Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

DIT UNIVERSITY
Dehradun

Detailed Course Structure
of

B.Tech- Petroleum Engineering

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

			L	T	P	
UC	HS 103	Professional Communication	2	0	2	3
UC	MA 101	Engineering Mathematics-I	3	1	0	4
UC	EE 103	Basic Electrical Engineering	3	1	2	5
UC	PY102 / PY 103 / PY104	Introduction to Mechanics / Waves and Optics and Introduction to Quantum Mechanics / Introduction to Electromagnetic Theory	3	1	2	5
UC	ME 103	Engineering Graphics	0	0	3	1.5

			L	T	P	
UC	MA 102	Engineering Mathematics - II	3	1	0	4
UC	CH 101	Engineering Chemistry	3	1	2	5
UC	ME 105	Engineering Mechanics	2	1	2	4
UC	ME 104	Workshop Practice	0	0	2	1
UC	CS 105	Programming for Problem Solving	3	0	4	5

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

			L	T	P	
SC	MA 202	Probability and Statistics	3	1	0	4
DC	PE 201	Applied Geology	3	1	2	5
DC	PE 202	Fluid Mechanics & Machinery	3	1	2	5
DC	PE 203	Chemical Thermodynamics	3	1	0	4
DC	PE 204	Oil & Gas Well Drilling Technology and Well Completion	3	1	0	4
AC	CH 201 / HS 244	(Environmental Science / Indian Constitution)	2	0	0	0
AC	HS201	Aptitude & Soft Skills- 1	2	0	0	0

			L	T	P	
HE	HS24*	Humanities Elective-I	2	0	0	2
DC	PE 211	Unit Operation	3	0	2	4
DC	PE 212	Formation Evaluation	3	1	0	4
DC	PE 213	Drilling Fluid and Cements	3	0	2	4
DC	PE 214	Petroleum Production Operation-I	3	1	0	4
DC	PE 215	Elements of Reservoir Engineering	3	1	2	5
HC	CH 201 / HS 244	(Environmental Science / Indian Constitution)	2	0	0	0
AC	HS204	Aptitude & Soft Skills- 2	2	0	0	0

HS241	Education and Social Change
HS242	Introduction to Psychology
HS243	Science, Technology and Society
HS245	Ethics and Self-Awareness

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

			L	T	P	
DC	PE 301	Petroleum Exploration Methods	3	0	2	4
	PE 302	Petroleum Production Operation-II	3	1	0	4
	PE 303	Oil and Gas Pipeline Engineering	3	0	2	4
	PE 304	Enhanced Oil Recovery	3	0	2	4
	PE 306	Heat Transfer Process	3	0	2	4
HE		Humanities Elective-2	2	0	0	2
PRJT	PE 311	Study Project	0	0	4	2
ST	PE 312	Summer Training Evaluation				0
VAT	PE313	Value Addition Training	0	0	2	0
AC	HS301	Aptitude & Soft Skills- 3	3	0	0	0

HS384	Principles of Management
HS385	Engineering Economics
HS391	Positive Psychology & Living
HS382	Literature, Language and Society

			L	T	P	
DC	PE 351	Petroleum Refining and Petrochemicals	3	0	2	4
	PE 352	Oil and Gas Well Testing	3	1	2	5
	PE 353	Petroleum Engineering System Design	3	1	0	4
	PE 354	Petroleum Field Instrumentation and Control	3	0	2	4
	PE 355	Health, Safety and Environment in Petroleum Industry	3	0	0	3
DE	PE 35*	Department Elective-1	2	0	0	2
AC	PE 322	Industrial Tour				0
PRJT	PE 361	Design/LAB Project (Minor)	0	0	10	5
AC	HS304	Aptitude & Soft Skills- 4	3	0	0	0

PE 356	Offshore Oil and Gas Drilling and Production Operations
PE 357	Unconventional Hydrocarbon Resources
PE 358	Oil and Gas Transportation System

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

			L	T	P	
DC	PE 401	Reservoir Simulation	2	0	4	4
DE	PE 40*	Department Elective-2	2	0	2	3
	PE 40*	Department Elective-3	3	0	0	3
OE		Open Elective-1	3	0	0	3
PRJT	PE411	Design/ LAB Project (Major)	0	0	16	8
HE		Humanities Elective-3	2	0	0	2
UC	ME381	Entrepreneurship & Start Up	2	0	2	3
AC	HS311	Employment Enhancement Program	2	0	0	0

PE 402	Fluid Flow Through Porous Media
PE 403	Computer based Numerical Techniques

PE 404	Petroleum Equipment Design
PE 405	Polymer Science

HS481	Application of Psychology
HS484	Intellectual Property Rights
HS482	Human Values
HS492	Indian English Literature

CS481	Software Quality Engineering	3	0	0
IT353	Basics of Data Science	3	0	0
IT356	Multimedia	3	0	0
EC383	Consumer Electronics	3	0	0
EC385	Analog Electronics	3	0	0
EE481	New and Renewable Energy Sources	3	0	0
ME342	Composites Materials	3	0	0
ME445	Total Quality Management	3	0	0
MA451	Statistical Techniques & their application	3	0	0
AR481	Graphics & Product Design	3	0	0

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

			L	T	P	
IP/THESIS	PE 461	Industrial Project/Thesis				16
		OR				
DE	PE 45*	Department Elective-4	3	0	0	3
	PE 45*	Department Elective-5	3	0	0	3
	PE 45*	Department Elective-6	3	0	0	3
	PE 45*	Department Elective-7	2	0	0	2
OE		Open Elective-2	3	0	0	3
HE		Humanities Elective-4	2	0	0	2

PE 451	Applied Petroleum Reservoir Engineering
PE 454	CBM and Gas Hydrates

PE 452	Oil and Gas Marketing and Resource Management
PE 453	Oil and Gas Field Development

PE 456	Well Control
PE457	Directional Drilling

PE 458	Petroleum Law and Policies
PE 459	Natural Gas Engineering
PE 460	Well Integrity and abandonment
PE461	Refinery Utilities and Energy Optimization

HS493	Indian Culture & Tradition
HS483	Indian Philosophy
HS491	Industrial Sociology
HS485	Sustainable Development

CS482	Human Computer Interaction	3	0	0
IT357	Internet of Things	3	0	0
IT359	Mobile Computing and Services	3	0	0
EC386	Fundamental of communication & Networks	3	0	0
EC382	Biomedical Instrumentation	3	0	0
EE485	Basic Instrumentation & Process Control	3	0	0

ME382	Ergonomics and Value Engineering	3	0	0
ME366	Product Design and Development	3	0	0
ME452	Renewable Energy Sources	3	0	0
CE483	GIS	3	0	0
MA452	Optimization Techniques	3	0	0
AR485	Art Appreciation	3	0	0
PY481	Nano scale science and technology	3	0	0

1	1	19
	2	18.5
2	3	22
	4	23
3	5	24
	6	27
4	7	26
	8	16
Total		175.5

AC	0	8
DC	83	20
DE	19	7
HE	8	4
IP/THESIS	16	1
OE	6	2
PRJT	15	3
VAT	0	1
SC	4	1
ST	0	1
UC	40.5	11
Grand Total	175.5	59

	2-0-2		3		UC		1st		I / II

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

Communication: Meaning, Types of Communication: General and Technical Communication. Knowledge and adoption of Non Verbal cues of communication: Kinesics, Proxemics, Chronemics, Oculesics, Haptics, Paralinguistics. Barriers to Communication, Overcoming strategies.

