P&ID, PFD, Layouts, and all fabrication Drawings)
2. PIPE STRESS ANALYSIS - CAESAR II:

Learning Outcome
By the end of the course students should be able.
1. Understand pipe fittings, selections, drawings and dimensioning
2. Understand the piping fundamentals, codes and standards
3. Understand pipe fittings, selections, drawings and dimensioning, and pipe material specifications.
4. To be able to design the piping outlay and construction.
5. To understand the regulations and standards related to pipeline system.

Text book [TB]:

Reference books [RB]:
2. M. Mohitpour, H. Golshan and A. Murray; Pipeline design and construction: A practical approach; ASME; 2006.

<table>
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<tr>
<th>Subject Code</th>
<th>PE304</th>
<th>Subject Title</th>
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Course Objective:
- The objective of enhanced oil recovery (EOR) is to give an insight of processes beyond primary and secondary recovery.

Detailed Syllabus

UNIT 1 9L
Principles and Mechanism. Screening criteria, Macroscopic displacement of fluids: Areal sweep efficiency. Vertical sweep efficiency Displacement efficiency, mobility ratio, well spacing.

UNIT 2 9L
Water flooding in reservoir: Equation of motion. Continuity, solution methods, Pattern flooding, recovery etc., permeability heterogeneity.

UNIT 3 7L
Chemical flooding: Polymer flood; mobility control in-situ permeability modification, foam flooding; WAG process. Surfactant flooding, miscellar/polymer flooding, micro emulation phase behavior, wettability modification, Alkaline flooding.

UNIT 4 7L
Miscible displacement processes – miscibility condition, high pressure gas injection, enriched gas injection, LPG flooding, carbon dioxide flooding, alcohol flooding.

UNIT 5 7L
Thermal Recovery processes: Hot water flooding, steam flooding, cyclic steam injection, in-situ combustion, air requirement; combustion front monitoring, microbial oil recovery.

Learning Outcome
1. The students should know basic reservoir and production engineering of gas reservoirs, oil reservoirs, and PVT of gas condensate reservoirs.
2. The students will able to understand Significant developments and economics of EOR technology
3. The student will able know about Gas Injection and Thermal Recovery process.
4. To understand and apply Chemical Flooding method to candidate well.
5. To understand and apply pattern flooding method to the field.

Text book [TB]:
2. Marcel Latil; Enhanced Oil Recovery; Technip; 1980.

Reference books [RB]:
1. Erle C. Donaldson, George V. Chillingarian, The fu yen; Enhanced Oil Recovery fundamentals and analyses; Elsevier; 1985.
2. Green D W and Willhite G P; Enhanced Oil Recovery; SPE; 1998.

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<th>Subject Code</th>
<th>PE306</th>
<th>Subject Title</th>
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Course Objective:
To understand and apply the basics of calculations related to material and energy flow process in the interacting systems.

Detailed Syllabus

UNIT 1  
8L
Heat Transfer Modes: Conduction, Convection And Radiation; Basic Concepts of Conduction In Solids; Liquids And Gases; Fourier Law of Heat Conduction; Material Properties of Importance In Heat Transfer: Thermal Conductivity, Specific Heat Capacity. General Equation of Heat Conduction Through Plane And Composite Walls; Cylinders and Spheres Critical and Optimum Insulation Thickness

UNIT 2  
8L
Convection: Principle of heat flow in fluids and concept of heat transfer coefficient; Individual and overall heat transfer coefficient; Heat transfer between fluids separated by a flat solid wall; Heat transfer between fluids separated by a cylindrical wall; Enhanced heat transfer: concept of fins; Fin efficiency; Forced Convective Heat Transfer; Heat Transfer by Natural Convection.

UNIT 3  
7L
Heat Exchange Equipment: Construction Details; Operating Characteristics: Shell & Tube; Double Pipe; Plate & Frame Heat Exchangers; LMTD Correction Factor; Individual Heat Transfer Coefficient.

UNIT 4  
8L
Radiation heat transfer: Laws of Radiation; Shape factor; Radiation heat exchange between two long parallel plates and concentric cylinders, Radiation shield. Boiling; Boiling regimes; condensation; dropwise and film wise condensation

UNIT 5  
8L
Evaporators: Concentration; Foaming; Degradation Due To High Temperature; Scaling; Natural Circulation Evaporator; Forced Circulation Evaporator; Falling Film Evaporator; Performance Of Steam Heated Tubular Evaporators; Capacity And Economy; Boiling Point Elevation.

List of Experiments:
1. To determine the thermal conductivity of insulating material (powder) using sphere in sphere method.
2. To evaluate the thermal conductivity of metallic rod using thermal conduction method. Also, determine the temperature gradient along the length of rod.
3. To determine the Stefan Boltzmann constant.
4. To determine emissivity of radiating surface.
5. To determine the natural heat transfer coefficient from the surface of the tube in both horizontal and vertical position.
6. To determine the temperature distribution along the given fin for constant base temperature under natural convection conditions.

Learning Outcome
1. After successfully completing this course, the student will understand the basic laws of heat transfer.

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2. Account for the consequence of heat transfer in thermal analyses of engineering systems.
3. Understand the fundamentals of convective heat transfer process.
4. Evaluate heat transfer coefficients for natural and forced convection.
5. Analyze heat exchanger performance by using the method of log mean temperature difference.

Text book [TB]:

Reference books [RB]:

Humanities Electives II

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<th>Subject Code</th>
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Course Objective

- The objective of this course is to familiarize B.Tech. Students with the roles, responsibilities, and skills required of modern managers.
- This course will present the concepts of management as it applies to current thinking in the workplace.

Unit 1 Overview of management

5 Hrs.
Definition-Management-Role of managers-Organization and the internal and environmental factors – Trends and Challenges of Management in India.
Directing – delegation –span of control– communication, Controlling

Unit 2 Management Information

4 Hrs.
Introduction to functional areas of management, Operations management, Human resources management, Marketing management, Financial management

Unit 3 Planning Approach to Organizational Analysis

10 Hrs.
Design of organization structure; job design and enrichment; job evaluation and merit rating

Unit 4 Motivation and Productivity

7 Hrs.
Theories of motivation, Leadership styles and Managerial grid. Co-ordination, monitoring and control in organizations. Techniques of control; Few Cases on current management issues in India

COURSE OUTCOME:

- To present the topics in management, management theories, while at the same time focusing on practical applications in the real world especially for engineers.
- Evaluate the global context for taking managerial actions of planning, organizing and controlling.
- Assess global situation, including opportunities and threats that will impact management of an organization.
- Integrate management principles into management practices.

TEXT BOOKS:

1. Schermerhorn, Management and Organisational Behaviour essentials, Wiley India
4. A V Rau: Management Science, BSP, Hyderabad
6. Stephan R Robbins Fundamental of Management, Pearson

REFERENCE BOOKS

- Mahadevan, B., Operations Management, Theory and Practice, Pearson Education Asia, 2009

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Humanities Electives II

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Course Objective:
- To provide the basic overview of economics in engineering perspectives.
- To increase the understanding of students to solve the engineering problems through economic theories.
- To increase the understanding of students to use economics theories in project investment of industries.

Unit 1 General Overview of Economics
6Hrs.
Nature and Scope of Economics in engineering perspective; Theory of Demand Analysis: Meaning and Types, Law of demand, Exceptions to the Law of Demand, Elasticity of Demand; Theory of Supply Analysis: Law of Supply and Elasticity of Supply; Mathematical Explanation on cost, revenue and profit function

Unit 2 Production Function and Its Applications
6Hrs.
Production Function: Short-run and long-run Production Function; Mathematical Explanation: Laws of Returns to Scale & Law of Diminishing Returns Scale; Concept of Cost and Its Types: Total cost, fixed cost, variable cost, average variable cost, average fixed cost, marginal cost, explicit and implicit cost; Break-Even Analysis: Importance and graphical presentation, mathematical problems

Unit 3 Time Value of Money and Project Evaluation
8Hrs.

Unit 4 Banking and Finance
6 Hrs.

COURSE OUTCOME
- Students will be able to apply economic principles and calculations to solve engineering projects.
- To students will be efficient to get the idea of production activities and its applications in industries.
- Students will be competent to estimate the present and future value of money on their various investment plans.
- Develop the ability to account for time value of money using engineering economy factors and formulas, as well as the implications and importance of considering taxes, depreciation, and inflation.

TEXT BOOKS

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

REFERENCE BOOK

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<tr>
<th>Subject Code</th>
<th>Subject Title</th>
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<td>HS382</td>
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Humanities Electives II

Course Objective
- The focus of the programme is on the interaction between literature & Society, and Literature and visual culture
- To discuss how Literature reacts to major changes in society

Unit 1
4Hrs.

Unit 2
7Hrs.
Approaches to the Study of Literature, Reader response to the study of Literature, Interpretation, Appreciation, Evaluation, Special problems in understanding Modern Literature.

Unit 3
9Hrs.
Social dimension of language. problems of multilingual communities, dominance and conflict, shift and attrition, language and the state, language and nation, Indian multilingualism, language variation, language and identity, linguistic prejudice and inequality, standardization, linguistic determinism, critical discourse analysis, and methodological issues.

Unit 4 TEXT
6 Hrs.
Jerome K Jerome: Three Men on a Bummel (selection), Martin Amis: Last Days of Muhammad Atta, Li Ho: A Girl Comb her hair, R.K. Narayan: Malgudi Days (selection)

COURSE OUTCOME
- Students will read critically from a variety of genres, specifically poetry, drama, non fiction, and fiction.
- Students will read literature more carefully and meaningfully, practicing close-reading skills.
- Students will understand the relation between historical and cultural contexts.
- The students will develop a critical understanding of how literature can both uphold and resist existing structures of power.

TEXT BOOKS
2. R.K. Narayan: Malgudi Days (selection), Indian Thought Publications

REFERENCE BOOKS
- Robe Pope, An Introduction to Language Literature and Culture. Routledge, 2005

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Course Outline: The first step of an intensive two-step placement training module equips the students to successfully handle the placement program of any on-campus/off-campus company. It not only provides career guidance about the selection process but also helps students in profile building; self-introduction and proactive internship search techniques.

Course Objective:

1. Interpret the questions of aptitude building objectively and prepare for various competitive examinations
2. Understand the optimized approach of dealing with placement questions
3. Learn ways of representing themselves effectively in formal settings

Course Pre / Co-requisite (if any): Understanding of writing concepts, general intelligence of LR, algebra concepts and equation formation, time management and presentation skills covered in Aptitude and Soft Skills I and II.

Detailed Syllabus

UNIT 1 - QUANTITATIVE APTITUDE

Number System 03 L
Types of numbers; Factors; Divisibility test; Place and face Value; Base system; Remainder theorem; digits at the unit places and finding last two digits in a given expression; Calculating number of zeroes, Finding maximum power of any prime number or any composite number in any factorial, HCF and LCM.

Fractions–Types of fractions; Conversion of terminating and non-terminating types of decimal into fraction; Subtraction, addition and multiplication of terminating and non-terminating decimals.

Percentage 02 L
Basic concepts; Conversion from fraction to percentage; Application of percentage in – Expenditure, Cost, Consumption problems; Population increase or decrease problems; Production, Manpower and Working hour problems; successive increment or decrement; Comparison of salary or numbers; Percentage change in area or volume, etc.

Ratio and Proportion 02 L
Ratio, Proportion and Variation: Ratio- Introduction; Types of ratios; Comparison of Ratios; Concept of duplicate, triplicate, sub-duplicate and sub-triplicate ratios. Proportion and variation – Concept of direct, inverse, continuous and mean proportions.

Profit and Loss 02 L
Introduction; Concept of single, double and triple discount and marked price.

Simple / Compound Interest 02 L
Simple Interest and compound Interest: Basic concept of Principal, Time, Amount and Rate of Interest; Concept of Lent money.
## UNIT 2- VERBAL APTITUDE 09 L

<table>
<thead>
<tr>
<th>Tenses</th>
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<tbody>
<tr>
<td>Understanding and aligning them with the various question types.</td>
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<table>
<thead>
<tr>
<th>Subject – Verb Agreement</th>
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<tbody>
<tr>
<td>Subject-Verb Agreement: Rules and Applications; commonly confused words-II; Gerunds, Active and Passive voice.</td>
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<tr>
<th>Question Types</th>
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<tbody>
<tr>
<td>Introduction to Question types-I: Fill in the blanks, One word Substitution, Spellings, understanding the right word choice, concept of para jumbles and para completion, reading comprehension, verbal analogies, odd man out, phrases and idioms.</td>
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</tr>
<tr>
<td>Introduction to Question types-II: Error identification, Homophones, Usage of the various figures of speech, commonly confused words and phrases, techniques for tackling synonyms and antonyms.</td>
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<table>
<thead>
<tr>
<th>Reading Comprehensions</th>
<th>02 L</th>
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<tbody>
<tr>
<td>Comprehension: Basics of Comprehensions, different tones of comprehensions, cracking question types like contextual vocabulary, fill in the blanks, true/false questions, reference to context, summary and title of the passage, paraphrasing the text.</td>
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## UNIT 3- LOGICAL REASONING 10 L

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<th>Coding Decoding and Sequences</th>
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<tr>
<td>Coding Decoding, Cryptarithmetic, Sequence and Series - Finding the missing term/wrong term in the logical sequence of letter/number/word/alphanumeric, Continuous pattern series.</td>
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</table>

<table>
<thead>
<tr>
<th>Verbal Analogies and Odd man out</th>
<th>02 L</th>
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<tbody>
<tr>
<td>Verbal Analogy based on various parameters - Antonym / synonym relationship, Quantity and unit, Individual and Group, Product and Raw material, cause and Effect etc.</td>
<td></td>
</tr>
<tr>
<td>Odd man out based on several kind of relationship – Relationship based on meaning, functional relationship, even-odd or prime-composite, divisibility rule, etc.</td>
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<table>
<thead>
<tr>
<th>Blood Relation and Direction Sense</th>
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<tbody>
<tr>
<td>Indicating form / puzzle form / coding form, Direction Sense, Direction puzzles.</td>
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</table>

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<tr>
<th>Seating Arrangements</th>
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<tbody>
<tr>
<td>Arrangements – Linear / Circular / Distribution / comparison/ Floor and box arrangement /Quant based arrangements/ etc.</td>
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<tr>
<th>Critical Reasoning--I</th>
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<tbody>
<tr>
<td>Statement and assumptions, course of action, statement and conclusion, probably true/false.</td>
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</table>

## UNIT 4- NON VERBAL COMMUNICATION 04 L

| Types of Non Verbal Communication, Body Language-Exercises and Activities, Error Analysis & Feedback Sharing. |


Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018
UNIT 5 - ONLINE PROFILING & SOCIAL MEDIA ETHICS

Social Media ethics and etiquette, Do’s & Don’ts, LinkedIn Profile Development, Example Sharing, Feedback Sharing & Error Analysis.