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

Reading Strategies and Vocabulary Building Reading Comprehension.Paragraph development. Intra office Correspondence: Notice, Agenda, Minutes and Memorandum. Technical Proposal & Report.

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

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

1. Rizvi, Ashraf. Effective Technical Communication, McGraw Hill, New Delhi. 2005.
2. Raman, Meenakshi and Sangeeta Sharma,. Technical Communication: Principles and Practice, 2nd Edition. New Delhi: Oxford University Press. 2011.

1. Aslam, Mohammad. Introduction to English Phonetics and Phonology Cambridge.2003.
2. Ford A, Ruther. Basic Communication Skills; Pearson Education, New Delhi.2013.
3. Gupta, Ruby. Basic Technical Communication, Cambridge University Press, New Delhi.2012.
1. Kameswari, Y. Successful Career Soft Skills and Business English, BS Publications, Hyderabad.2010.
2. Tyagi, Kavita& Padma Misra. Basic Technical Communication, PHI, New Delhi. 2011.

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

	3-1-0		4		UC		1st		I / II

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

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.

Limit, Continuity, Partial Derivatives, Euler's Theorem, Total Derivatives, Taylor's series, Maxima and Minima, Method of Lagrange's multipliers.

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.

Scalar and Vector functions, fields, Gradient and its applications, Directional derivative, Divergence and Curl and their applications. Line integral, Surface integral, Statement of Green's Theorem, Volume integral, Statements of Stokes and Divergence Theorems and their applications.

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.

1. G. B. Thomas Jr. and R. L. Finney, Calculus and Analytic Geometry, 9th Edition, Pearson Education, 2017.
2. R. K. Jain and S. R. K. Iyenger, Advanced Engineering Mathematics, 2nd Edition, Narosa Publishing House, New Delhi, India, 2014.

1. B. S. Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publication, New Delhi, India, 2012
2. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, U.K., 2006.

	3-1-2		5		UC		1st		I / II

- 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.

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.

Single Phase A.C.: Phasor representation of voltage and current, A.C. circuit behavior of resistance, inductance, capacitance & their combination in series and parallel, Power triangle, Power factor, Concept of series & parallel resonance.
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.

Single line diagram of simple power system.
Single phase Transformer: Principle of operation, Types of construction, Phasor diagram, Equivalent circuit, Efficiency and voltage regulation, O.C. and S.C. tests.

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.

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
Single Phase Induction Motor: Principle of operation of single phase induction motor by double revolving field theory, Methods of starting of single phase induction motor.

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.

1. V. Del Toro. “Principles of electrical Engineering”, Prentice hall International.
2. J. Nagrath, “Basic Electrical Engineering”, Tata Mc Graw Hill.

1. W.H. Hayt& J.E. Kemmerly, “Engineering circuit Analysis”, Mc Graw Hill.
2. H. Cotton, “Advanced Electrical Technology” Wheeler Publishing.

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.
4. Measurement of efficiency of a single phase transformer by load test.
5. Determination of parameters and losses in a single phase transformer by OC and SC test.
6. Study of characteristic of DC Motor.
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.

	3-1-2		5		UC		1st		I / II

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.

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.

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.

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

Magnetization and associated bound currents; auxiliary magnetic field $\vec{H}$; Boundary conditions on $\vec{B}$ 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.

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 (4L)

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.

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.

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.

David Griffiths, Introduction to Electrodynamics, PHI Learning, 2012.

1. Halliday and Resnick, Physics, Wiley, 2013.
2. W. Saslow, Electricity, Magnetism and Light, Academic Press, 2002.

1	Identification of various electronic components.
2	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.
3	Charging and discharging of capacitor through resistance and determination of time constant.
4	To determine the specific resistance of a given wire using Carey Foster's bridge.
5	To verify Stefan's law by electrical method.
6	To study the variation of magnetic field with distance along the axis of a current carrying coil and determination of radius of the coil.
7	To calibrate the given voltmeter using potentiometer.
8	To calibrate the given ammeter using potentiometer.
9	To determine the band gap of a semiconductor p-n junction.
10	To determine the resistance of a sample using four probe method.
11	To determine the band gap of semiconductor using four probe method.
12	To determine a unknown resistance using Wheatstone bridge.

	3-1-2		5		UC		1st		I / II

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.

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

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

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.

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

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

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.

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.

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

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

1. H. J. Pain, The physics of vibrations and waves, Wiley, 2008
2. AjoyGhatak, Optics, McGraw Hill Education, 2017.
3. B.G. Streetman, Solid State Electronic Devices, Prentice Hall of India, 2015.
4. D. J. Griffiths, Quantum mechanics, Pearson Education, 2015.

1. E. Hecht, Optics, Pearson Education, 2008.
2. O. Svelto, Principles of Lasers, Springer Science & Business Media, 2010.
3. D. A. Neamen, Semiconductor Physics and Devices, Times Mirror High Education Group, Chicago, 2017.

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.

1	(a) To determine wavelength of sodium light using Newton's Rings. (b) To determine the refractive index of a liquid using Newton's Rings.
2	To determine wavelength of sodium light using Fresnel's Biprism.
3	(a) To determine wavelength of prominent lines of mercury using plane diffraction grating. (b) To determine the dispersive power of a plane transmission diffraction grating.
4	To determine the specific rotation of cane sugar solution using bi-quartz polarimeter
5	To study the diffraction pattern of Single slit and hence determine the slit width.
6	(a) To verify cosine square law (Malus Law) for plane polarized light. (b) To study the nature of polarization using a quarter wave plate.
7	To study the variation of refractive index of the material of the prism with wavelength and to verify Cauchy's dispersion formula
8	(a) To study photoelectric effect and determine the value of Planck's constant. (b) To verify inverse square law using photocell.
9	To determine the frequency of AC mains using sonometer.
10	To determine the frequency of AC mains or of an electric vibrator by Melde's experiment
11	To measure the numerical aperture (NA) of an optical fiber.

	3-1-2		5		UC		1st		I / II

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.

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.

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.

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.

Magnetization and associated bound currents; auxiliary magnetic field $\vec{H}$; Boundary conditions on $\vec{B}$ 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.

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.

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.

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 Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

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

1. David Griffiths, Introduction to Electrodynamics, PHI Learning, 2012.

1. Halliday and Resnick, Physics, Wiley, 2013.
2. W. Saslow, Electricity, Magnetism and Light, Academic Press, 2002.

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
9. Determine a high resistance by leakage method using Ballistic Galvanometer.

	0-0-3		1.5		UC		1st		I / II

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.

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

Orthographic Projections covering, Principles of Orthographic Projections, Projections of Points and lines inclined to both planes; Projections of planes inclined Planes

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

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

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

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.

1. N. D. Bhatt and V.M. Panchal, “Engineering Drawing”, Charotar Publishing House Pvt. Ltd., 53rd edition, 2016 reprint.
2. P.S. Gill, “Engineering graphics”, S. K. Kataria& Sons, 13th edition, 2016

1. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education.
3. Narayana, K.L. & P Kannaiah (2012), Text book on Engineering Drawing, Scitech Publishers
4. D.M. Kulkarni, A.P. Rastogi, A.K. Sarkar, “Engineering Graphics with AutoCAD” , PHI Learning Pvt. Ltd., Ist edition, 2009.
5. (Corresponding set of) CAD Software Theory and User Manuals

	3-1-0		4		UC		1st		I / II

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.