Suggested Activities & Exercises: (i) Online Portfolio Creation, (ii) Fun Social Media Projects, (iii) LinkedIn profile development project with feedback sharing and error analysis

LEARNING OUTCOME:
By the end of this semester,
1. students will be able to perceive and analyse the requirements of placement trends as detailed information about the selection process would be provided by career guidance.
2. They will be more confident and will be able to develop a professional profile, both online and offline.

Text book [TB]:
3. Chetanand Singh; Verbal Aptitude: English is Easy; BSC Publication; 2018.

Reference books [RB]:
3. Nishit K Sinha; LR: Logical Reasoning and Data Interpretation for the CAT; Pearson India; 2016.

<table>
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<tr>
<th>Subject Code</th>
<th>PE351</th>
<th>Subject Title</th>
<th>Petroleum Refining and Petrochemicals</th>
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<tbody>
<tr>
<td>LTP</td>
<td>3 0 2</td>
<td>Credit</td>
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**Course Objective:**
- The course objective is to understand the basics of refining techniques, analyze the performances of the processes concerned, and optimize them.

**Detailed Syllabus**

**UNIT 1**  **8L**
Overview of Petroleum refining processes. Crude oil evaluation (Based on Residue, Based on Key Fraction, Based on Characterization factor and correlation index) Evaluation methods for petroleum products like LPG, gasoline diesel, kerosene, Lubricating oil etc. choice of crude types for a product mix, various products with their boiling range, Uses of petroleum products

**UNIT 2**  **7L**
Distillation system: pipe still heater, distillation column, heat exchangers, condenser, reflux control, pressure control; Atmospheric distillation system, vacuum distillation system.

**UNIT 3**  **7L**
Other refining processes: Visbreaking, Thermal cracking, catalytic Cracking, catalytic reforming, alkylation, isomerization, hydrocracking, hydorfinishing

**UNIT 4**  **9L**
Specialty products: Lube oil production, propane deasphalting, solvent extraction (Phenol Extraction, Furfural Extraction, Duo sol methods) dewaxing (Chilling and pressing, Propane Dewaxing, MEK Dewaxing etc.) coke and carbon black production (Delayed Coking and Fluid Coking), Types and Uses of coke.

**UNIT 5**  **9L**
Status of Petrochemical industry in India, Main Building blocks of petroleum industry, Different chemical obtained from main building blocks, Petro-chemical feed stock: BTX, olefins Production: (Steam Cracking) method ethane and butane treated products from natural gas, Synthesis gas production, Storage and safety measures: Floating roof tanks, spherical storage vessels; fire safety measures.

**List of Experiments**
1. Study of ASTM distillation characteristics of various fuel
2. To study determination of Calorific Value of Fuels
3. Determination of flash point of oil sample using Abel Apparatus
4. Determination of flash point and fire point of a given oil sample using Cleveland Open cup Apparatus
5. Determination of % carbon residue content in Lubrication Oil
6. Determination of drop melting point of grease
7. Determination of pour & cloud point temperatures of samples
8. To determine the kinematic viscosity and absolute viscosity of the given lubrication oil using Redwood Viscometer-I
9. To determine the kinematic viscosity and absolute viscosity of the given lubrication oil using Redwood Viscometer-II
10. To determine the kinematic viscosity and absolute viscosity of the given lubrication oil Saybolt Viscometer
11. Determination of flash point of oil sample using Pensky Martens Apparatus
12. ASTM Distillation

*Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018*

**Learning Outcomes**
1. The students will be able to get an overview of the petroleum refining processes.
2. The students will become exposed to information on distillation and refining processes of crude oil.
3. The students will get an idea about the midstream processes and their functioning.
4. Students will understand the role of catalyst and operating parameters in the refining process.
5. Students will be aware about uses of various petrochemicals, their production and consumption pattern.

**Text book [TB]:**

**Reference books [RB]:**

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<th>Subject Code</th>
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Course Objective:
1. The course shall enable students to impart the knowledge of fundamentals of well testing along with the field operations of data acquisition, data processing and interpretation to obtain the desired parameters.

Detailed Syllabus

UNIT 1 8L
Objectives of Pressure Transient Testing; Types of Pressure Transient Tests; Flow of compressible fluid through porous media: Steady state, Unsteady state, Semi-steady State Fluid Flow Equations; Diffusivity Equation; Solutions to Diffusivity Equation; Horner’s Approximation.

UNIT 2 8L
Ideal Pressure Build-up Test: Assumptions and Equations; Pressure Build-up Test Analysis: Permeability, Skin Factor, Initial Reservoir Pressure and Reservoir Drainage area; Actual Pressure Build-up Test; Effects and Duration of Afterflow; Well Damage and Stimulation; Gas Well Build-up Test Analysis.

UNIT 3 8L
Pressure Draw-down Test: Objectives, Assumptions and Equations; Constant Rate Drawdown Test Analysis: Formation Permeability, Skin Factor, Wellbore Storage, Reservoir Pore Volume and Radius of Investigation; Varying Rate Drawdown Test Analysis; Multirate Drawdown Test Analysis.

UNIT 4 8L
Fundamentals of Type curves; Ramey’s Type Curve; McKinley’s Type Curve; Gringarten et al Type Curve; Drawdown Test Analysis Using Type Curves; Pressure derivative; Gas well testing: Flow After Flow Test, Isochronal Test, Modified Isochronal Test.

UNIT 5 7L
Drill Stem Testing; Reservoir Limit Test; Injection and Fall-off Test; Interference Test; Pulse Test.

Learning Outcome
1. To be able to identify and select the suitable method of well testing.
2. To be able to identify and obtain the parameters for each testing method.
3. To understand the basic equation for fluid flow and its solutions.
4. To understand the field operations for well test data acquisition and processing.
5. To be able to interpret and use the well test data to meet the operational objective.

Text book [TB]:

Reference books [RB]:
1. Dominique Bourdet ; Well Test Analysis: The Use of Advanced Interpretation Models; Elsevier; 2002.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

<table>
<thead>
<tr>
<th>Subject Code</th>
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<th>Petroleum Engineering System Design</th>
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### Course Objective:
1. This course shall make a student competent in designing a drilling rig system including the various system employed to drill a well optimally.

### Detailed Syllabus

#### UNIT 1
- **8L**
- Selection and Design of Drilling Rig: Environmental Load, Power System, and Operating System (Hoisting, Rotary, Circulating System); Selection and Design of Drill String and casing.

#### UNIT 2
- **8L**
- Directional Well Planning; Directional Tools; Well Path Correction; Directional Well Profile Selection and Design; Directional Well Surveying Methods and Data Analysis; Well Economics; Cased and Perforated Well Performance: Total Perforation Skin.

#### UNIT 3
- **7L**

#### UNIT 4
- **8L**

#### UNIT 5
- **8L**

### Learning Outcome
1. The student will be able to identify different designing aspects of a drilling rig.
2. The student will be given an insight into the casing integrity aspects.
3. To be able to write different design equations for different practical situations.
4. To be able to select and design the surface separation equipment.
5. To be able to select, design, operate Artificial lifts and its components.

### Text book [TB]:

### Reference books [RB]:
1. H. Dale Beggs; Production optimization; OGCI and Petroskills publications; 2003.

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<tr>
<th>Subject Code</th>
<th>PE354</th>
<th>Subject Title</th>
<th>Petroleum Field Instrumentation and Control</th>
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<tbody>
<tr>
<td>LTP</td>
<td>3 0 2</td>
<td>Credit</td>
<td>DC Year 3rd Semester VI</td>
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</table>

Course Objective:
1. Objective of this course is to disseminate knowledge about fundamentals of instrumentation & control system and to develop understanding of various measuring instrument i.e. Temperature, pressure, viscosity, specific gravity, flow rate & their construction and working principle.
2. Students learn about types of controller, various control system, their mechanism and application of Instrumentation and control system in petroleum field operation.

Detailed Syllabus

UNIT 1

UNIT 2
Introduction to controllers and final control element, Principles of pneumatic and electronic controllers and mechanism of control system & block diagram, Mechanism of controllers, Mechanism of control valves, Dynamic behavior of controllers

UNIT 3

UNIT 4
Control systems with single loops: Feedback control systems with examples. Control systems with multiple loops: cascade control, selective control systems and split-range control with examples. Feedforward and Ratio Control with examples. Control of distillation column: control of composition and pressure. Microprocessor-based controllers: Introduction to PLC’s and DCS.

UNIT 5

List of Experiments
1. ON-OFF Controller of Thermal Process
2. Simulation of proportional controller
3. Flow Control loop and Flow transmitter
4. Level Control loop and Level transmitter
5. Pressure Control loop and Pressure transmitter
6. Characteristics of control valve
7. Verifying the response of Non-interacting level system
8. Verifying the response of Interacting level system.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

1. Level Control Trainer
2. Pressure Control Trainer
3. Temperature Control Trainer
4. Flow control Trainer

Learning Outcome
1. Students gain knowledge about fundamentals of Petroleum Field Instrumentation and Control system
2. Students become familiar with working principles of different measuring instruments and controllers
3. Students will able to draw a Process & Instrumentation Diagram and devise simple but effective plant wide control strategies using appropriate methods.
4. Understand about the interacting and non-interacting response system.
5. Be able to differentiate between PLC, SCADA and DCS.

Text book [TB]:
2. Stephanopolous, G; Chemical Process Control: An Introduction to Theory and Practice; Prentice Hall of India; 2009.

Reference books [RB]:
3. Eckman, D.P.; Industrial Instrumentation; Wiley Eastern; 1952.

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<tr>
<th>Subject Code</th>
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<th>Health Safety and Environment in Petroleum Industry</th>
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Course Objective:
The primary objective of this course is to inculcate the safety culture in personal and professional life.

Detailed Syllabus

UNIT 1 8L
Well Integrity & Environmental control: Mechanism of cement set failures, Improved cementing for annular integrity, integrity of injection wells, sustained casing pressure, rig less and rig intervention for SCP isolation. Well barriers and verification during drilling & production operations (NORSOK 10D).

UNIT 2 8L
Environmental control of drilling fluids and produced water: Control of drilling fluid toxicity, testing and low toxicity substitutes, SBM, cuttings disposal and de-oiling. Health hazard, Toxicity, physiological, asphyxiation, respiration and skin effects when using completion fluids. Effect of sour gases (H2S and CO) on human health.

UNIT 3 8L

UNIT 4 8L
Well control during drilling, completion and production operations, containment and casing design, relief well planning, oil spill and response management, Manual and automatic shutdown systems, blow down systems. Gas leakage, fire detection and suppression systems.

UNIT 5 7L
Control of atmospheric, aqueous emissions in refineries. Soil and groundwater protection during petroleum operations. Control of solid wastes, treatment and disposal, recycling to minimize waste and re-use.

Learning Outcome
After completion of this course, the students will be able to,

1. Comprehend different industry hazards and plane safety.
2. Recognize modes of transportation of oil and gas, and safety measures in transportation
3. Realize procedure of safety auditing and prepare safety reports
4. Apply concepts of risk analysis to develop probabilistic assessment.
5. Be aware of the waste treatment and disposal.

Text book [TB]:
1. OrzuOrszulik; Environmental Technology in oil Industry; Springer; 1996.
2. Reis, J.C.; Environmental control in Petroleum Engineering; Gulf publications; 1998.

Reference books [RB]:
2. C V Efobi; Site safety handbook for the petroleum industry; Partridge Publishing; 2015.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

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<td>Offshore Oil and Gas Drilling and Production Operations</td>
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### Course Objective:
1. To develop good understanding of various offshore drilling and production operations along with the challenges associated with it.

### Detailed Syllabus

#### UNIT 1
5L
Sea states and weather; Meteorology, oceanography & physical & biological features. Met ocean, Sea States and Environment; Air masses, Cloud, Wave, Tide, Sea Ice, Wave currents, squalls, wave condition; Wave-structure Interaction. Sea-bed soil condition, soil strength, Soil sampling via geotechnical & geophysical tools.

#### UNIT 2
6L
Off-shore structures for Drilling, Production and Storage; Classification of structures on the basis of their operation and buoyancy, Description and Installation, Station keeping, Mooring and Dynamic positioning. Offshore installation, wellhead & production platform.

#### UNIT 3
6L
Off-shore drilling; Unique challenges in offshore drilling like reduced fracture gradient, narrow Pore pressure fracture gradient, varying drilling mud density due to temperature and pressure, gas solubility etc, Well head and riser, sea floor connections & connector load envelopes, common subsea connectors and gaskets; Riser & Conductor & fatigue analysis, axial and lateral loading. Off-shore well completion: Platform and subsea completion system, well control and work-over system.

#### UNIT 4
5L
Sub-sea layouts of subsea systems; Subsea equipment; horizontal and vertical trees, umbilical, flow-lines & pipelines, manifolds, templates and tie back system to Host facility and production riser systems. Use of Divers and Robots and ROV systems. Off-shore production; Platform oil and gas processing concepts, water and gas injection system.

#### UNIT 5
5L
Storage for Oil; SPM & SBM system. FLNG systems, Major components like Turret, topside, hull & marine and offloading systems. FLNG challenges, ballast control and stability, space and station keeping using turret system for FPSO/FLNG.

### Learning Outcome
1. A good understanding of this subject will assist in analysis of environmental loads on different platform and suitable platform selection.
2. The well control and rheological challenges associated with offshore.
3. The application of riser system and well head selection for different platforms.
4. Production monitoring through SCADA.
5. Transportation and storage of hydrocarbons in offshore.

### Text book [TB]:

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

Reference books [RB]:
1. Mohamed A El-Reedy; Offshore Structures: Design Construction and Maintenance; Gulf professional Publication; 1968.
Course Objective:
1. To understand the geographic distribution of unconventional hydrocarbon resources and to understand characterization of source and reservoir rocks.

Detailed Syllabus

UNIT 1
Introduction to Unconventional Energy Resources; Occurrence; Economic Significance Of Each Technical; Economic; Political; Environmental Constraints On Development.

UNIT 2
Hydrocarbon Origin; Hydrocarbon Migration; Hydrocarbon Entrapment; Importance In Unconventional Reservoirs; Origin, Occurrence, And Predictability; Fracture Effects On HC Storage, Porosity, And Permeability; Permeability Anisotropy; Coning; Breakthrough; Boundaries.

UNIT 3
Roles In Exploration; Roles In Reservoir Management: Primary And Enhanced Recovery; In-Situ Stress - Importance In Unconventional Reservoir Performance; Classification Of Fractured Reservoirs.

UNIT 4
Low-Permeability (Tight) Sands: Occurrences, Resources, Reservoir Characteristics; Drilling And Completion Methods; Facilities, Reservoir Management, Limitations On Development, Present Activity; Coalbed Gas: Occurrences; Resources; Reservoir Characteristics; Drilling And Completion Methods; Facilities, Reservoir Management, Limitations On Development, Present Activity; Water And Environmental Issues.

UNIT 5
Shale Reservoirs (Gas And Oil): Occurrences; Resources; Reservoir Characteristics; Drilling And Completion Methods; Facilities, Reservoir Management; Limitations On Development; Water And Environmental Issues; Heavy Oil: Occurrences; Resources; Reservoir Characteristics; Drilling And Completion Methods; Limitations On Development; Environmental Issues.

Learning Outcome
At the end of the course, the student will be able to
1. Recognize and apply the concept of continuous accumulation system.
2. Apply the concepts related to exploration and development of Shale Gas Reservoirs
3. Apply the concepts related to exploration and development of Coal Bed Methane.
4. Understand and apply the concepts related to formation of gas hydrates.
5. Understand and apply different conversion processes for the production of hydrocarbons.
6. Demonstrate awareness related to environmental issues involved in the development of non-conventional hydrocarbon resources.

Text book [TB]:

3. Pramod Thakur, Steve Schatzel and KashyAminian; Coal Bed Methane: From Prospects to Pipeline; Elsevier; 2014.

Reference books [RB]:

<table>
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<tr>
<th>Subject Code</th>
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Course Objective:
1. To disseminate knowledge about various modes of transportation of Oil and Gas, Challenges associated with transportation.

Detailed Syllabus

**UNIT 1** 6L
Road and Rail Transport of Crude Oil & Product; Tanker Design, Safety Features, Oceanic Transport of Oil and Liquefied Natural gas; Design of Ocean Going Tankers and Safety Features

**UNIT 2** 5L
Pipe Line Transport of Oil and Gas; Route Selection, Pipe line Construction Process and Equipment: Trenching, aligning, Connecting Pipes, Corrosion Protection, Lowering & Back filling.

**UNIT 3** 6L
Flow of oil and Gas through Pipelines; Pressure Drop Calculation in Series and Parallel, Types, Sizing and location of Pumps and Compressor, Instrumentation and Control.

**UNIT 4** 5L
Flow Measurement and Control Arrangement; Corrosion in Pipelines, Types, Chemical and Electrochemical process; Coating, Cathodic protection principle and design. Pigs and it’s application for pipeline cleaning and maintenance.

**UNIT 5** 5L
Pipe line branching; Gas distribution control, Offshore pipe line; Sag and overbend; stinger and riser, under-water welding

Learning Outcome
1. A good knowledge of this course will enable student to design tankers and pipeline for transportation of oil and gas.
2. To enable students in route selection and pressure loss calculations in laying the pipelines.
3. To determine the auxiliary equipment required for the transportation of oil and gas.
4. To identify corrosion and its protection methods.
5. To control pipeline branching and gas distribution.

Text book [TB]:
2. M. Mohitpours, H. Golshan and A. Murray; Pipeline design and construction A practical approach; ASME; 2006

Reference books [RB]:
1. George A. Antaki; Piping and pipeline engineering; Marcel Dekker Inc.; 2003.
2. J. Vincent Genod; Fundamentals of pipeline engineering; Technip; 2003.

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**Course Outline:** Aptitude and Soft Skills IV is the final step of the programme, designed to enhance the analytical and interpersonal skills of students, making them ready to face various placements and interviews. It also helps them learn various personality development techniques by enhancing their GD and PI skills. The Mock Placement Drive will test and improve students through Feedback Sharing & Error Correction.

**Course Objective:**
1. Align themselves with the placement requirements and their needs
2. Learn analytical and employability skills
3. Prepare students for job placements so that they could clear the selection process successfully and give them strategies and skills to crack GD as well as PI to get selected with decent job offers

**Course Pre/Co-requisite (if any):**
1. Understanding grammar, number system, arithmetic, and analytical reasoning concepts covered in Aptitude and Soft Skills III
2. Professional profile building and Self introduction

**Detailed Syllabus**

**UNIT 1: QUANTITATIVE APTITUDE 11 HOURS**

- **Partnership 02 hours**
  Introduction & types; Speed, Distance and Time: Average Velocity; Race tracks - Straight and Circular; Trains; Boats and Streams.

- **Time and Work 02 hours**
  Basic concepts (relationship between men, days and work); Understanding group efficiency; Alternate work; Negative work; Wages; Pipes and Cisterns.

- **Permutation and Combination 02 hours**
  Basic Principles of Counting (Addition and Multiplication); Arrangements around - Circular, Square and Rectangular tables and in straight lines, circular permutation, selection, distribution.

- **Probability 02 hours**
  Introduction, various types of events; Classical definition of probability; Random and Discrete variables; Bayes’ Theorem and question types.

- **Data Interpretation 03 hours**
  Introduction; Different ways of representing data - Narration based, pictorial, pie chart, Bar graph, line charts; various questions based upon them.

**UNIT 2: VERBAL APTITUDE 09 HOURS**

- **Cloze test 02 hours**
  Intricacies of cloze test, correct use of specific adjectives, concept of sentence improvement, writing concept, auxiliaries and modals.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

Words 02 hours
Concept of consistency, precision, concision in terms of reading and writing, advance word choice with respect to placement papers, SAP (Subject-Audience-Purpose) approach.

Clauses 02 hours
Subordinate Clauses- The noun clause, the adjective clause, the adverb clause, Analysis of simple and complex sentences, prepositional phrases, transformation of sentences.

Vocabulary 01 hour
Revisiting vocabulary- high, medium and low frequency words, organization of ideas an thoughts in order to understand the text- The Pyramid Principle.

Questions 02 hours
Various test taking skills in accordance with the placement papers.

UNIT 3: LOGICAL REASONING 11 HOURS

Deductive Logic 03 hours
Premises and conclusion structure, Quality of deductive argument, Categorical arguments, Syllogism, Conditional Arguments- If..then, only if..then, If and only if , Either or.

Puzzles 02 hours
Grouping and selection, Double line up, Binary logic- truth teller-lie teller, Team formation and miscellaneous puzzles.

Set Theory and Critical Reasoning-II 03 hours
Union and Intersection of sets, Use of venn diagrams in problem solving with two, three, four set, concept of maxima-minima through Venn diagram.

Critical reasoning II: Statement and Inference, cause and Effects, Statement and Arguments- Strengthen or Weaken the argument, Statement Assertion and Reason.

Non-Verbal Reasoning 01 hour
Mirror-image, Water-image, Spotting out the embedded figures, Completion of incomplete pattern, Figure matrix, Paper folding, Paper cutting, Grouping of identical figures, Counting figures, Non verbal series / analogies / odd man out.

Data Sufficiency 02 hours
Data Sufficiency based on logical reasoning field like Coding-Decoding / Puzzle Test / Blood Relations / Mathematical calculations / clock / calendar / etc.

UNIT 4: SOFT SKILLS 08 HOURS

Group Discussion 04 hours
Importance, Do’s & Don’ts, Personality Traits, Tips and Strategies, Types of Group Discussions.
Suggested Exercises, Games & Activities: Mock Group Discussions (on basic topics), with feedback sharing and error analysis.

Personal Interview 04 hours
Importance, Do’s & Don’ts, Personality Interview, Tips and Strategies, Etiquette Rules.
Suggested Exercises, Games & Activities: Mock Personal Interviews (contd.) with feedback sharing and error analysis.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018
Learning Outcomes:
By the end of this semester, students will:
1. Be prepared for the upcoming placements and they will also be ready for other competitive exams.
2. Improve their GD and PI Skills and be able to have firsthand experience of a Placement drive and gain sufficient confidence to perform well.

Text book [TB]:
3. Chetanand Singh; Verbal Aptitude: English is Easy; BSC Publication; 2018.
4. P. N. Joshi; Soft Skills: Group Discussion on Current Topics; UpkarPrakashan; 2010.

Reference books [RB]:
5. Suzanne W. Woodward; Verbal Aptitude: Fun with grammar; Pearson Education ESL; 1996.

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>PE401</th>
<th>Subject Title</th>
<th>Reservoir Simulation</th>
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<td>Subject Category</td>
<td>DC</td>
<td>Year</td>
<td>4th</td>
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</table>

Course Objective:
Understand the basics of reservoir simulation and its bigger picture and to understand the physical and mathematical principles used in simulating the reservoirs.

Detailed Syllabus

UNIT 1 8L
Introduction & Overview: Definition, Objectives and applications of reservoir simulation with brief overview of the system, Steps of the reservoir simulation.
Model types: Physical, Analog and mathematical, Single-phase, Multi-phase in one, Two and Three dimension mathematical model for reservoir fluid flow, Grid blocks and Grid orientation.

UNIT 2 8L

UNIT 3 8L

UNIT 4 8L

UNIT 5 7L
Simulating special processes: Simulation of a reservoir using available commercial software for black oil, Briefly discuss other models such as compositional simulation, Miscible, Chemical and Polymer flooding, Thermal recovery processes, Capabilities and Limitations.

Learning Outcome
After completing this course the student will be able to
1. Understand and evaluate the basic data required for construction of a reservoir simulation model.
2. Develop awareness of the mathematical techniques at the back-end that are used in simulation.
3. Display knowledge of various types of boundary conditions and their impact in simulation.
4. Create a replica for reservoir environment.
5. Develop production plan for the field.

Text book [TB]:

Reference books [RB]:
2. J.R.Fanchi; Principles of Applied Reservoir Simulation; Gulf Publication; 2006.

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<thead>
<tr>
<th>Subject Code</th>
<th>Subject Title</th>
<th>Fluid Flow Through Porous Media</th>
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</table>

Course Objective:
1. The course shall enable the students to understand and analyze the flow regime and flow behavior of fluid in porous and permeable media.

Detailed Syllabus

UNIT 1
5L
Homogeneous and Heterogeneous System; Isotropic And Anisotropic System; Compressible, Slightly Compressible And Incompressible Fluids; Porous Media: Systematic Packing Of Spheres, Packing Of Natural Materials, Compaction Of Sand And Gravel, Compaction Of Clay.

UNIT 2
6L
Fluid Movement In Capillary Zone; Fluid Movement Below The Water Table, Occurrence Of Connate Water, Migration Of Connate Water, Migration And Accumulation Of Hydrocarbon; Equation Of Transport; Darcy’s Law; Generalized Form Of Darcy’s Law, Applications Of Darcy’s Law.

UNIT 3
6L

UNIT 4
5L
Steady-State Laminar Flow: Darcy’s Law using the analogy of the Poiseuille equation; Steady-State Non-Laminar Flow; Pseudosteady-State Flow conditions in a radial system.

UNIT 5
5L
Pressure Distribution Over An Infinite Array Of Wells, Central And Peripheral Flooding, Concept of Pattern Flooding, Model Experiments With Line Floods, Effect Of Barrier In Flooding System, Conductivity Of Direct Line Drive Flood, Five Spot Flood, Seven Spot Flood, Nine Spot Flood, Flooding Efficiencies, Flooding Networks.

List of Experiments
1. Determination of effective porosity by gas expansion method.
2. Determination of porosity and pore size distribution by BET.
3. Measurement of surface tension & interfacial tension with the ring Tensiometer.
5. Liquid viscosity measurement using capillary tube viscometer (Ostwald type).
6. Determination of capillary pressure of reservoir rock (core) using porous plate method.
7. Measurement of contact angle (between oil, water and solid surface) using imaging method.
8. Determination of relative permeability of oil-water using unsteady state method.
9. Absolute Permeability measurement of water.

Equipment/Instruments Required and need to be purchased
1. Helium Porosimeter
2. BET Surface analyser
3. Pycnometer
4. Capillary tube viscometer
5. Capillary Pressure cell
6. Goniometer/contact angle measuring device

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

7. Relative Permeability apparatus
8. Darcy Apparatus (Can be fabricated/bought)

Learning Outcome
1. To be able to understand the principle of fluid flow in permeable media.
2. To be able to flow geometries and flow behavior of Oil and Gas.
3. To be able to understand the flooding mechanism.
4. To understand the flow conditions in the reservoir.
5. To be able to flooding patterns and its applications.

Text book [TB]:

Reference books [RB]:
2. L P Dake; Fundamentals of Reservoir Engineering; Elsevier; 1978.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

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Course Objective:
1. The objective of this course is to explore complex systems through simple optimization, interpolation from the known to the unknown, linear algebra underlying systems of equations, ordinary differential equations to simulate systems, and stochastic simulation under random influences.

Detailed Syllabus

UNIT 1 6L
Errors and Finite Differences Error & their analysis, Computer arithmetic, Floating-point number operation. Finite differences: Difference operator, Difference tables, Factorial polynomials, Summation of series.

UNIT 2 6L
Interpolation Newton's formula, Gauss, Stirling's and Bessel's formula for equal interval, Lagrange's formula and Newton's divided difference formula for unequal interval.

UNIT 3 5L

UNIT 4 5L

UNIT 5 5L

Learning Outcome
After studying this course, you should be able to:
1. Understand of common numerical methods.
2. To understand their uses to obtain approximate solutions to otherwise intractable mathematical problems.
3. Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations.
4. Analyze and evaluate the accuracy of common numerical methods.

Text book [TB]:

Reference books [RB]:

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

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<td>Petroleum Equipment Design</td>
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</table>

Course Objective:
1. The objective of this course is to Enable the students to learn the methods and practices followed in the design of process equipment’s and to draw the equipment’s designed to scale.