Matrices, Elementary row and column operations, row reduced echelon form, rank of a matrix, invertible matrices. Consistency and solution of a system of linear equations. Linear dependence and independence of vectors, Vector space and its basis, Matrix transformation, Rank-Nullity theorem, Eigen-values and eigen-vectors, Similar matrices, Cayley–Hamilton theorem and its applications. Diagonalization of matrices.

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.

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.

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

Laplace Transform, Existence theorem, Properties of Laplace transform, Laplace transform of derivatives and integrals, Laplace Transform of Periodic functions, Unit Step function and Error Function, Dirac- Delta function. Inverse Laplace transform and their properties, Convolution theorem, Applications of Laplace Transform to solve linear differential equations pertaining to engineering problems.

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.

1. R. K. Jain and S. R. K. Iyenger, Advanced Engineering Mathematics, 2nd Edition, Narosa Publishing House, New Delhi, India, 2014.
2. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, U.K., 2006.

1. B. S. Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publications, New Delhi, India, 2012.
2. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

	3-1-2		5		UC		1st		I/II

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

Standards for drinking water, Water Quality parameters, Determination of alkalinity of water, Hardness of water: Units and determination. Demineralization of water.
Softening of water: Lime soda Process, Ion exchange process, Zeolite process and RO process. Internal conditioning methods: Carbonate conditioning, Phosphate conditioning, Colloidal conditioning, Calgon conditioning. Desalination of brackish water. Numerical Problems based on all these parameters.

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.
Corrosion and its economic aspects, Types of corrosion: Galvanic, Erosion, Crevice, Pitting, Waterline, Soil, Microbiological. Theories of corrosion: Acid, Direct Chemical attack, Electrochemical. Corrosion prevention by metallic, organic/inorganic coatings and corrosion inibitors

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)

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.

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

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.

1. Engineering Chemistry by Shikha Agarwal. Cambridge University Press Edition 2015.
2. Engineering Chemistry by S. Vairam& Suba Ramesh. Wiley India Pvt. Ltd. 2014.

1. Environmental Chemistry by Stanley E. Manahan. CRC Press Taylor and Francis.
2. Organic Chemistry by Morrison and Boyd. Pearson.
3. Physical Chemistry by Atkins. Oxford University Press.
4. Concise Inorganic Chemistry by J.D. Lee. Oxford University Press.
5. Basic Biotechnology by S Ignacimuthu. Tata Mcgraw-Hills
6. Spectroscopy by Silver Stein. Pearson.
7. Nano: The essentials by T. Pradeep. McGraw Hill Education.
8. Biochemistry by StryerLubert. Mcmillan learning. 2015.

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

	2-1-2		4		UC		1st		I / II

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

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.

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; Impending motion on horizontal and inclined planes; Numerical Problems on single and two blocks on inclined planes, ladder and wedge friction.

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.

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.

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

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.

3. Engineering Mechanics by S.S. Bhavikatti, New Age International Publisher, New Delhi, 3rd edition 2009.
4. Engineering Mechanics-Statics and Dynamics by A Nielson, Tata McGraw Hill Education Private Ltd, New Delhi, 2009.

1. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education
2. Beer FP and Johnson ER, “Mechanics for Engineers- Dynamics and Statics”- 3rd SI Metric edition, Tata McGraw Hill. - 2008
5. Shames IH, “Engineering Mechanics – Statics & Dynamics”- PHI

---

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

	0-0-2		1		UC		1st		I / II

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

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.

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

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

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

To observe the demonstration of making a Lap joint/Butt joint with mild steel sheet using oxyacetylene flame as per the drawing provided in the manual. To perform the spot welding operation on G.I. sheet

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.

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

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

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.

1. A course in Workshop Technology Vol I and Vol II by Prof. B.S. RaghuwanshDhanpat Rai & Co.(P) Ltd.
2. Elements of Workshop Technology Vol I and Vol II by S.K. Hajara Choudhury ,A.K. Hajara Choudhury &Nirjhar Roy ;Media Promoters & Publishers Pvt. Ltd, Mumbai

---

1. WorkshopTechnology Part 1 , Part2 & Part3 by W.A.J. Chapman;CBS Publishers & Distributors, New Delhi

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

	3-0-4		5		UC		1st		I / II

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.

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

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

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)

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.

Pointers: Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list.
File handling: different modes of opening a file in C, reading, writing from files.

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.

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

1. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", 2nd edition 1988, Prentice Hall of India.

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.
6. Programming for Matrix problems, String operations.
7. Programming for Simple functions
8. Programming for Recursive functions.
9. Programming for Pointers and structures.
10. Programming for File operations
11. Programming for solving Numerical methods problems

	CH201								
	2 0 0		0		AC		2nd		III

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.

Definition and Concept of Environment, Multidisciplinary nature of environmental studies.Scope and importance of environmental studies, Need for public awareness, Environmental concerns and people.Introduction and classification of natural resources. Energy Resources, Water Resources, Land Resources, Forest Resources, Food Resources, Mineral Resources, Case studies related to over exploitation of resources and their impacts. Role of an individual in conservation of natural resources, Sustainable lifestyles.

Definition and concept of ecology, Structure and Function of an Ecosystem, Energy Flow in Ecosystems, Biogeochemical cycles (Nitrogen, Carbon, Phosphorus, Oxygen, Hydrological). Species interactions in ecosystems.Ecological succession and ecological pyramids. Characteristic features of grassland, pond, desert and forest ecosystems. Ecosystem services and conservation.

Introduction and types of biodiversity. Bio-geographic classification of India, Value and significance of biodiversity, Biodiversity at global, national and local levels, India: A mega-diversity nation, Biodiversity hotspots, Threats to Biodiversity: Poaching and man-wildlife conflicts, IUCN Red Data Book and endangered & endemic species of India. Biodiversity conservation strategies, Institutes and organizations.

Introduction and Definition. Causes, consequences and control measures of: Air pollution, Water pollution, Noise pollution, Nuclear pollution, Soil pollution, Thermal and Marine pollution. Solid waste management, Bio-medical waste management.Disasters and its mitigation strategies, Global warming, Climate change, Acid rain, Ozone depletion and Smog.Pollution case studies.Role of an individual in pollution prevention.

Sustainable Development: Concept and importance, Environmental Impact Assessment (EIA), GIS, Remote sensing. Water conservation and rain water harvesting. Resettlement and rehabilitation problems, Environmental audit, eco-labeling and eco-friendly business. Environmental Legislation in India, Population explosion and its impact on environment and human health, Value Education and environmental ethics.

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
3. Study of common flora and fauna.
4. Study of a common ecosystem-pond, river, hill slopes, etc.

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.
3. Establish man-wildlife harmonious relationship.
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.

---

1. BharuchaErach; Textbook for Environmental Studies; University Grants Commission, New Delhi; 2004.
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.

1. Miller T.G. Jr; Environmental Science; Wadsworth Publishing Co.; 2002.
2. De A.K.; Environmental Chemistry; Wiley Eastern Ltd.; 1996.
3. Sharma, P.D.; Ecology and environment; Rastogi Publication; 2005.

	HS244								
	2 0 0		0		AC		2nd		III

1. To familiarize the students with the features of the Indian Constitution
2. To provide a knowledge of their constitutional rights

Constitution- meaning of the term, basic features Indian Constitution: Sources and constitutional history. Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive, Principles of State Policy, debates on Fundamental Rights and Directive. Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive, Principles of State Policy, debates on Fundamental Rights and Directive.

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

Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected, Representative, CEO of Municipal Corporation. Pachayati Raj: Introduction, PRI: ZilaPachayat, Elected officials and their roles, CEO ZilaPachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

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.

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.

1. Abbas, H., Kumar, R. &Alam, M. A.; Indian Government and Politics; New Delhi: Pearson; 2011.
2. Chandhoke, N. &Priyadarshi, P.; Contemporary India: Economy, Society, Politics; New Delhi: Pearson; 2009.

1. Chakravarty, B. & Pandey, K. P.; Indian Government and Politics; New Delhi: Sage; 2006.
2. Chandra, B., Mukherjee, A. & Mukherjee M.; India after Independence; New Delhi: Penguin; 2010.
3. Vanaik, A. & Bhargava, R.; Understanding Contemporary India: Critical Perspectives; New Delhi: Orient Blackswan; 2011.

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

	3 1 0		4		SC				III

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.

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

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

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 -χ^2 and F-distributions- Point estimation- Maximum error of estimate - Interval estimation

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

Introduction - Fitting a straight line –Second degree curve-exponential curve-power curve by method of least squares-Goodness of fit. Correlation and Regression – Properties

Introduction - Methods for preparing control charts - Problems using x-bar, p, R charts and attribute charts

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.

1. Jay l.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.

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

1. Shron L.Myers, Keying Ye, Ronald E Walpole; Probability and Statistics Engineers and the Scientists; Pearson; 2007.
2. Johannes Ledolter and Robert V.Hogg; Applied statistics for Engineers and Physical Scientists; Pearson; 2010.

	3 1 2		5		DC				III

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.

Rock types: Igneous, Sedimentary and Metamorphic rock formation and their geological processes. Introduction to Sedimentary rocks: Rock cycle, Morphology and Textural properties. Primary and secondary Sedimentary structures. Sedimentary rocks classifications and their characteristics – Clastics and Non Clastics

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

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

Sedimentary environment: Non-Marine, Mixed Marine and Marginal environments. Sedimentary facies and their applications.Various Depositional systems.Basin formation and Basin Analysis. Introduction to Sequence stratigraphy, Base level concepts: Transgression, Regression. Sequences, Seismic stratigraphy

Introduction to Petroleum Geology; Organic and Inorganic origin of petroleum and their supporting theories. Introduction to source rock and reservoir rocks and cap rocks their formation processes and characteristics.Migration of petroleum; Kerogen studies: Formation, Maturation and types. Petroleum entrapment – process and types. Geology of producing & prospective basins in India: on shore & off-shore. Plate Tectonics & petroleum occurrences

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 metamrphic 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

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.

The outcome creates ability to apply the principles of exploration , evaluation, development, and recovery of hydrocarbons , and other fluids in various subsurface reservoirs.

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.

Develop skills for solving basic Petroleum related problems.

Develop into successful, socially and ethically responsible careers in the petroleum industry.

1. Parbin Singh; Engineering and General Geology;,Katson Publication House, 1987.
2. Sam Boggs. Jr.; Principles of Sedimentology & Stratigraphy; Pearson; 2011.
3. Leverson; Geology of Petroleum; Elsevier; 2006.

1. Bhagwan Sahay; Petroleum Exploration and Exploitation Practices; Allied Publishers; 2001.
2. Richard C. Selley; Elements of Petroleum Geology; Elsevier; 1997.
3. Marland P. Billings; Structural Geology; Prentice-Hall; 1972.
4. John D. Winter; An Introduction to Igneous and Metamorphic Petrology; Library of Congress Cataloging-in-Publication Data; 2001.

	3 1 2		5		DC				III

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.

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

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

One and two dimensional flow equations.Bernoulli‟s equation, application, venturimeter, orifice meter.Equivalentlength.Slurry transport

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

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

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

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.

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.

---

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.

1. Frank M. White; Fluid Mechanics; Mc Graw Hills; 2017.
2. Cengel and Cimbala; Fluid mechanics; McGraw Hills; 2017.

			4		DC				III

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 al so for non-ideal gases.
3. To understand the concept of partial molar properties, phase equillibria, fugacity, phase rule.
4. Understand the working principle and performance of refrigerators and heat pumps

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

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

Solution Thermodynamics: Vapour-liquid equilibria, partial molar properties, chemical potential, Raoult‟s Law and Henry‟s Law. ideal and non-ideal solutions, activity and activity coefficients.

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

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

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 equillibria, 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

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.

1. J M Smith; Introduction to Chemical Engineering Thermodynamics; McGraw Hills; 1975.
2. Cengel and Boles; Thermodynamics an Engineering Approach; McGraw Hills; 1998.

			4		DC				III

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.

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

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

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

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

Well orientation survey. Well deflection; direction determination and presentation

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.

1. Neal J. Adams; Drilling Engineering-A complete well planning approach; PennWell publishing Company; 1985.
2. Carl Gatlin; Drilling Well Completions; PHI; 1965.

1. Adam T. Bourgyne Jr., Keith K. Milheim; Applied Drilling Engineering; SPE Series; 1986.
2. S.S. Rahman, G.V. Chilingarian; Casing design theory and practice; Elsevier; 1995.

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

	HS201		Aptitude and Soft Skills I						
	2 0 0		0		AC		II		III

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.

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

Basic understanding of elementary Mathematics and Logical reasoning and basic understanding of Soft Skills.

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.
AgesProblems 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.

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).

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.

MBTI and other personality tests, strategies to develop interpersonal skills.

(i) I Am (ii) Flip (iii) A Letter to Yourself, (iv) Card Pieces, (v) Blindfold Game, (vi) Crazy Comic.

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.

(i) Stand Up for Fillers, (ii) Mimes, (iii) Short Speech Challenge.

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.

---

1. Quantitative Aptitude :How to prepare for Quantitative Aptitude, Arun Sharma, McGraw Hill, 8th edition, 2018.
2. Logical Reasoning A Modern Approach to Logical Reasoning-R.S. Aggarwal, S Chand Publishing; 2nd Colour edition-2018.
3. Verbal Aptitude : English is Easy- Chetanand Singh, BSC Publication-2018.
4. Soft Skills- The Power of Now- Eckhart Tolle, Yogi Impressions Books Pvt. Ltd.-2010.

---

1. Quantitative Aptitude:Quantitative Aptitude for Competitive Examinations- R.S. Agarwal S. Chand Publications-2018.
   Quantitative Aptitude: Quantitative Aptitude- Saurabh Rawat and AnushreeSahRawatSavera Publishing House, 1st edition-2016.
2. Logical Reasoning: Logical Reasoning and Data Interpretation for the CAT - Nishit K Sinha; Pearson India; 5th edition-2016.
   Logical Reasoning: Wiley's Verbal Ability and Reasoning - P A ANAND,Wiley -2016.
3. Verbal Aptitude: Fun with grammar- Suzanne W. Woodward Pearson Education ESL-1996.
4. Soft Skills- The Greatness Guide – Robin Sharma, Jaico Publishing House- 2006.