Detailed Syllabus

UNIT 1
Design of distillation column, degree of freedom analysis, various design methods of distillation column, general design consideration of multicomponent distillation, plate efficiency, tray hydraulics of sieve and valve - trays.

UNIT 2
Basic design procedure of heat transfer equipment, overall heat transfer coefficient and dirt factors, shell and tube heat exchangers - construction details, selection algorithm, design codes, mean temperature difference, general design considerations, tube-side heat transfer coefficient and pressure drop, shell-side heat transfer coefficient and pressure drop.

UNIT 3
Design of condensers for single vapors, heat transfer coefficient correlations for condensation inside and outside of tubes of the vertical and horizontal condensers, pressure drop in condensers.

UNIT 4
Reboilers, vaporizers and evaporators - Pool boiling, convective boiling, selection of reboilers, and vaporizers, design of reboilers, vaporizers and evaporators, drawing of evaporators.

UNIT 5
Design of pressure vessel; Introduction of codes for pressure vessel design

Learning Outcome
After studying this course, you should be able to:

1. Apply the methods and practices followed in the design of process equipment’s and draw the process equipment’s used in chemical industries
2. Improve the ability of solving process design problems
3. Expose to the concept of detailed design and drawing of chemical process equipment.
4. Understand the codes of equipment design.
5. To know the operation and maintenance of equipment.

Text book [TB]:

Reference books [RB]:
Course Objective:
1. The objective of this course is to provide an integrated view of the fundamentals of polymer science and engineering, including the chemical structure of various polymers, methods of measuring the molecular weight, polymerization kinetics and reactors, rheological behavior, polymer processing technologies.

Detailed Syllabus

UNIT 1  7L
Introduction To Polymer Science: History of Polymeric Materials; Classification of Polymers; Configuration and Conformation of Polymers; Nature of Molecular Interaction in Polymers; Cumulative Interaction; Entanglement; Random Chain Model; Various Structures of Copolymer: Linear; Branched And Cross Linked Copolymer.

UNIT 2  5L
Crystal Morphologies: Extended Chain Crystals; Chain Folding; Crystallization and Crystallinity; Determination of Melting Point; Degree of Crystallinity.

UNIT 3  6L
Properties of Polymers: Physical Properties; Thermal Properties; Flow Properties; Mechanical Properties; Glass Transition Temperature ($T_g$) and Factors Affecting Glass Transition Temperature – WLF Equation.

UNIT 4  4L
Polymer Solution: Solubility Parameter; Properties of Dilute Solutions.

UNIT 5  4L
Nature and Structure of Polymers: Structure Property Relationships; Molecular Weight of Polymers; Molecular Weight Distribution; Determination of Molecular Weight.

Learning Outcome

After studying this course, you should be able to:

1. Isolate the key design features of a product which relate directly to the materials used in its construction.
2. Indicate how the properties of polymeric materials can be exploited by a product designer.
3. Describe the role of rubber-toughening in improving the mechanical properties of polymers.
4. Identify the repeat units of particular polymers and specify the isomeric structures which can exist for those repeat units.
5. Estimate the number- and weight-average molecular masses of polymer samples given the degree of polymerisation and mass fraction of chains present.

Text book [TB]:

1. G. Odian; Principles of polymerization; Wiley – Inter science; 1981.
3. Fred W. Billmeyer; Textbook of Polymer Science; Wiley publication; 1994.

Reference books [RB]:


Humanities Electives III

<table>
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<th>Subject Code</th>
<th>Subject Title</th>
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Course Objective
- To develop a broad base of knowledge in the various domains of psychology and its applications.
- To Synthesis and demonstrate of useful skills in the field of psychology namely areas of organization, society, stress management etc.

Unit 1  Role of Psychology in Understanding the Self  7Hrs.
Three Stages – Self awareness, Self acceptance and Self realization; Exploration through JOHARI Window; Development of Self-Mead & Cooley

Unit 2  Application of Psychology at Work Place  7Hrs.
Work Motivation: Theories and applications: Maslow, Herzberg, Goal Setting, Emotion: Emotional Quotient & Job Satisfaction, Early approaches to leadership, contemporary approaches to leadership- Transformational & Transactional Leadership, styles of leadership

Unit 3  Application of Psychology in Personal & Professional Excellence  6Hrs.
Achieving Success: Creativity & Innovation; Role of attitude; Role of competence; Role of Self-confidence; Time management; Role of Human Values

Unit 4  Role of Psychology in Health & Fitness  6Hrs.
Stress & Coping Strategies: Meaning, Types, Sources, Effects of stress on health, and coping strategies; Characteristics of a healthy personality

COURSE OUTCOME:
- The students will be able to understand basic concepts of psychology in major domains.
- The students will be able to apply the fundamentals of psychology in order to solve real life problems.
- The students will use scientific reasoning to interpret psychological phenomena.
- To apply ethical standards to evaluate psychological science and practice

TEXT BOOKS

REFERENCE BOOKS

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

Humanities Electives III

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<tr>
<th>Subject Code</th>
<th>Subject Title</th>
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<td>HS484</td>
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**Course Objective**

- To provide the basic understanding of intellectual property rights, the rationale behind making provision for these rights and the recent concerns in the field.
- To increase the attention of students to protect their IP though legal provision and also they can reduce the imitation rate.
- To increase the understanding of students to get their involvement in technology transfer and commercialization

**Unit 1 Introduction of IP** 5Hrs.
Public Funded Research and Its Implications in an Economy; Public Funded Research and Economic Development; Research & Development and Industrial Development

**Unit 2 Historical Perspectives of IPRs** 4Hrs.
History and concept of Property; Introduction to intellectual property rights (IPRs); Patent, Industrial design; Copyrights, Trademarks, Geographical Indications; Trade Secrets; International aspect of IPRs; Development at International level regarding IPRs

**Unit 3 Polices on IPRs in India** 10 Hrs.
The debate: Copyright vs Copy left; Research ethics; role of IPRs in economic development in developed and developing economies; Overview of Various Policies on IPRs in India; Success Story of Bayh Dole Act of IPRs in USA

**Unit 4 IPRs and Technology Commercialization** 7Hrs.
Technology Transfer and Commercialization; Key Determinants and Participants of Technology Transfer and Commercialization; Types of Technology Transfer and Commercialization; Technology Transfer and Commercialization in India and Other Developing Economies

**COURSE OUTCOME**

- The students will be able to understand the importance of IPRs in academic field.
- The student gets idea how they can protect their IP through IPRs regime.
- The student gets more incentive towards technology transfer and commercialization
- Apply intellectual property law principles (including copyright, patents, designs and trademarks) to real problems and analyse the social impact of intellectual property law and policy

**TEXT BOOKS**


Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018


REFERENCE WORK

Course Objective

- To inculcate the skills of ethical decision making and then to apply these skills to the real and current challenges of the engineering profession.
- To enable student to understand the need and importance of value-education and education for Human Rights.

Unit 1 INTRODUCTION

Nature of Value-Crisis in the contemporary Indian society, Meaning, Nature & Types of Values; Sources of Value Formation, Foundational Human Values – Integrity, Freedom, Creativity, Morals, Love and Wisdom, Case Studies Case Studies on the above aspects

Unit 2 SOCIETAL VALUES & MATERIAL VALUES


Unit 3 PSYCHOLOGICAL & SPIRITUAL VALUES

Humanistic Psychology; Concept of Intelligence, Emotional Intelligence& Mental health; Cognitive Dissonance & Ego Defense, Maslow’s Hierarchy of Human Need; Characteristics of ‘Self-Actualizing’ persons; Understanding Common Religion & Concept of Dharma and Spirituality; Case Studies Case Studies on the above aspects

Unit 4 PSYCHOLOGICAL & SPIRITUAL VALUES

Bases for moral Judgments: Customary Morality, Religious Morality, Reflective Morality. Concept of Professional values: Competence, Confidence, Devotion to Duty, Efficiency, Accountability, Respect for learning / Learned, Willingness to Learn, Open and Balanced mind; Team spirit; Willingness for Discussion, Aims, Effort, Avoidance of Procrastination and Slothfulness, Alertness, IEEE; Case Studies Case Studies on the above aspects

COURSE OUTCOME

- Students are expected to become more aware of their self and their relationships and would have better reflective and discerning ability.
- They would also become more sensitive to their surroundings including both people and nature, with commitment towards what they believe in (human values).
- To understand how universal values can be uncovered by different means, including scientific investigation, historical research, or public debate and deliberation (what some philosophers call a dialectic method)
- To understand and discuss the idea of moral relativism and the challenges it poses to universal values

TEXT BOOK

Human Values - Prof. A.N.Tripathi New Age International, 2009

REFERENCE BOOK

Human Values and Professional Ethics - Jayshree, Suresh and B.S. Raghwan, S. Chand Publication, 2011-12

Humanities Electives III

<table>
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<th>Subject Code</th>
<th>HS492</th>
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**Course Objective**
- The course will enable the students to understand the level of Indian English Literature.
- It will also enable the students to understand different genres such as prose, poetry, and fiction in Indian Writers in English.

**Unit 1**

**Prose**
- APJ Abdul Kalam: Unity of Minds
- Mahatma Gandhi: Hind Swaraj What is Civilization? (Chapter XIII) Education (Chapter XVIII)
- Swami Vivekananda: The Cosmos-Macrocosm

**Unit II**

**Poetry**
- Rabindranath Tagore: Geetanjali – Where the mind is without fear
- Kamla Das: An Introduction
- Nissim Ezekiel: The Night of Scorpion
- Sarojani Naidu: Life
- Toru Dutt: Our Casuarina Tree
- Sri Arbindo: Stone Goddess

**Unit III**

**Short Stories**
- R.N.Tagore: Kabuliwala
- R.K. Narayan: An Astrologer’s Day
- Mulk Raj Anand: Duty
- Nayantara Sehgal: Martand

**Unit IV**

**Novel**
- Ruskin Bond: Flights of Pigeons

**Course Outcome:**
- The students will develop an insight into Indian literature.
- The students will learn to appreciate different genres of literature of Indian Literature in English.
- The students will understand the role of literature in reflecting the social context and the shaping of a young nation.
- The students will demonstrate knowledge and comprehension of major texts and traditions of language and literature written in English as well as their social, cultural, theoretical, and historical contexts.

**Text Books**
- Kumar, Shiv K. (ed), Contemporary Indian Short Stories in English, 2007 SahityaAkademi
- Anand, Mulk Raj; SarosCowasjee (ed.); Selected Short StoriesPenguin Books, 2006

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018


Reference Books


Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

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<td>Software Quality Engineering</td>
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UNIT-I: Introduction (7 L)

UNIT-II: Software Quality Metrics (8 L)

UNIT-III: Software Quality Management and Models (8 L)

UNIT-IV: Software Quality Assurance (8 L)

UNIT-V: Software Verification, Validation & Testing: (8 L)

Text Book:

Reference Book:
1. Stephen H. Kan, Metrics and Models in Software Quality Engineering, Addison-Wesley Professional

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018
Course Objective:

1. The objective of the course is to make the students understand the different techniques for efficient mining of the data.
2. To introduce students to the concepts, processes and practice of Inference Rules at different abstraction levels of Data.
3. To provide an understanding of the Data management perspective regarding the use of business intelligence (BI), Data Mining systems and Advanced Applications.

Detailed Syllabus

UNIT 1

**Data Science**: Introduction to Data Science, Overview, Motivation, Data Mining-Definition & Functionalities.

**Data Warehousing**: Overview, Definition, Delivery Process, Difference between Database System and Data Warehouse, Multi-Dimensional Data Model, Data Cubes, Stars, Snow Flakes, Fact Constellations, Concept hierarchy, Process Architecture, 3 Tier Architecture, Data Marting.

(12L)

UNIT 2

**Data Pre-Processing**: Data Cleaning: Missing Values, Noisy Data,(Binning, Clustering, Regression, Inconsistent Data, Data Integration and Transformation.

Data Reduction: Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Clustering, Discretization and Concept hierarchy generation.

Data objects and attribute types, Measuring Data Similarity and Dissimilarity, Cosine Similarity.

(7 L)

UNIT 3

**Concept Description**: Definition, Data Generalization, Analysis of attribute relevance, Mining Class comparisons, Statistical measures in large Databases. Measuring Central Tendency, Box Plots, Measuring Dispersion of Data, Apriori Algorithm, Mining Multilevel Association rules from Transaction Databases, FP-growth algorithm.

(7 L)

UNIT 4

**Classification**: What is Classification, Issues regarding Classification, Attribute selection measures, Information Gain, Gain Ratio, Gini Index, Decision tree, Naïve Bayesian Classification, Metrics for evaluating classifier performance, Confusion matrix.

(6 L)

UNIT 5

Learning Outcome

The course provides the students the ability to:
1 - Undertake systematic investigation/research related to the Data mining Concepts
2- Understand advanced Database systems and technologies for today’s dynamic business environment.

Text book [TB]:
1. Jiawei Han, Micheline Kamber, ”Data Mining Concepts & Techniques” Elsevier.

Reference books [RB]:
1. M.H.Dunham,”Data Mining :Introductory and Advanced Topics” Pearson Education
**Course Objective:**
1. To make students learn about basic understanding of the multimedia objects and tools for object generation.
2. To teach students audio and video file formats used nowadays as a part of IT generation.
3. To make students learn clear understanding of multimedia projects.
4. To make students learn different compression techniques.

**Detailed Syllabus**

**UNIT 1**

**Introduction:** Introduction to Multimedia, Multimedia Information, Multimedia Objects, Multimedia in business and work, Stages of Multimedia Projects, presentation tools, tools for object generations, video, sound, image capturing, authoring tools, card and page based authoring tools. 

**(8 L)**

**UNIT 2**

**Multimedia Building Blocks:** Text, Sound MIDI, Digital Audio, audio file formats, MIDI under windows environment Audio & Video Capture.

**(8 L)**

**UNIT 3**

**Data Compression:** Introduction to data compression, Compression ratio, lossless & lossy compression, Huffman Coding, Shannon Fano Algorithm, Huffman Algorithms, Adaptive Coding, Arithmetic Coding, Finite Context Modelling, Dictionary based Compression, Sliding Window Compression, LZ77,LZ78, LZW compression.

**(8 L)**

**UNIT 4**

**Image, Audio and Video Compression:** Digital Audio concepts, Sampling Variables, Loss less compression of sound, loss compression & silence compression, lossy graphic compression, image file format, animations Images standards, JPEG Compression, Zigzag Coding, Multimedia Database. Content based retrieval for text and images, Video Compression, MPEG standards, MHEG Standard Video Streaming on net.

**(8 L)**

**UNIT 5**

**Advanced forms of interaction in Multimedia:** Video Conferencing, Elements of (immersive/non-immersive) Virtual Reality, Augmented Reality, Tele presence, Mobile technologies.


**(8 L)**

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

Learning Outcome
At the end of the course, Learning Outcomes Having successfully completed this course, the student will demonstrate:
1. Students will understand various multimedia tools available.
2. Students will be able to learn with Multimedia projects
3. Students can differentiate between lossy and lossless compression.

Text Book [TB]:

Reference Book [RB]:

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<td>Semester</td>
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Objectives of the Course: The students will learn

- Consumer Electronics and its application
- Concept of audio and video related system.
- Concepts of recording and power supplies.

UNIT-I
Audio Systems: Microphones, Loudspeakers, Speaker baffle and enclosure, Acoustics, Mono, Stereo, Quad, Amplifying Systems, Equalisers and Mixers, Electronic Music Synthesisers, Commercial Sound, Theater Sound System 8LU

UNIT – II
Video Systems and Displays: Monochrome TV, Colour TV standards and systems, TFT, Plasma, HDTV, Digital TV, Video Telephone and Video Conferencing 8L

UNIT III:
Domestic Appliances: Washing machines, Microwave ovens, Air-conditioners and Refrigerators, In car computers Office Systems: FAX, Xerox, Telephone Switching System, Mobile Radio System 8L

UNIT IV:
Recording and Reproduction Systems: Disc recording and reproduction, Magnetic recording and reproduction, Video tape recording and reproduction, Video disc recording and playback, Distortion and Noise reduction in Audio and Video System 8L

UNIT-V
Power Supplies and other systems: SMPS, UPS and Preventive Maintenance, Set Top Boxes, Remote controls, Bar codes, ATM 8L

Text Books:

OUTCOMES OF THE COURSE:
The course provides an understanding of:

- Electronic systems related to consumer applications.
- Principle of working of various home appliances.
- Skills to use modern consumer electronics systems used in day to day life.

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</table>

**Objectives of the Course:** To teach the fundamental concepts of various electronic devices, circuits and their application. To develop ability among students for problem formulation, system design and solving skills.

**UNIT-I**

Semiconductor materials and properties Group-IV materials, Covalent bond, electron-hole concepts Basic concepts of energy bands in materials, concepts of forbidden gap Intrinsic and extrinsic semiconductors, donors and acceptors impurities 4L

**UNIT-II**

Junction diode and diode applications p-n junction, depletion layer, v- i characteristics, diode resistance, capacitance diode ratings (average current, repetitive peak current, non-repetitive current, peak-inverse voltage). 4L

Diode Applications Rectifiers (half wave and full wave), filter (C – filter), clipping circuits, clamping circuits, voltage multipliers 4L

**UNIT-III**

Breakdown diodes Breakdown mechanisms (zener and avalanche), breakdown characteristics, zener diode application as shunt regulator 4L

**UNIT-IV**

Bipolar Junction Transistor Basic construction, transistor action, CB, CE and CC configurations, input/output Characteristics, Transistor Amplifier Graphical analysis of CE amplifier, concept of voltage gain, current gain. 6L

**UNIT-V**

Field Effect Transistor

JFET: Basic construction, transistor action, concept of pinch off, maximum drain saturation current, input and transfer characteristics, characteristics equation CG, CS and CD configurations, MOSFFT: depletion and enhancement type MOSFET-construction, operation and characteristics. 6L

**Reference Books:**


Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018
OUTCOME OF THE COURSE:

- Students will be able to build, develop, model, and analyze the electronic circuits along with learning the device ratings and characteristics
- Students will be able to design and analyse electronic circuits

List of Experiments:

1. To study V-I characteristics of p-n junction diode.
2. To study V-I characteristics of zener diode.
3. To study half-wave rectifier and calculate ripple factor and efficiency.
4. To study full-wave rectifier and calculate ripple factor and efficiency.
5. To study clipper circuits.
6. To study clamper circuits.
7. To study the input and output characteristics of CB and CE transistor.
8. To study drain and transfer characteristics of JFET.

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<th>Subject Code</th>
<th>EE481</th>
<th>Subject Title</th>
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Objectives of the Course

- To introduce fundamentals of various renewable energy sources.
- To introduce fundamentals of technologies used to harness usable energy from solar, wind,
- To introduce fundamentals of technologies used to harness usable energy from ocean and Biomass energy sources.

**Unit 1**
Introduction: Energy resources and their classification, oil crisis of late 20th century and its impacts on energy planning, consumption trend of primary energy sources, world energy future, energy audit and energy conservation, energy storage.

**Unit 2**
Solar Energy Conversion: Solar resources, passage through atmosphere, solar thermal energy conversion: solar energy collectors, solar thermal power plant, solar PV conversion: solar PV cell, V-I characteristics, MPPT, Solar PV power plant and applications.

**Unit 3**

**Unit 4**

**Unit 5**
Other Alternate Energy Sources/Technologies: Geothermal Energy: geothermal fields, types, geothermal energy generation systems, ocean tidal energy systems, fuel cell: basic operation and classification, principle of MHD generation, output voltage and power, environmental aspects.

Text Books:

Reference Books

Outcome of the Course:
- Identify renewable energy sources.
- Understand the mechanism of solar, wind and ocean energy sources.
- Demonstrate the understanding of various technologies involved in power generation from renewable energy sources.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

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<th>Subject Code</th>
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</table>

Course Objective: To enable the students, know and understand the mechanical behavior of composite materials

Course Pre/Co-requisite (if any): Strength of Materials, Materials Engineering

Detailed Syllabus

UNIT 1:
Definition and applications of composite materials, classifications, Fibers- glass, carbon, ceramic and aramid fibers. Matrices- polymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices. Fillers and whiskers. Advantages and limitations of composites

UNIT 2:
Mechanical behaviour of composite materials, surface treatment of fibers, thermosets matrix materials, Thermoplastics and other matrix materials. Manufacturing of thermoset composites, bag moulding, compression moulding, pultrusion, filament welding, other manufacturing processes

UNIT 3:

UNIT 4:
Analysis of laminated composites, symmetric laminates, angle ply laminates, cross ply laminates, laminate, evaluation of lamina properties, determination of stress and strain in laminate, maximum stress and strain criteria, von Mises Yield criterion for isotropic materials

UNIT 5:
Residual stresses during curing, prediction of laminate failure, thermal analysis of composite laminates. Analysis of laminated plates - equilibrium equations of motion, static bending analysis, buckling analysis, free vibrations, natural frequencies

Learning Outcome

At the end of the course the student can:
CO1: Have an overview of the mechanical behaviour and application of composite materials.
CO2: Get an overview of the methods of manufacturing composite materials
CO3: students will understand various mechanics of composite materials.

Text book [TB]:

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018


Reference books [RB]:

<table>
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<tr>
<th>Subject Code</th>
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**Course Objective:** To facilitate the understanding of total quality management principles and processes.

**Course Pre/Co- requisite (if any):** Manufacturing Process, Industrial Engineering and Management

**Detailed Syllabus**

**UNIT 1:**
Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality.

**UNIT 2:**
TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

**UNIT 3:**
The seven traditional tools of quality; New management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types.

**UNIT 4:**
TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures.

**UNIT 5:**
Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation, Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.

**Learning Outcome**

At the end of the course the student can:
CO1: To facilitate the understanding of total quality management principles and processes.
CO2: Student will learn about ISO systems
CO3: Student will learn about various quality tools to improve products quality.

**Text book [TB]:**

*Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018*


REFERENCES [RB]:

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018
OBJECTIVE: The objective of this subject is to give the basic knowledge of descriptive and mathematical part of statistics. Applications of various probability distribution in the field of insurance and finance. The course will focus on the different situations in the field of actuarial science which can be dealt with transformation of variables. The course will make able the students to understand the association between two random quantities and to find their mathematical measure.

Unit I

Unit II
Bivariate data: Definition, scatter diagram, simple, partial and multiple correlation, rank correlation. Simple linear regression.

Unit III
Principle of least squares and fitting of polynomials and exponential curves. Theory of attributes Independence and association of attributes, consistency of data, measures of association and contingency, Yule’s coefficient of colligation.

Unit IV
Testing of hypothesis: Z-test, t-test, F-test, Chi-square test for goodness of fit, Introduction to analysis of variance.

LEARNING OUTCOME: Students will able to:
- Analyze given statistical data.
- Have confidence to deal with real life situation, especially, in insurance and finance.
- Understand applications of standard probability distributions in every span of life.
- Find the association between two random quantities using mathematical theory.

Text Books:

Reference Books:

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018
Course Objective:
To introduce the various aspects of graphics design and important stages of product design and development.

Unit 1: Introduction

Unit 2: Product Design Cycle
Stages of product development. Introduction to ergonomics

Unit 3: Design Process

Unit 4: Technology & Market Assessment
Customer needs identification, Market research essentials. Advertising and marketing tools.

Unit 5: Design Tools
Introduction to various design tools.

LEARNING OUTCOME:
1. The student will be able to understand the importance of Graphics.
2. The students will be able to understand and demonstrate their ideas visually.
3. The students will be able to understand the various stages of product development.

Text Books:
1. The Elements of Graphic Design, Alex W. White
2. The Design of Everyday Things, Don Norman

Reference Books:
1. Product Design & Development, Karl T. Ulrich & Steven D. Eppinger

<table>
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<tr>
<th>Subject Code</th>
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<td>ME381</td>
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<td>LTP 2 0 2 Credit 3 Subject Category UC Year 4th Semester VII</td>
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COURSE OBJECTIVE:
To understand the basic concepts Entrepreneurship and start up. To understand role and importance of entrepreneurship for economic development. To develop personal creativity and entrepreneurial initiative or start up.

COURSE OUTCOME
At the end of the course the student can:
- CO1: Analyse the business environment in order to identify start up opportunities
- CO2: Identify the elements of success of entrepreneurial ventures
- CO3: Consider the legal and financial conditions for starting a start up
- CO4: Evaluate the effectiveness of different entrepreneurial strategies

Unit 1: 4Hrs.

Unit 2: 6Hrs.

Unit 3: 5Hrs.

Unit 4: 5Hrs.

Unit 5: 6Hrs.

TEXT BOOKS:

REFERENCE:
Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018


EVALUATION BREAKUP:

- Case study – 25 Marks (Internal)
- Assignments – 10 Marks (Internal)
- Mid Term Evaluation of Project – 10 Marks (Internal)
- Startup Idea, Seminar - 15 Marks (External)
- End Term Evaluation of Project – 40 Marks (External)

*The End Term evaluation will consist of 25 to 30 minutes’ presentation followed by questionnaire by External Experts.

RESOURCE PERSONS FROM VARIOUS DEPARTMENTS:

- Mechanical Engineering
- MBA
- Computer Science Engineering.
- Information Technology.
- Industry Persons.
  1. Experts from Industry – As recommended by STPI
  2. DrUmakantPanwar – Entrepreneur
  3. MrVivekHarinarian- Entrepreneur.

<table>
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<th>Subject Code</th>
<th>Subject Title</th>
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<td>PE451</td>
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Course Objective:
1. The objective of this course is to make students familiar with the principles and applications of material balance mathematical equation in petroleum reservoir.

Detailed Syllabus

UNIT 1 8L
Overview of applied reservoir engineering; Material balance equation: Generalized and specific form for different drive systems, Drive-type identification, Havlena and Odeh method, Rock and fluid compressibility factor; Recovery factor estimation.

UNIT 2 8L
Gas, gas-condensate and oil reserves: Identification from fluid composition, Performance of volumetric reservoir, Production characteristics; Reservoir drive mechanics.

UNIT 3 7L
Performance prediction; Water influx: steady and unsteady models; Drive-Index: Reservoir pressure maintenance, Choice and system.

UNIT 4 8L
Immiscible displacement process: Fractional flow and fractional displacement process in linear reservoir, Buckley and Leverett treatment Reservoir; Decline curve analysis.

UNIT 5 8L
Oil and gas field development: Water flood performance, Injection-Production wells distribution patterns and characteristics, Optimum well spacing from techno economic analysis of field performance, Well and field production rate estimation.

Learning Outcome
1. The candidate will be able to solve petroleum engineering problems by integrating different types of data used in the oil industry.
2. Identify, formulate, and solve petroleum engineering problems using real world engineering tools.
3. Recognize the main terminology, concepts, and techniques that applies to reservoir engineering founded on a theory based understanding of mathematics and the natural and physical sciences.
4. Develop a field development plan.
5. Analyze the techno-commercial aspects of field development.

Text book [TB]:
2. J P Nguyen; Fundamentals of Exploration & Production: Oil and Gas field development techniques; Technip; 1996.

Reference books [RB]:
1. Tarek Ahmed; Reservoir Engineering Handbook; Gulf publication; 2001.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

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<th>Subject Code</th>
<th>Subject Title</th>
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Course Objective:
The objective of this course is that it works to enhance the productivity in the Energy, Oil & Gas and Transportation industries. It offer support in research and development activities in technical and managerial aspects of Oil and gas industry.

Detailed Syllabus

UNIT 1 8L

UNIT 2 8L
Natural Gas: Introduction, Natural Gas Measurements; Demand, Supply & Storage of natural gas: Gas production, Source of demand in India, The supply system, Gas Sales Pattern in India, Gas Pipeline Regulations in India, Gas Trading, Gas Pricing.

UNIT 3 8L
International & National Institutions of Oil & Gas: API, OPEC, OECD, OIDB, DGH, PNGRB, CHT, PII, PPAC, PCRA.

UNIT 4 7L
Petroleum Contracts: NELP - Role & Background, Types of Contracts and fiscal components, Production sharing contracts in India, Crude Oil trading and pricing, CBM Contracts.

UNIT 5 8L
Trade Practices & Taxation: Norms on various trade practices, Elements of Petroleum Development Policy, Financial and taxation issues; Risk Management: source of risk, managing risks by risk reduction, diversification, and uncertainty and decision analysis by decision tree.