			2		Elective				IV

- 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.

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.

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

Class, conflict, legitimation processes, reproduction of society. Anarchist perspectives."New" Sociology of Education.Symbolic interactionist perspectives on education.Resistances to schooling.Critical theory and education.

Neo-Weberian perspectives on education.Status politics and education.Caste, class, gender and education in India.Indian thinkers on education.Current debates on the place of education in India.

- The students will understand how theeducation 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.

Desai, A.R. (2005), *Social Background of Indian Nationalism,* Popular Prakashan.
Giddens, A (2009), *Sociology*, Polity, 6th ed.

- Guha, Ramachandra (2007), *India after Gandhi,* Pan Macmillan.
- Sharma R.S. (1965), *Indian Feudalism,* Macmillan.
- Deshpande, Satish (2002), *Contemporary India: A Sociological View,* Viking.
- Gadgil, Madhav& Ramachandra Guha(1993), *This Fissured Land: An Ecological History of India,* OU Press.
- Haralambos M, RM Heald, M Holborn (2000), *Sociology*, Collins.
- Mohanty, M (ed.) (2004), *Class, Caste & Gender- Volume 5,* Sage.
- Dhanagare, D.N., *Themes and Perspectives in Indian Sociology,* Rawat

			2		Elective				IV

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

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

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

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

Nature and Theories; Intelligence: Nature and Theories

- 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.

1. Baron, R.A. and Misra, G., Psychology (Indian Subcontinent Edition). Person Education Ltd. (2014)
2. Chndha, N.K. & Seth, S., The Psychological Realm: An Introduction. Pinnacle Learning, New Delhi. (2014)

- Ciccarelli, S.K. & Meyer, G.E., Psychology (South Asian Edition). New Delhi: Tata Mc Graw Hill. (2008)
- Glassman, W.F., Approaches to Psychology (3rd Ed.) Buckingham: Open University Press. (2000)
- Passer, M.W., Smith, R.E., Holt, N. and Bremmer, A., Psychology: The Science of MinandBehaviour, McGraw-Hill Education, UK. (2008)

			2		Elective				IV

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

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.

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.

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.

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

- 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.

1. Federic A. Lyman: Opening Engineering Students Mind to Idea to Ideas Beyond Technology. IEEE Technology and Society Magazine, Fall, pp.16-23. (2002)
2. John Theodore Rivers: Technology and the use of Nature. Technology in Society, 25(3), August, pp.403-416 (2003).

- Ronald R. Kline: Using History & Sociology to Tech Engineering Ethics. IEEE Technology and Society Magazine, Winter, pp.13-20 (2002).
- V.V. Krishna: A portrait of the scientific community in India: Historical Growth and Contemporary Problems, Gaillard et al. (eds). Scientific Communities in the Developing World, Sage (1997

			2		Elective				IV

- To introduce the concepts pertaining to ethical and moral reasoning and action
- To develop self – awareness

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

View of Kohlberg,Morality and Ideology, Culture and Morality, Morality in everyday context

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

Perceived Self-control, Self-serving bias, Self-presentation, Self-growth: Transactional Analysis and Life Scripts. Self-Development: Character strengths and virtues, Emotional intelligence, Social intelligence, Positive cognitive states and processes (Self-efficacy, Empathy, Gratitude, Compassion, and Forgiveness).

- 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.

1. Leary M.R., “The Curse of Self: Self-awareness, Egotism and the Quality of Human Life”, Oxford University Press. 2004
2. Louis P. P., “The Moral Life: An Introductory Reader in Ethics and Literature”, Oxford University Press. 2007

- Corey, G., Schneider Corey, M., &Callanan, P., “Issues and Ethics in the Helping Professions”, Brooks/Cole. 2011
- Snyder, C.R., Lopez, Shane, J., &Pedrotti, J.T., “Positive Psychology” Sage, 2nd edition. 2011

			4		DC				IV

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.

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

Molecular and turbulent diffusion, diffusion coefficient, Fick's Law of diffusion, Dependence of diffusion coefficient on temperature, pressure and composition.

: 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.

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

: 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.

: Fundamental concept of humidification, Dehumidification and water cooling, Wet bulb temperature. Classification and design of cooling towers.

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.

Having successfully completed this course,

Student will be able to calculate heat transfer by conduction, convection and thermal radiation for practical situations.

Student will be able to calculate flux in a diffusion process and number of theoretical stages in a stage-wise mass transfer operations.

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.

Fundamental knowledge of downstream engineering, designing of columns, skills both in analysis and synthesis will be improved.

Operation of cooling tower will be clearly understood.

Separation by adsorption, types of adsorbents.

1. Treybal, R. E.; Mass Transfer Operations; McGraw-Hill; 1981.
2. McCabe, W.L., Smith, J.C. and Harriott, P.; Unit Operations of Chemical Engineering; McGraw-Hill; 2001.
3. Geankoplis; Transport Processes and Unit Operations; Prentice-Hall of India; 1993.

1. Hines, A.L. and Maddox, R.N.; Mass Transfer Fundamentals and Applications; Prentice Hall; 2000.
2. Skelland, A.H.P.; Diffusional Mass Transfer; John Wiley & Sons; 1985.
3. Sherwood, T.K, Pigford, R.L., and Wilkes, C.R; Mass Transfer; McGraw Hill; 1975.

			4		DC				IV

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.

classification of logs , Downhole & surface logging equipment, Log presentation, repeatability and Calibration, logging environment and effect of temperature, pressure and depth;

Conventional coring, side wall coring and core evaluation, mud and cutting analysis and significance. Indirect Methods: Application of MWD and LWD in formation evaluation ,SP log: principles and application, Resistivity logs: principles; electrodes systems: Normal, lateral, latero logs; Non-electrode system: Induction log; principles and application. Geosteering principles.

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.

Natural gamma-ray and neutron-log: Principles, system and application. Special logging methods: Casing inspection tools, formation micro scanner, NMR log. Logging high angle wells. Production logging, Tracer logging, temperature logging, spinner logging, Flow velocity tools. Noise tools, Fluid density measurements techniques.

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.

Knowledge and understanding on completion of this module students should be able to demonstrate

Principles and practices of wire-line logs and their importance in formation and reservoir evaluation

How to identify reservoirs

To determine mineralogy, porosity and saturation in various lithologies

Examine various logging tools: advantages and limitations; read and comprehend different log responses; apply integrated log interpretation techniques in formation evaluation;

Differentiate between reservoir and non reservoir rocks

Develop optimum tools and logging programs

Solve formation evaluation problems and demonstrate results

Diagnose the effect of down hole conditions on tool response and log quality

1. ZakiBassiouni; Theory, Measurement, and Interpretation of Well Logs; Society of Petroleum Engineers; 1994.
2. M.H. Rider; The geological interpretation of well logs; French Consulting Limited; 2011.
3. Edward J. Lynch; Formation Evaluation; Harper and Row; 1962.

1. Donald P. Helander; Fundamentals of Formation Evaluation; OGCI Publications, 1983.
2. George Asquith, Charles Gibson; Basic Well Log Analysis For Geologists; 1982.

			4		DC				IV

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.