Learning Outcome
After successful completion of the course, student will be able to

1. Understand the structure and classification of oil and gas industry.
2. Understand planning of development activities in managerial aspect of oil & gas industry.
3. Understand the background of oil & gas industry and able to analyze the market trends of crude oil pricing.
4. Understand the oil and gas regulatory bodies and their roles.
5. Understand the bidding system and fiscal regimes.

Text book [TB]:
2. IFP; Oil and Gas Exploration and Production, Reserves, Costs and Contracts; Technip; 2007.

Reference books [RB]:
2. K. Abdel-Alal and Mohamed A; Petroleum and Gas Field devepolment; Marcel Dekker Inc.; 2003.

<table>
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<tr>
<th>Subject Code</th>
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Course Objective:
1. The course shall enable students to impart the knowledge of planning and developing a field throughout the economic life of the well.

Detailed Syllabus

UNIT 1
Introduction to Field Development; Life Cycle of Field: Exploration, Appraisal, Development, Production and Decommissioning Phase; Reservoir Data Acquisition and Interpretation; Volumetric Reserve Estimation: Deterministic and Probabilistic Approach.

UNIT 2
Field Appraisal: Identification and Quantification of Sources of Uncertainty, Appraisal Tools, Cost Benefit Calculations and Practical Aspects of Field Appraisal; Reservoir and Well Dynamic Behavior; Initial Development Plan; Final Development Plan.

UNIT 3

UNIT 4

UNIT 5

Learning Outcome
1. To be able to identify and select the resources of field development.
2. To be able to understand the project and contract management.
3. To be able to manage the producing fields.
4. To be able to manage the decline and decommissioning.
5. To be able to understand and prepare petroleum contracts.

Text book [TB]:

Reference books [RB]:
1. K. Abdel-Alal and Mohamed A; Petroleum and Gas Field development; Marcel Dekker Inc.; 2003.
2. IFP; Oil and Gas Exploration and Production, Reserves, Costs and Contracts; Technip; 2007.

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Course Objective:
1. To understand methodology to produce these reserves and to understand environmental consequences of producing these reserves.

Detailed Syllabus

UNIT 1
Coal Bed Methane: Introduction & Present Status Of Coalbed Methane- Global And Indian Scenario; Formation And Properties Of Coalbed Methane; Generation Of Coalbed Methane Gas & Its Properties; Properties Of Coal As Reservoir Rock & Reserve Estimation.

UNIT 2
Thermodynamics Of Coalbed Methane; Isotherm Studies; Overview Of Drilling And Production Systems Of Coalbed Methane Wells; Hydro-Fracturing Of Coal Seams; Treating And Disposing Produced Water; Testing Of Coalbed Methane Wells.

UNIT 3
Introduction And Present Status Of Gas Hydrates; Formation And Properties Of Gas Hydrates; Thermodynamics Of Gas Hydrates; Phase Behavior Of Gas Hydrates. Kinetics Of Gas Hydrates; Drilling And Completion Of Gas Hydrates Wells; Prevention And Control Of Gas Hydrates.

UNIT 4
Gas Hydrates Accumulation In Porous Media; Gas Extraction From Gas Hydrates; Uses And Applications Of Gas Hydrates.

UNIT 5

Learning Outcome
1. To apply the concepts related to exploration and development of Coal Bed Methane.
2. To understand and apply different conversion processes for the production of hydrocarbons.
3. To understand the global scenario of unconventional resources.
4. To understand shale gas exploration and exploitation.
5. To understand the oil and gas market and its world impact.

Text book [TB]:
4. Shahab D. Mohaghegh; Shale Analytics- Data Driven Analytics in Unconventional Resources; Springer; 2012.

Reference books [RB]:

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

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Course Objective:
1. To Disseminate the knowledge about controlling the influx resulting into kick and blow out.

Detailed Syllabus

UNIT 1
Bottom hole pressure BHP; Normal, abnormal pressure, U tube concept, Shallow gas, Surge effect, choke line friction, ECD. Kick indication and shut in procedure, Causes of kicks, kick signs, shut in procedure for land, jack up, floating rig, type of influx, influx behavior, close circulation. Surface Warning Signal, Wellbore Mechanics

UNIT 2
Pressure Relationships, Influx Behavior, Drilling Pipe Pressure Method, Blow out Preventer equipment surface / subsea Annular, ram preventer, packing element, accumulator system, sizing of accumulator surface and subsea unit, IBOP, bit float, subsea BOP stack and control system, choke manifold, kill manifold, diverters, function and pressure test, mud gas separator, vacuum Degasser, rotating head, rotating BOP.

UNIT 3
Well killing method: Driller’s method, wait weight method, comparison, pressure behavior at different points during killing, volumetric method, subsea considerations, stripping and snubbing, well control considerations for horizontal wells, multilateral wells, associated problems.

UNIT 4
Unusual Situations in Well Control: Plugged Nozzles, pump failure, Plugged and Washed Choke, String wash out, lost circulation, reversing out of Influx through drill pipe, bull heading, hydrate formation, problems and their remedial actions.

UNIT 5
Deep water well control; Shallow flows on floating rigs, drilling with and without riser, kick prevention and detection, well killing techniques, choke and kill line consideration, hydrate formation and prevention, deep water equipment consideration, riser booster pump and remote operated valve, pressure testing of BOP.

Learning Outcome
1. This course will develop good knowledge about various factors resulting in kick and type of influx.
2. Various procedures of primary and Secondary Well control.
3. Well killing procedures and BOP stack selection depending on operational conditions

Text book [TB]:

Reference books [RB]:
1. Neel Adams; Well Control Problems and Solutions, Petroleum Publishing company; 1983.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018
Course Objective:
1. The objective of this course is make students familiar with the principles and applications of directional drilling in petroleum operations.

Detailed Syllabus

UNIT 1 8L
Objectives; Directional Well planning, Reference systems and Coordinates, Allocation of Slots and Targets. Deflection tools; Types of Deflection Tools, Tool orientation, Directional well profiles, Well path deflection & Correction. Application of Sliding and Rotary mode for motors, Effect of torque, Drag and Weight on bit in directional wells.

UNIT 2 8L
Positive Displacement Motors and Turbo-drills; Motor Description, Power Calculation and Applications. Effect of Build Rate on hole inclination, Weight on bit, Rotary speed, Flow rate and Drill Collar diameter. Rotary Steerable Systems; Geo-steering tool; Bit walk estimation and correction; critical buckling force in directional wells. BHA configuration for directional drilling. Selection of stabilizers and reamers for directional drilling.

UNIT 3 8L
Horizontal well objectives and selection; Different profiles, Drilling techniques, Mud requirements & characteristics, casing and drill string requirements and completion programs. Hole cleaning and mud requirements, casing while drilling.

UNIT 4 7L
Slant Hole Drilling; Objectives and selections, Well profiles and Applications. Down the Hole Well Surveying; Well surveying objectives, surveying methods, Surveying Analysis methods and calculations for well coordinates. Drilling problems in directional wells; (key seating, wellbore instability, differential sticking, fishing and milling) Extended reach drilling wells.

UNIT 5 8L
Objectives of MWD/ LWD, MWD Tools, Telemetry System and Data Interpretation. Directional Drilling Problems and Remedies.

Learning Outcome
1. This course will assist students in developing the principles of directional drilling.
2. To understand the applications and limitations of directional drilling.
3. Good knowledge of this course will assist in drilling Extended Reach wells and horizontal wells.
4. To understand the tools and methods used to create a directional well.
5. To understand the concept of sidetracking, multilateral drilling and combating problems.

Text book [TB]:
1. J A Short; Introduction to Directional and Horizontal Drilling; PennWell Books; 1993.

Reference books [RB]:
2. T.A Inglis; Directional Drilling; Graham & Trotman; 1987.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

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## Course Objective:
The course shall familiarize students to contracts and policies followed in oil and gas industry.

## Detailed Syllabus

### UNIT 1
6L
Petroleum Resource Management System, Introduction of petroleum and natural gas rules, grant of license and lease, fees for license and lease, rights of licensee and lessee, area and terms of license, royalties, Assignment, Preemption right, Suspension of license or lease, Cancellation of License or Lease, Shut Down of Wells, delivery of premises, arbitration penalties.

### UNIT 2
5L
Petroleum Regulatory bodies including DGH, API, MoP&NG and PNGRB along with their Roles & Responsibilities, Oil Field Regulations and Development Acts, Definition of Mineral Oil, Mining lease, Coal Bed Methane, Condensate, Continental Shelf, Exclusive Economic Zone, Territorial waters.

### UNIT 3
5L

### UNIT 4
6L

### UNIT 5
5L
Notice Inviting offers, Format for Submission for Bids, Bid qualifying criteria, Bid rejection criteria, Fiscal package, Classification of Petroleum Resources as per Petroleum Resource Management System, crude oil benchmarks including WTI, Brent Crude and Dubai Crude.

## Learning Outcome
1. To be able to understand the lease agreement and ownership.
2. To be able to understand exploration and exploitation licensing policies.
3. To be able to identify and understand the working and significance of petroleum regulatory bodies.
4. To understand the fiscal regime and petroleum contracts.
5. To understand the oil and gas bidding system.

## Text book [TB]:

## Reference books [RB]:
9. D Johnston; Petroleum fiscal systems and production sharing contracts; PennWell Books; 1994.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

<table>
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<th>Subject Code</th>
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<tr>
<td>PE459</td>
<td>Natural Gas Engineering</td>
<td>200</td>
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<td>4th</td>
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</table>

Course Objective:
1. To know about the properties of natural gas and salient features of a gas reservoir and to develop systems for natural gas production.

Detailed Syllabus

UNIT 1

UNIT 2
Flow Of Gas In Well Tubing; Pws, Pwf, Pwh Equations; Gas Flow Measurement: Orifice Meter; Turbine Meter; Principles And Performance.

UNIT 3
Natural Gas Processing: Free-Liquid Removal; Low Temperature Separation; Dehydration Process: Chemical and Refrigeration System

UNIT 4
Natural Gas Sweetening: Amine Process; Sulphur Recovery; LPG; CNG Production; Natural Gas Liquefaction (NGL): Process; System; Storage; Transportation and Utilization.

UNIT 5
Underground Storage System and Production Performance; Special Problems: Natural Gas Hydrates; CBM; In-Situ Coal Gasification.

Learning Outcome
After completing the course student will be able to
1. Understand the properties of natural gas.
2. Apply different measures in the recognition of reservoir performance.
3. Understand and apply flow behavior of gas in production tubing.
4. Conversant with different methods of processing of gas.
5. Understand and apply gas compression fundamentals.
6. Conversant with the system of gathering stations, modes of transportation and problems associated.

Text book [TB]:

Reference books [RB]:

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>PE460</th>
<th>Subject Title</th>
<th>Well Integrity and Abandonment</th>
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<td>LTP</td>
<td>200</td>
<td>Credit</td>
<td>2 Subject Category DE Year 4th Semester VIII</td>
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</tbody>
</table>

Course Objective:
The course shall enable students to understand the methods and regulations of well integrity management and well abandonment.

### Detailed Syllabus

**UNIT 1**
Well Integrity: Definition, Objectives, Components and Issues; Life Cycle of Well Integrity; Well Integrity Diagnostics; Case Histories; Implementing Well Integrity Management System.

**UNIT 2**
Risk Factors and Risk Ranking of Non-Integral Wells; Integrity Status for Wells; Application of Intelligent System; Well Integrity Assessment and Assurance; Compliance Based Approach; Total Control.

**UNIT 3**
Well Barrier: Definitions, Classifications, Requirements and Functions Identification; Reliability Analysis Method; Failure and Failure Analysis; Barrier Design, Construction and Qualification Issues; Operation and Organizational Management and Control.

**UNIT 4**
Well plugging and abandonment techniques: Preliminary activities, Plugging, Abandonment practices, Review of well abandonment status.

**UNIT 5**
Well abandonment regulations; Abandonment Process: Onshore and Offshore Abandonment Regulations, Open-hole and Cased-hole Abandonment regulations; EPA and API Standards for Abandonment; Case Histories.

**Learning Outcome**
1. To be able to diagnose the well and create proper integrity management system.
2. To be able to understand the fundamentals of well barriers.
3. To be able to understand the abandonment and plugging techniques of wells.
4. To understand well barrier management and control.
5. To understand onshore and offshore abandonment regulations.

**Text book [TB]:**
1. British Standards Institute Staff; Well Integrity for the Operational Phase; B S I Standards; 1916.

**Reference books [RB]:**
1. Desheng Zhou; Well Integrity Mechanism, Failure, and Testing in Shallow Marine Sediments; Louisiana State University; 2000.
2. Andrew Duguid, BoyunGuo, RunarNygaard; Well Integrity Assessment of Monitoring Wells at an Active CO2-EOR Flood; Elsevier; 2017.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject Title</th>
<th>Refinery Utilities and Energy Optimization</th>
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LTP: 200  Credit: 2  Subject Category: DE  Year: 4th  Semester: VIII

Course Objective:
To gain knowledge on the various process plant utilities and their efficient use.

Detailed Syllabus

UNIT 1  STEAM
Steam generation and its application in chemical process plants, distribution and utilization, design of efficient steam heating systems, steam economy, condensate utilization, steam traps, their characteristics, selection and application, waste heat utilization.

UNIT 2  COMPRESSORS AND VACUUM PUMPS
Types of compressors and vacuum pumps and their performance characteristics. Methods of vacuum development and their limitations, materials handling under vacuum, piping systems, lubrication and oil removal in compressors in pumps.

UNIT 3  REFRIGERATION SYSTEMS
Refrigeration system and their characteristics, load calculation and load calculation and humidification and dehumidification equipments, drying and cooling tower, air blending, exhaust, ventilation, cryogenics, their characteristics and production of liquid N\textsubscript{2} and O\textsubscript{2}.

UNIT 4  INSULATION
Importance of insulation for meeting for the process equipment, insulation material and their effect on various materials of equipment piping, fitting and valves, insulation for high, intermediate, low and sub zero temperatures including cryogenic insulation, determination of optimum insulation thickness.

UNIT 5  ENERGY OPTIMIZATION
Heat exchanger networking- Pinch Technology, Demand side Process Integration, Targeting for energy, Area, unit and cost Heat exchanger network design and evolution, Heat exchanger design, Mathematical optimization techniques, Process integration of different systems: fired heater, Cogeneration and utility system, standalone power system distillation column, evaporators.

Learning Outcome
1. To gain knowledge on the various process plant utilities
2. To gain knowledge on the application the correct type of insulation
3. To gain knowledge on the Efficient design of HVAC systems
4. Proper utilization of inert gases on the process plants
5. To understand Energy optimization processes.

Text book [TB]:
1. Jack Broughton; Process utility systems; Institution of Chemical Engineers; 1994.
2. Reid, Prausnitz poling; The properties of gases & liquids; McGraw Hill; 1990.

Reference books [RB]:
1. S.C.Arora&S.Domkumdwar; A course in refrigeration and air conditioning; Dhanpat Rai Publication; 1980.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

Humanities Electives IV

<table>
<thead>
<tr>
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<th>Subject Title</th>
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**Course Objective**
- To promote an integral and holistic growth of young minds
- Develop a broad understanding of Indian society and intercultural literacy through cultural immersion.
- Deepen your knowledge of Indian development, environmental, and cultural issues through coursework, local engagement, and independent projects.

**Unit 1: Indian Culture: An Introduction**
8Hrs.

Characteristics of Indian culture, Significance of Geography on Indian Culture; Society in India through ages- Ancient period- Varna and Caste, family and marriage in India, position of women in ancient India, Contemporary period; caste system and communalism.

**Unit 2: Indian Languages and Literature**
6 Hrs.


**Unit 3: Brief History of Indian Arts and Architecture**
6Hrs.

Indian Art & Architecture: Gandhara School and Mathura School of Art; Hindu Temple Architecture, Buddhist Architecture, Medieval Architecture and Colonial Architecture.

Indian Painting Tradition: ancient, medieval, modern Indian painting and Odishan painting tradition

**Unit 4: Spread of Indian Culture Abroad**
6Hrs.

Causes, Significance and Modes of Cultural Exchange - Through Traders, Teachers, Emissaries, Missionaries and Gypsies, Indian Culture in South East Asia India, Central Asia and Western World through ages

**COURSE OUTCOME:**
- Understand background of our religion, customs institutions, administration and so on.
- Understand the present existing social, political, religious and economic conditions of the people.
- Analyze relationship between the past and the present relevance of Indian tradition.
- Develop practical skills helpful in the study and understanding of historical events.

**TEXT BOOKS**

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<tr>
<th>Subject Code</th>
<th>HS483</th>
<th>Subject Title</th>
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Course Objective

- Develop an understanding of Indian philosophical systems
- To empower for self-exploration

Unit 1 Introduction
Meaning of Philosophy, Origin of Philosophy in India, Major Indian philosophical systems: Sankhya: Metaphysics, Theory of causation, Prakriti, Purusha, Evolution, Yoga: Concept of Chitta, Types and Modification of Chitta, Eight-fold Yoga & Vedant: Notions of Maya & Brahma

Unit 2 Major Principles
Panchkosha, Triguna, Tridosh, Macrocosm-Microcosm

Unit 3 Major Contemporary Indian Philosophers

Unit 4 Activities & Projects
Identifying human prakriti, Using Trigun inventory, Understanding self

COURSE OUTCOME:

- Students will acquire understanding of concepts of Indian philosophy.
- Students will be enabled to analyze their self.
- The students will be able to relate some of the core concepts and theories of modern Indian philosophy to concepts and ideas in classical Indian philosophy.
- The students will be able to appreciate how philosophical approaches may be integrated more practically as a “way of life”.

TEXT BOOK

REFERENCE BOOKS
- The Yoga Sutras of Patanjali: (annoted commentary) (Divine Cool Breeze Realized Writers Book 15) by Shri Patanjali, Shri Mataji Nirmala Devi (Introduction), Charles Johson (Translation)

Humanities Electives IV

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<td>Industrial Sociology</td>
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Course Objective

- The course attempts to analyze the structure and process of industrial organizations from the sociological perspective.
- The course enables students to have a general view of modern industry.

Unit 1


Unit 2

Industrial Disputes: Concept, Features and Kinds of disputes, Settling disputes, Mediation, Arbitration, Conciliation, Negotiation, The Indian Worker: Features of Indian worker, the contribution of social philosophy, family, caste and community in determining the attitude of workers.

Unit 3

Trade Union: Concept, Features, Functions and Types, History of Trade Union Movement in India Trade Unions and Challenges of Privatization and Globalization; Law and work, Decline of Trade Unions.

Unit 4

Dynamics of Industrial Relations: Corporate Social Responsibility, Inclusion of Women in the Corporate Sector, Scope of Industrial Sociology in India; Impact on Employment, Impact on HRD, impact on wages and benefits, Modern Industry in India

COURSE OUTCOME:

- It will enable students to demonstrate the different human components that make up modern industry.
- The student will get exposed to a specialized area of sociology and its insights.
- Apply sociological concepts and theories to understand contemporary social issues and/or public debates about these issues
- Communicate sociological concepts and/or research in a manner that is appropriate for the intended audience (e.g., academic, lay audience)

TEXT BOOKS

4. Pascal Gilbert: Fundamental of Industrial Sociology; Orient-Longman.
5. E.V.Schneider – Industrial sociology

REFERENCE BOOKS

- Sheth, N R, 1979, Industrial Sociology in India, Jaipur Rawat.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018
Course Objective

- To provide the overview of sustainable and its needs to the students.
- To provide the importance and components of sustainable development to the students.
- To provide the association of social and economic development to the students.

Unit 1 Overview of Sustainable Development 5 Hrs.
History and emergence of the concept of Sustainable Development, Components of SD i.e. Economic, Social, Human, Institutional, Technological and Environmental development; Definitions, Sustainability in Ecosystem Services; natural resource degradation, greenhouse gases, factors affecting SD (i.e. Industrialization, urbanization, population growth, globalization, etc.)

Unit 2 Policies on Sustainable Development at international level 4 Hrs.
Government Policies for SD in India; Socio-economic policies for sustainable development in India, Sustainable development through trade, Carrying Capacity, global policies for sustainable development

Unit 3 Sustainable Development and International Contribution 10 Hrs.
SDGs and MDGs, Complexity of growth and equity, International Summits, Conventions, Agreements, Initiations of international organizations like WHO, UNDP, WTO, FAO and World Bank towards sustainable development

Unit 4 Measurement of Sustainable Development 7 Hrs.
Role of developed and developing countries in the sustainable development, Demographic dynamics and sustainability, integrated approach for resource protection and management; Index based estimation of SD i.e. Environmental Sustainable Development Index and sustainable development, and other index

Course Outcome:
- The students will be able to understand the importance of natural resource in economic development.
- The students contribute significant efforts towards sustainable development
- Develop a future-oriented perspective that highlights the significance of their decisions, choices and actions on the quality of life of present and future generations.
- Understand and are empowered to address the real causes and consequences of unsustainable behaviour within the context of an interdependent and globalised world.

TEXT BOOK

REFERENCE BOOKS

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<thead>
<tr>
<th>Subject Code</th>
<th>Subject Title</th>
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<td>DE/OE</td>
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</table>

Unit 1
Introduction: Importance of user Interface–definition, importance of good design. Benefits of good design. A brief history of Screen design. The graphical user interface–popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user – Interface popularity, characteristics- Principles of user interface.

Unit 2
Design process–Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, understanding business junctions.

Unit 3
Screen Designing: Design goals–Screen planning and purpose, organizing screen elements, ordering of screen data and content –screen navigation and flow, Visually pleasing composition - amount of information -focus and emphasis, presentation of information simply and meaningfully, information retrieval on web - statistical graphics –Technological consideration in interface design.

Unit 4

Components – text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors.

Unit 5

TEXT BOOKS:

REFERENCE:

![Course structure and syllabus](image-url)

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<tr>
<th>Subject Code</th>
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</table>

**Course Outline:** To provide a detailed idea how the internet is connecting the entire world and helps to live a smart life with its technology.

**Course Objective:**

1. Vision and Introduction to IoT.
2. Understand IoT Market perspective.
5. Real World Design Constraints, Industrial Automation and Commercial Building Automation in IoT.

**Course Pre/Co-requisite (if any):** Wireless Sensor Networks

**Detailed Syllabus**

**UNIT 1: M2M to IoT (05 Lectures)**

The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, use case example, Differing Characteristics.

**UNIT 2: M2M to IoT (A Market Perspective) (10 Lectures)**

Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview—Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. IOT related open source software tools introduction; tools like IoTivity, IBM Blue Mix. Introduction to Contiki, Cooja, Raspberry Pi etc.

**UNIT 3: M2M and IoT Technology Fundamentals (05 Lectures)**

Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management.

**UNIT 4: IoT Architecture-State of the Art (12 Lectures)**


**UNIT 5: Industrial Automation (08 Lectures)**

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018


Learning Outcome

- Explain the definition and usage of the term 'The Internet of Things' in different contexts
- Understand where the IoT concept fits within the broader ICT industry and possible future trends
- Able to build and test a complete working IoT system Pursue lifelong learning for professional advancement.

Text book [TB]:


Reference books [RB]:


<table>
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<th>Subject Code</th>
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<td>DE /OE 4th Year VIII Semester</td>
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Course Objective:
1. Understand the fundamentals of wireless networks.
2. Understand and evaluate emerging wireless technologies and standards.
3. To explore mobile security issues.
4. To explore the mobility concept.

Detailed Syllabus

UNIT 1


(3 L)

UNIT 2

Emerging Technologies: Bluetooth, Rfid, WiMAX, Mobile IP, IPv6, GSM architecture, Call routing in GSM, Mobile computing over SMS, Value added service through SMS, GPRS architecture & operations, 3G & applications

(10 L)

UNIT 3

Wireless Transmission:
Signal propagation- path loss of radio signals, additional signal propagation effects, Multipath propagation,
Multiplexing- Space division, frequency division, time division, code division,
Modulation- ASK, FSK, PSK, AFSK, APSK, Multi-carrier modulation
Spread spectrum- Direct sequence & frequency hopping
Mac- Hidden & exposed terminals, near- far terminal, SDMA, TDMA, FDMA, Fixed TDM, CSMA, PRMA, Multiple access with collision avoidance

(12 L)

UNIT 4

Wireless LAN: IEEE 802.11 in details, HIPERLAN, Link manager protocol, L2CAP, security, SDP.

(5 L)

UNIT 5

Mobility & Security in mobile computing: HTTP,
Wireless application protocol- architecture, wireless datagram protocol, wireless transport layer security, wireless transaction & session protocol, WML, Push architecture, push/ pull services, i-mode & SyncML

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Information security, Security techniques & algorithms, public key infrastructure, (10 L)

Learning Outcome

At the end of the course, Learning Outcomes Having successfully completed this course, the student will demonstrate:

1: Apply the fundamental design paradigms and technologies to mobile computing applications.
2: Develop consumer and enterprise mobile applications using representative mobile devices and platforms using modern development methodologies.
3: Appraise the quality and performance of mobile applications.
4: Assess and implement security principles in mobile applications.
5: Evaluate wireless network topologies, wireless connectivity and characteristics, and the impact of wireless networks on security and Internet communications.
6: Select appropriate wireless technologies in commercial and enterprise applications.

Text book [TB]:

Reference books [RB]:

<table>
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Objectives of the Course:

- To understand the concept of Computer Communication.
- To learn the basics of Data communication and Networks
- To develop and design the protocol systems for advance computer communication.

UNIT I: Introduction to Communication:

Communication system, Analog and Digital Communication, channel bandwidth. Ideal and Practical Filters, Concept of Signal Distortion over a Communication Channel, Energy Signal and Power Signal, Introduction to noise in Communication systems.  

UNIT II: Introduction to Modulation techniques:

Concept of Amplitude Modulation, Concept of Frequency & Phase Modulation, Concept of ASK, FSK & PSK, Concepts of PCM.  

UNIT III: Introduction to Data Communication Network & OSI Model:

Switching systems, network hardware and software, Layering, design issues for layering, reference models and their comparison, example of networks. Concepts of OSI model.  

UNIT IV: Introduction to Data Communication Protocols and transmission media


Text Books:


Reference Books:


List of Experiments:

1. To generate amplitude modulated wave and determine the percentage modulation and Demodulate the modulated wave using envelope detector.
2. To generate AM-Double Side Band Suppressed Carrier (DSB-SC) signal.
3. To generate the SSB modulated and Demodulated wave.
4. To generate frequency modulated signal and determine the modulation index and bandwidth for various values of amplitude and frequency of modulating signal and to demodulate a FM signal
5. To study ASK modulation and Demodulation.
6. To study FSK modulation and Demodulation.
7. To study PSK modulation and Demodulation.
8. To Study TDM/PCM Transmitter /Receiver.

OUTCOMES OF THE COURSE:

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018
The course provides an understanding of:

- Computer Communication and networks.
- Protocol design and their design issues.

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<tr>
<th>Subject Code</th>
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<td>Biomedical Instrumentation</td>
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Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018
Objectives of the Course: The students will learn
- Requirement of bio-medical and its application
- Concept of bio-potential electrodes and measurements related to them.
- Concepts of bio-transducers and measurements related to them.
- Concept of bio-medical instruments and their uses experimentally.

UNIT I: ANATOMY AND PHYSIOLOGY:
Basic Cell Functions, Origin of Bio-potentials, Electrical Activity of Cells, components of man Instrument system, types of bio-medical stems, design factors and limitations of biomedical instruments, terms and transducers to various physiological events.  8L

UNIT II: BIO-POTENTIAL ELECTRODE:
Types of bio-potential electrodes., Electrode-Electrolyte interface, half cell potential, Polarization- polarisable and non-polarisable electrodes, Ag/AgCl electrodes, Electrode circuit model; Electrode and Skin interface and motion artifact. Body surface recording electrodes for ECG. Electrodes standards.  8L

UNIT III: BIO-TRANSDUCER:
Transduction Principles: Resistive Transducers Strain Gauge- types, construction, selection materials, Gauge factor, Bridge circuit, Temperature compensation. Strain Gauge type Blood pressure transducers. Inductive Transducers, Capacitive Transducer, Piezoelectric Transducer.  8

UNIT IV: BIOTELEMETRY AND ELECTRICAL SAFETY:
Bio-telemetry design, single channel bio telemetry transmitter and receiver system based on AM, FM and, pulse modulation. Significance of Electrical Danger, physiological effect of current, ground shock Hazards.  8L

Text Books:

Reference Books:
1. J.G. Webster, ‘Medical instrumentation application and design’, Houghton Mifflin Co., Boston USA.