Types of drilling fluid, components of drilling fluid system: bentonite types and hydration characteristics

Fluid-loss characteristics and characteristics of Filter cake

Oil-base and Saline mud system. Additives used to control drilling fluid system

Oil-well cements; composition, cement slurry components

Cement-slurry preparation and down hole displacement processes and system

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

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.

1. RyenCaenn and HCH Darley; Composition and Properties of Drilling and Completion Fluids; GPP; 2011.
2. ASME; Drilling fluids processing; Elsevier; 2005.

1. Drilling Mud and Cement Slurry Rheology Manual; Technip; 1982.
2. Smith.P.K; Cementing; SPE Pulications; 1976.

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

			PETROLEUM PRODUCTION OPERATION – I						
			4		DC				IV

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.

Well Equipment: Well Head Equipment, Christmas Tree, Valves, Hangers, Flow Control Devices, Safety Devices and Packers; Well Completion Design: Completions Techniques.

Self-flow Well Characteristics, Oil and Gas Production Optimization: Inflow performance, Outflow performance, Multiphase flow in tubing and flow-lines, Wellhead and Choke performance; Nodal System Analysis; Fluid Production Handling System.

Artificial Lift Methods: Introduction, Objectives and Classifications; Sucker Rod Pump: Surface and Sub-surface Working System, Classifications, Selection Criteria, Advantages and Disadvantages, Plunger and Rod Stress Conditions; Dynamometer System and its Applications.

Gas Lift: Introduction, Classifications on the Basis of Installations and Applications, System Characteristics, Applications, System Advantages and Disadvantages, Gas Injection Volume Requirements, Gas Lift Valve Types and Mechanics.

Introduction, Working Principle, Advantages and Disadvantages, and Selection Criterion of Electrical Submersible Pump, Progressive Cavity Pump, Hydraulic Pump, Plunger Lift, Common Problems Affecting Artificial Lift Selection.

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.

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.
3. Kermit E. Brown, H. Dale Beggs; The Technology of Artificial Lift Methods, Vol - 1; Pennwell Books; 1977.

1. Ken Arnold & Maurice Stewart; Surface production Operation Vol.-1 & Vol. 2; Gulf publishing compony; 1989.
2. Michael J. Economides, A. Daniel Hill and Christine Ehlig- Economides; Petroleum Production Systems; Prentice hall Petroleum Engineering Series; 1994.

			5		DC				IV

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

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.

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

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

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

Reservoir drives: Depletion, water drive, gas cap drive, combination drive, and recovery factor. Reserve estimation: Resource and reserve, SPE classification of reserve, volumetric reserve estimation.

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

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.

1. L.P. Dake ; Fundamentals of Reservoir Engineering; Elsevier Science; 1978.
2. Tarek Ahmed; Reservoir Engineering Handbook; Gulf Professional Publishing, 2006.

1. B. C. Craft, M. Hawkins; Applied Petroleum Reservoir Engineering; Prentice Hall; 2014.
2. Rene Cosse; Basic Reservoir Engineering; Editions Technip; 1993.
3. James W Amyx, Daniel M. Bass Jr., Robert L. Whiting; Petroleum Reservoir Engineering; McGraw Hill, 1960.

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

	HS204		Aptitude and Soft Skills II						
	2 0 0		0		AC		II		IV

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.

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

Basic understanding of simplification and calculation tricks, non-verbal pattern completion LR, covered in Aptitude and Soft Skills I.

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.

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.

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.

Importance, How to develop Leadership Skills? Best Leadership & Team Building Examples.
(i) Leadership Pizza, (ii) Minefield, (iii) Leaders You Admire.

What Skills Do Employers Expect From Graduates? CV vs. Resume, CV writing Do's & Don'ts, Tips with Best Examples/ Samples, Feedback Sharing & Error Analysis.

(i) Relevant Videos on 'Employability', (ii) Group Discussions on Newspaper Articles, (iii) Sample correction, (iv) writing exercise.

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.

---

1. Quantitative Aptitude:How to prepare for Quantitative Aptitude, Arun Sharma, McGraw Hill, 8th edition-2018.
2. Logical Reasoning: A Modern Approach to Verbal & Non-Verbal Reasoning by R.S.Aggarwal, S Chand Publishing; 2nd Colour edition-2018.
3. Verbal Aptitude: English is Easy- Chetanand Singh, BSC Publication-2018

---

1. Quantitative Aptitude: Quantitative Aptitude for Competitive Examinations- R.S. Agarwal S. Chand Publications-2018.
   Quantitative Aptitude: Quantitative Aptitude- Saurabh Rawat and AnushreeSahRawatSavera Publishing House, 1st edition-2016.
2. Logical Reasoning: Analytical & Logical Reasoning by Peeyush Bhardwaj-Arihant Publications; 4th edition-2015.
   Logical Reasoning: Analytical Reasoning by M.K.Pandey BSC publishing; 3rd edition . -2009.
3. Verbal Aptitude: Oxford Guide to English Grammar- John Eastwood, Oxford University Press-2003.
4. Soft Skills: Talk like Ted – Carmine Gallo, St. Martin's Press.
   Soft Skills: No Excuses – Dr Wayne Dyer, Hay House Inc.

			4		DC				V

1. To develop better understanding of Geophysical and Geochemical methods for exploitation of Oil and Gas.

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.

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.
Gravity method: Units, Measuring instruments, Gravity anomaly, Data correction and reduction. Free- air and Bouguer Anomalies.Anomaly interpretation and Application.

Seismic methods: Type, Methodology of Refraction profiling. Field survey arrangements.Recoding instruments. Data correction, Special shooting methods: Fan and broadside. Data interpretation and application in identification of structures.Reflection Seismograph and Seismogram relative Advantage over refractive survey. Common Depth Point Profiling and stacks time correction. Well seismic methods. Vertical seismic profiling.Interpretation.3D data acquisition and interpretation, application of reflection survey.

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

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

1. To determine the free-air correction by measuring the gravitational acceleration at different elevations.
2. Todetermine the Bouguer gravity anomaly due to theoffset 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

This subject will assist students to delineate the subsurface features for exploration of oil and gas.

The Geochemical methods will assist in hydrocarbon correlation, maturity and classification of reserves

The good concepts of geophysics will assist students in building better concepts of well logging.

The sound knowledge of this course will make student competent for better understanding of petroleum operation.

The student will learn about the prospect of oil and gas in India and abroad.

1. John Milsom; Field Geophysics; Wiley; 2007.
2. Allen P A and J R Allen; Basin Analysis: Principles and Applications; Wiley Blackwell; 2005.

1. Tedesco S. A.; Sur face Geochemistry in Petroleum Exploration; Chapman and Hall Publishing, 1993.
2. William Murray Telford, W. M. Telford, L. P. Geldart, Robert E. Sheriff ; Applied Geophysics; 1990.
3. Philip Kearey, Michael Brooks, Ian Hills; An Introduction to Geophysical Exploration; Wiley; 2013.

			4		DC				V

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.

Sick Well Analysis; Water and Gas Shut Off: Extraneous Gas and Water Entry into Wellbore; Source Identification, and Control Measures.
Sand production: Causes, Effects, Factors Affecting Sand Production, Sand Control Techniques, Produced Sand Analysis, Gravel Size Selection, Gravel Packing.

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.

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.

Separation: Introduction, Factors Affecting Separation and Separation Mechanism; Separators: Types, Components, Control Systems, and Comparison; Operation and Maintenance of Separators, Operation Problems, Safety Features of Separators.
De-Emulsification, Dehydration and Desalination of Crudes; Produced Water Treating System.