OUTCOMES OF THE COURSE:
The course provides an understanding of:
- Bio-medical instruments and measurements.
- Principle of working of bio-medical transducers.

- Skills to use modern bio-medical tools and equipment for measurements related to human body.

LIST OF EXPERIMENTS

2. Pulse measurement
3. Heartbeat measurement
4. Automatic BP measurement
5. Heart sound study using electronics stethoscope
6. ECG measurement

Following experiments to be done on the breadboard

7. Design of low noise and low frequency amplifier for biomedical application
8. Design of Instrumentation amplifier
9. Construction of chopper amplifier

Two Value Added Experiments to be added by Instructor.

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<th>Subject Title</th>
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Objectives of the Course

- To make students understand the construction, working principle and application of various transducers used for flow measurement, strain measurement, pressure and vacuum measurement,
- force, torque and power measurement
- To develop an understanding about the different types of telemetry systems used and types of instruments required for display and recording of the data to be transmitted
- Understand about components, characteristics of various control processes used and their modes of operation.

Unit 1

Transducer – I: Definition, advantages of electrical transducers, classification, characteristics, factors affecting the choice of transducers, Potentiometers, Strain guages, Resistance thermometer, Thermistors, Thermocouples, LVDT, RVDT

Unit 2

Transducer – II: Capacitive, Piezoelectric Hall effect and opto electronic transducers.

Measurement of Motion, Force pressure, temperature, flow and liquid level.

Telemetry: General telemetry system, land line & radio frequency telemetering system, transmission channels and media, receiver & transmitter. Data Acquisition System: Analog data acquisition system, Digital data acquisition system, Modern digital data acquisition system.

Unit 3

Telemetry: General telemetry system, land line & radio frequency telemetering system, transmission channels and media, receiver & transmitter. Data Acquisition System: Analog data acquisition system, Digital data acquisition system, Modern digital data acquisition system.

Display Devices and Recorders: Display devices, storage oscilloscope, spectrum analyser, strip chart & x-y recorders, magnetic tape & digital tape recorders.

Unit 4

Process Control: Principle, elements of process control system, process characteristics, proportional (P), integral (I), Derivative (D), PI, PD and PID control modes. Electronic, Pneumatic & digital controllers.

Text Books:

Reference Books
3. RajendraPrasad,“Electronic Measurement and Instrumentation Khanna Publisher

Outcome of the Course:

- Identify the appropriate instruments for measurement of different quantities.
- Ability to analyze, formulate and select suitable sensor for the given industrial applications
- Ability to analyze various control processes used and their modes of operation.

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<th>Subject Code</th>
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<td>3 0 0</td>
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<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
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**Course Objective:** This course provides an overview on principles of ergonomics and human factors, their applications to the design and management of industrial systems, Engineering anthropometry, Human performance, human-technology interaction, work place and work station design and concept of value engineering. To address the underlying concepts, methods and application of Value Engineering

**Course Pre/Co-requisite (if any):**

**Detailed Syllabus**

**UNIT 1: Introduction of Ergonomics**
Background of ergonomics, historical evolution of ergonomics, definition of ergonomics, aspect of ergonomics, man machine interaction, and man machine closed loop system, man machine system (MMS)

**Work physiology**
Muscle structure, metabolisms, circulatory and respiratory systems, energy expenditure and workload

**UNIT 2: work related MSDs risk and work postures assessment**
Introduction, assessment of work postures using RULA Methods, work posture assessment using rapid entire body assessment tool (REBA)

**Office Ergonomics-**
Introductions, Issues in workstation design, seat design, engineering anthropometry and work design, A case study: an investigation on passenger seat design in sleeper class coaches in Indian trains.

**UNIT 3: Physical stress-**
Introduction, vibration, occupational noise exposure, sound, source of noise and vibration, basic theory of noise measurement, Noise measuring meters, basic sound level meters, noise control , permissible limits of exposure with respect to occupational noise.

**UNIT 4: Value Engineering**
Introduction: Definition, value engineering recommendations, programs, advantages, Evaluation of function, determining function, classifying function, evaluation of costs, evaluation of worth, determining worth, and evaluation of value.

**Value Engineering Job Plan:**
Introduction, orientation, information phase, Function phase, creation phase, evaluation phase, Investigation phase, implementation phase, speculation phase, analysis phase.

**UNIT 5: Selection of Evaluation of Value Engineering Projects:**
Project selection, Methods selection, value standards, application of Value Engineering methodology.

Initiating Value Engineering Program: Introduction, training plan, career development for Value Engineering specialties.

Fast Diagramming: Cost models, life cycle costs.

Value Engineering level of Effort: Value Engineering team, Co-ordinator, designer, different services, definitions, construction management contracts, value engineering case studies

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

Learning Outcome

At the end of the course the student can:
CO1: Specify and design ergonomically appropriate industrial workstations for the industrial and office work environment.
CO2: Identify information-centered human factors relating to visual, illumination, controls, displays and symbols.
CO3: Compare, contrast and assess human body-centered ergonomic designs for posture, material handling, repetitive motion factors, heat stress, noise and vibration.
CO4: Define the ergonomic factors intrinsic in evaluating accidents, human errors and safety related incidents.
CO5: Student will understand the concepts, methods and application of Value Engineering

Text book [TB]:

Reference books [RB]:

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<th>Subject Code</th>
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**Course Objective:** This course aims at introducing the students to the basic concepts of engineering design and product development with focus on the front end processes. At the end of this course the student is expected to demonstrate an understanding of the overview of all the product development processes and knowledge of concept generation and selection tools.

**Course Pre/Co- requisite (if any):** Manufacturing Process, Industrial Engineering and Management

**Detailed Syllabus**

**UNIT 1:**
Significance of product design, Need for developing products, product design and development process, the importance of engineering design, sequential engineering design method, relevance of product lifecycle issues in design, the challenges of product development.
Product Planning and Project Selection: generic product development process, Identifying opportunities, evaluate and prioritize projects, allocation of resources, various phases of product development-planning for products.

**UNIT 2:**
Identifying Customer Needs voice of customer, customer populations, Interpret raw data in terms of customers need, hierarchy of human needs, need gathering methods, establish the relative importance of needs.
Product Specifications: Establish target specifications, setting final specifications
Concept Generation: Activities of concept generation, clarifying problem, search both internally and externally, explore the output

**UNIT 3:**
Industrial Design: Assessing need for industrial design, industrial design process, management, assessing quality of industrial design, human factors design, user friendly design
Concept Selection: Overview, concept screening and concept scoring, methods of selection, case studies.

**UNIT 4:**
Theory of inventive problem solving (TRIZ): Fundamentals, methods and techniques, General Theory of Innovation and TRIZ, Value engineering Applications in Product development and design, Model based technology for generating innovative ideas measurement of customers response.
Concept Testing: Elements of testing: qualitative and quantitative methods including survey.

**UNIT 5:**
Intellectual Property: Elements and outline, patenting procedures, claim procedure.
Design for Environment: Impact, regulations from government, ISO system, case studies.

**Learning Outcome**

At the end of the course the student can:
CO1:Product Design and Innovation course is intended to introduce overall awareness of the product design process.
CO2:This course will give an understanding of methods, tools and techniques applied in product design.

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

CO3: This course includes overview of innovation, product design process, user study, need/problem identification, development of design brief, understanding competitive benchmarking, aspects of human factors in product design, tools for creative concept generation, and prototyping/model making and evaluation techniques for user-product interaction.

CO4: This course will be explained with lectures including case studies and hands-on exercises. This will help students to generate creative ideas in to product design, considering human factors aspects.

Text book [TB]:

REFERENCES [RB]:
Course Objective: To provide students an overview of global energy resources with focus on renewable energy sources and their importance in the context of limited supply of conventional energy resources & global warming.

Course Pre/Co-requisite (if any): Basic Thermodynamics, Heat Transfer

Detailed Syllabus

UNIT 1: ENERGY RESOURCES
Introduction: Energy & its importance in social & economic development; energy demand & supply, world energy status, energy scenario in India; energy & environment, greenhouse effect & global warming; role of renewable energy sources; a brief introduction to various renewable energy sources – hydro, solar, biomass, wind, geothermal & ocean energy – their availability & present status.

UNIT 2: SOLAR ENERGY
The sun as a source of energy, extraterrestrial & terrestrial solar radiation; solar radiation data & geometry, solar radiation on horizontal & inclined surfaces; solar thermal systems – various types of solar collectors & their applications in cooking, drying, water heating, distillation, space heating & cooling, refrigeration and power generation.
Solar photovoltaic systems, solar cell fundamentals, performance & characteristics, types of solar cells; solar cell, module, and array construction; solar PV applications.

UNIT 3: BIOMASS ENERGY
Origin of biomass, photosynthesis & generation of biomass, availability of biomass, usable forms of biomass – fuel wood, charcoal, fuel pellets, biodiesel, bioethanol, biogas and producer gas; biomass conversion technologies, thermochemical & biochemical methods, biomass gasification, classification & operational parameters of biogas plants, energy recovery from urban waste, sewage to energy conversion.

UNIT 4: WIND ENERGY
Origin & nature of winds; history of power from winds; global & local winds; estimation of wind energy at a site; maximum power extraction from wind – Betz criterion; capacity factor of wind power plants; types of wind turbines – horizontal and vertical axis wind turbines; wind energy storage; environmental & economic aspects; present status of wind energy systems.

UNIT 5: GEOTHERMAL & OCEAN ENERGY
Structure of earth’s interior; origin & distribution of geothermal energy, types of geothermal resources – exploration & development of hydrothermal, geo-pressured & hot dry rock resources; electrical power generation from geothermal energy; environmental & economic considerations.
Ocean energy; tidal, wave & ocean thermal energy, energy from tidal streams (marine currents); technology for harnessing tidal & wave energy; ocean thermal energy conversion technology.

Learning Outcome

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018
At the end of the course the student will:
CO1: Understand about the interaction between energy, economy, environment, and social development.
CO2: Appreciate the importance of renewable energy sources & future energy systems based on them.
CO3: Possess the basic technical knowledge to develop energy systems based on solar, biomass, wind, geothermal & ocean energy.

**Text book [TB]:**

**References [RB]:**

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Course Objective: The course provides wide knowledge about basics of GIS and its applications in various fields

Unit-1: Introduction

Definition of GIS, Cartography and GIS, GIS database: spatial and attribute date; Spatial models: Semantics, spatial information, temporal information, conceptual models of spatial information, representation of geographic information: point, line and area futures, topology,

Unit-2: Components

Raster and vector data, raster to vector data conversion, map projection, analytical transformation, rubber sheet transformation, manual digitizing and semi-automatic line following digitizer; Remote sensing data as an input to GIS data;

Unit-3: Classifications and Functions

Attribute database: scale and source of inaccuracy; GIS functionality; data storage and data retrieval through query, generalization, classification, containment search within a spatial region;

Unit-4: Analysis

Overlay: arithmetical, logical and conditional overlay, buffers, inter visibility, aggregation; Network analysis;

Unit-5: Applications

Applications of GIS in planning and management of utility lines and in the filed of environmental engineering, geotechnical engineering, transportation engineering and water resources engineering.

Course Outcome: The students will learn from this course:

- Basic understanding of GIS concepts, components.
- Analyzing geo-spatial data with various techniques and GIS tools
- Apply the concepts in solving environmental and engineering problems
- Create new information and theoretical knowledge after applying GIS tools

Books Recommended:

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

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Unit 3: Introduction to Transportation problems, various methods of Transportation problem, Variations in Transportation problem, introduction to Assignment problems, variations in Assignment problems, Sequential optimization, Representation of multistage decision process; Types of multi stage decision problems; Concept of sub optimization and the principle of optimality.

Unit 4: Optimization techniques, Memetic algorithm, Differential evolution, Evolutionary algorithms, Dynamic relaxation, Genetic algorithms, Hill climbing with random restart, Genetic Algorithm (GA), Artificial Bee Colony (ABC), Particle Swarm Optimization (PSO), Firefly algorithm, Fish School Search, Fly algorithm, Ant colony optimization algorithms.

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Course Objective:
To create an overview and understanding of various art forms that exists from ancient to modern times.

Unit 1: INTRODUCTION
Understanding various art forms in society and in different cultures.

Unit 2: Sociological Perspective
Relationship between art, culture and society. Influence of art forms on people.

Unit 3: Appreciation-I: Painting/ Sculptures
Understanding and appreciating films/ documentaries from past to present times and between east and west

Unit 4: Appreciation-II: Films/ Documentaries
Understanding and appreciating painting and sculptures from past to present times and between east and west

Unit 5: Appreciation-III: Indigenous/ Folk Art
Understanding and appreciating Indigenous/ Folk art from past to present times and between east and west.

LEARNING OUTCOME:
4. The student will be able to understand the various art forms.
5. The students will be able to understand and establish a relationship between art, culture and society.
6. The students will be able to appreciate the various art.

Text Books:
3. Creative Authenticity: 16 Principles to Clarify and Deepen Your Artistic Vision, Ian Roberts

Reference Books:
The Writer: A Concise Complete and Practical Text Book of Rhetoric. Designed to Aid in The Appreciation, George Lansing Raymond

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Unit 1
Introduction to nanotechnology, definition, history of nanotechnology, nanotechnology in relation to other branches of engineering, characteristic length scale of materials and their properties, classification of nano materials, dimensionality and size dependent phenomena, confinement in 0-D, 1-D, 2-D and 3-D, surface to volume ratio, fraction of surface atoms, surface energy.

Unit 2
Nanomaterials synthesis techniques; top-down and bottom-up techniques, ball milling, PVD, CVD, self-assembly.

Unit 3
Nanomaterials characterization; XRD, SEM, TEM, AFM, UV-VIS.

Unit 4
Nanomaterials and their properties: carbon based nano materials, metal based nano materials, quantum dots, biological nano materials.

Unit 5
Applications of nanotechnology in engineering, solar energy conversion, nanomedicine.

Text Books:
1. Poole, Jr. CP and Owens, FJ, “Introduction to Nanotechnology”, Wiley India. 2006.