Storage: Purpose, Classification (Offshore / Onshore / Underground), Types of Tanks, Tank Selection, Tank construction, Tank Inspection and Maintenance, Operation and Safety of Tanks.
Vapor Control: Purpose, Factors Contributing to Vapor Losses, Conservation Measures, Evaporation Prevention, Vapor Recovery System.

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.

1. Thomas O. Allen & Alan P. Roberts ; Production Operations Vol.- 1 & Vol. 2; Oil and Gas consultants international; 1982.
2. Ken Arnold & Maurice Stewart; Surface production Operation Vol.-1 & Vol. 2; Gulf publishing compony; 1989.

1. D. Perrin; Well Completion and Servicing; Technip; 1999.
2. Michael J. Economides, A. Daniel Hill and Christine Ehlig- Economides; Petroleum Production Systems; Prentice hall Petroleum Engineering Series; 1994.

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

			4		DC				V

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.

Scope Of Piping In Projects, Plant Piping Systems And Transportation, Difference Between Codes And Standards, ASME / API Codes And Standards. Principles For Piping Design, Major Piping Standards, Pipe Designators -NPS, IPS, NB, Pipe Wall Thickness And Schedule, Pipe Weights, Lengths, Grades, Ends, Joining Methods, Methods Of Manufacture, Pipe Ratings, Pipe Symbols.

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

Piping Material Specifications (PMS), PMS Creation Requirements, Piping Specifications, Material Selection, P-T Ratings, Valve Data, PMS Application, Piping Supports, Anchors, Pipe Guides, Limit Stops, Pipe Shoe, Shoe Guides / Hold Down Guides, Support, Rigid Hangers, Manifold Supports, Pipe Rack Design, Pipe Arrangements, Control Station And Utility Station On Pipe Racks, Pipe Stress Analysis: Objectives And Definition Of Stress Analysis. Critical Line List, Information Required For Stress Analysis, Piping Loads, Steam Piping

Block And Process Flow Diagrams, Utility Flow Diagram, Piping & Instrumentation Diagram, Line Numbering, Line Designation Table/ Line List Creation, Print Reading Exercise, Flow Diagram Versus Piping Drawings, Symbols And Abbreviations, Equipment Vendor Data, Instrument Types And Symbols – Flow, Temperature Pressure And Level, Instrument Hook-Up Drawings, Plot Plan And Equipment Layout.

Types of Corrosion, Prevention strategies – design and coatings, Inhibitors, design of corrosion resistance alloys, anodic protection, Biological aspects of corrosion

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

1. Drawing of Piping Components, Piping Fittings, Types of Flanges Types of Valves,Speciality Items.
2. Design of Equipment Layout, Pump Layout, Compressor layout, Column Layout, Reboiler Layout, Heat exchanger layout, Air cooler layout, Flare layout, Tank Farm design
3. Design of piping layout, pump piping, compressor piping system
4. Computer Aided Design – Basic Drawing functions.
5. Development of GA Drawings,Piping Isometrics
6. Hydraulic Design of Piping Systems,Design Calculations of Piping sizing,Pump Calculation
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

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

By the end of the course students should be able.

1. Understand pipe fittings, selections, drawings and dimensioning
   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.

1. Macetta, John; Piping Design Handbook; M.Dekker; 1992.
2. MohinderNayyar; Piping Handbook; McGraw-Hills; 2000.

1. Ed Bausbacher and Roger Hunt; Process Plant Layout and Piping Design; Prentice Hall; 1993.
2. M. Mohitpour, H. Golshan and A. Murray; Pipeline design and construction: A practical approach; ASME; 2006.

			4		DC				V

- The objective of enhanced oil recovery (EOR) is to give an insight of processes beyond primary and secondary recovery.

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

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

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.

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

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

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.

1. Bradley H B; Petroleum Engineering Handbook; SPE; 1992.
2. Marcel Latil; Enhanced Oil Recovery; Technip; 1980.

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.

			4		DC				V

To understand and apply the basics of calculations related to material and energy flow process in the interacting systems.

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

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.

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

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

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.

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.

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

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.

---

1. Holman J.P.; Heat Transfer; Mc Graw-Hill; 2002.
2. Dutta B.K.; Heat Transfer:Principles and Applications; PHI; 2001.
3. F. Kreith, R.M. Manglik, M.S. Bohn; Principles of Heat Transfer; Cengage Learning; 2011.

1. McCabe, W. L. Smith, J. C., and Harriott. P.; Unit Operations of Chemical Engineering; McGraw-Hill; 2001.
2. Coulson, J.M., Richardson, J.F; Chemical Engineering, Vol. I; Pergamon and ECBS; 1970.
3. Kern, D.Q.; Process Heat Transfer; Tata McGraw-Hill; 2008.

			2		Elective				V

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

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

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

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

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

- 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.

1. Schermerhorn, Management and OrganisationalBehaviour essentials, Wiley India
2. Koontz: Essentials of Management, PHI Learning.
3. Hirschey: Managerial Economics, Cengage Learning.
4. A V Rau: Management Science, BSP, Hyderabad
5. Mote, l Paul and Gupta: Managerial Economics Concepts & Cases, TMH, New Delhi.
6. Stephan R Robbins Fundamental of Management, Pearson

- Koontz, H., and Weihrich, H., Essentials of Management: An International Perspective, 8th ed., McGraw Hill, 2009.
- Hicks, Management: Concepts and Applications, Cengage Learning, 2007.
- Mahadevan, B., Operations Management, Theory and Practice, Pearson Education Asia, 2009
- Kotler, P., Keller, K.L, Koshy, A., and Jha, M., Marketing Management, 13th ed., 2009.
- Khan, M.Y., and Jain, P.K., Financial Management, Tata-Mcgraw Hill, 2008.

			2		Elective				V

- To increase awareness for relevance of positive emotions at workplace.
- To equip students with psychological skills to maximize happiness and virtues like compassion, love and wisdom through experiential, workshop based and interactive activities along with assigned lectures and reading

Introducing Positive Psychology: Definition, goals, assumptions, key concepts and relationships with health psychology, developmental psychology, social psychology and psychology of religion, Meaning and measure of Happiness: Hedonic and Eudemonic perspective, Yogic notion of bliss

What are positive emotions? The broaden and build theory, relevance of positive emotional states for physical, social & psychological resources, Positive emotions and well-being: Happiness and positive behavior, positive emotions and success, resilience, Self-efficacy, Optimism, Hope, Wisdom, Mindfulness and flourishing

Use of postures, breathing practices, Sounds, dietary consumption

Maximizing achievement, conflict resolution, gratitude, positive leadership

- Students learn about modern psychological knowledge of happiness.
- Students acquire skills to cultivate positive emotions.
- Measure and build individual, workplace and educational flourishing; plan, implement and assess positive psychology.
- Students will gain an understanding of what contributes to well-being and how to build the enabling conditions of a life worth living.

Snyder (2011). Positive Psychology: The Scientific and Practical Explorations of Human Strengths. New Delhi: Sage.

1. Carr, A. (2004). Positive Psychology: The science of happiness and human strength.UK: Routledge.
2. Peterson, C. (2006). A Primer in Positive Psychology. New York: Oxford University Press.
3. Seligman, M.E.P. (2002). Authentic Happiness: Using the New Positive Psychology to Realize YourPotential for Lasting Fulfillment. New York: Free Press/Simon and Schuster.
4. Snyder, C.R., &Lopez,S.J.(2007). Positive psychology: The scientific and practical explorations of human strengths. Thousand Oaks, CA: Sage.
5. Snyder, C. R., & Lopez, S. (Eds.). (2002). Handbook of positive psychology. New York: Oxford University Press.

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

			2		Elective				V

- 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

Nature and Scope of Economics in engineering perspective; Meaning and Types, Law of demand, Exceptions to the Law of Demand, Elasticity of Demand; Law of Supply and Elasticity of Supply; Mathematical Explanation on cost, revenue and profit function

Short-run and long-run Production Function; Laws of Returns to Scale & Law of Diminishing Returns Scale; Total cost, fixed cost, variable cost, average variable cost, average fixed cost, marginal cost, explicit and implicit cost; Importance and graphical presentation, mathematical problems

Simple and Compound, Uniform Series Compound Interest Formula, Present Worth Analysis, Future Worth Analysis, Future Value through Annuity, Rate of Return Analysis, Cash flow diagrams; : Introduction, Straight Line and Declining Balance Method of Depreciation; Present Worth Method, Future Worth Method, Annual Worth Method; Benefit Cost Analysis: Conventional and Modified B/C Ratio with PW method

Functions of the Commercial Bank and Central Bank, Financial Institutions; Money Market and Capital Market; Objectives, Instruments, Tools in Indian Economy; Causes, Effects and Methods to Control it, Measurement of Inflation-Consumer Price Index and Whole Price Index; Deflation and Stagflation; Various phases, Control and Measurement, Impact on business cycles on economic activities

- 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.

Pravin Kumar (2015). Fundamental of Engineering Economics. Raj Kamal Press, New Delhi.

Riggs J.L., Dedworth, Bedworth D.B., and Randhawa, S.U. (1996). Engineering Economics. McGraw Hill International, New Delhi

PanneerSelvam R. (2001). Engineering Economics. Prentice Hall of India Ltd, New Delhi.

- L.M. Bhole (2007). Financial Institutions and Markets. Tata McGraw Hill, New Delhi.

			2		Elective				V

- 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

Nature and Functions of Literature, Literature and Society with special reference to Indian Literature and Indian Society, Literary Forms, Poetry, Drama, Fiction, Essay, Autobiography

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

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.

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)

- 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.

1. Jerome K Jerome: Three Men on a Bummel (selection), Arrow smith Publications

2. R.K. Narayan: Malgudi Days (selection), I*ndian Thought Publications*

- Martin Montgomery, An Introduction to Language and Society (Studies in Culture and Communication)Routledge; 2 edition (December 22, 1995)
- Robe Pope, *An Introduction to Language Literature and Culture*.Routledge, 2005

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

	HS301		APTITUDE & SOFT SKILLS III						
	3 0 0		0		AC		III		V

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.

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

): 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.

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.

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, 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.

Introduction; Concept of single, double and triple discount and marked price.

Simple Interest and compound Interest: Basic concept of Principal, Time, Amount and Rate of Interest; Concept of Lent money.

Understanding and aligning them with the various question types.

Subject-Verb Agreement: Rules and Applications; commonly confused words-II; Gerunds, Active and Passive voice.

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.
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.

Reading 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.

Coding Decoding, Cryptarithmetic, Sequence and Series - Finding the missing term/wrong term in the logical sequence of letter/number/word/alphanumeric, Continuous pattern series.

Verbal Analogy based on various parameters - Antonym / synonym relationship, Quantity and unit, Individual and Group, Product and Raw material, cause and Effect etc.
Odd man out based on several kind of relationship – Relationship based on meaning, functional relationship, even- odd or prime-composite, divisibility rule, etc.

Blood Relation-Indicating form / puzzle form / coding form, Direction Sense, Direction puzzles.

Seating Arrangements – Linear / Circular / Distribution / comparison/ Floor and box arrangement /Quant based arrangements/ etc.

Statement and assumptions, course of action, statement and conclusion, probably true/false.

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

: (i) Communication Origami, (ii) Power of body language, (iii) Draw it.

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

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

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.

1. Arun Sharma; Quantitative Ability:How to prepare for Quantitative Aptitude; McGraw Hill; 2018.
2. R.S. Aggarwal; Logical Reasoning A Modern Approach to Logical Reasoning; S Chand Publishing; 2018.
3. Chetanand Singh; Verbal Aptitude: English is Easy; BSC Publication; 2018.
4. Barbara and Allan Pease; Soft Skills: The Definitive Book of Body Language; RHUS; 2006.

1. R.S. Agarwal; QA:Quantitative Aptitude for Competitive Examinations; S. Chand Publications; 2017.
2. Saurabh Rawat and AnushreeSahRawat; QA: Quantitative Aptitude; Savera Publishing House, 2016.
3. Nishit K Sinha; LR: Logical Reasoning and Data Interpretation for the CAT; Pearson India; 2016.
4. P A ANAND; LR: Wiley's Verbal Ability and Reasoning; Wiley; 2016.
5. John Eastwood; VA :Oxford Guide to English Grammar; Oxford University Press; 2003.
6. Suzanne W. Woodward; VA: Fun with grammar; Pearson Education; 1996.
7. Leil Lowndes; Soft Skills: How to Talk to Anyone; Harper Element; 2015.
8. Kerry Patterson, Joseph Grenny, Ron McMillan, and Al Switzler; Brilliance Audio; Soft Skills: Crucial Conversations: Tools for Talking When Stakes Are High; Abridged; 2013.

			4		DC				VI

- The course objective is to understand the basics of refining techniques, analyze the performances of the processes concerned, and optimize them.

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

Distillation system: pipe still heater, distillation column, heat exchangers, condenser, reflux control, pressure control; Atmospheric distillation system, vacuum distillation system.

Other refining processes: Visbreaking, Thermal cracking, catalytic Cracking, catalytic reforming, alkylation, isomerization, hydrocracking, hydorfinishing

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.

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.

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

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.

1. Mall I.D.; Petrochemical Process Technology; Macmillan India Ltd; 2007.
2. Gary J.H. and Handework G.E.; Petroleum Refining Technology and Economics; Marcel Dekker Inc.; 1984.

1. B.K.BhaskaraRao; Modern Petroleum Refining Processes; Oxford and IBH Publishing Co. Pvt. Ltd.; 2007.
2. Ramprasad; Petroleum Refining Technology; Khanna Publishers; 1998.

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

			5		DC				VI

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.

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.

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.

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.

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.

Drill Stem Testing; Reservoir Limit Test; Injection and Fall-off Test; Interference Test; Pulse Test.

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

1. John Lee; Well Testing; SPE of AIME Vol. 1; 1982.
2. Robert C. Earlougher Jr.; Advances in Well Test Analysis; SPE of AIME; 1977.

1. Dominique Bourdet ; Well Test Analysis: The Use of Advanced Interpretation Models; Elsevier; 2002.
2. Bath, England; Introduction to Well Testing; Schlumberger Wireline & Testing; 1998.
3. Ronald N. Horne; Modern Well Test Analysis – A Computer Aided Approach; Petroway, Inc; 1995.

			4		DC				VI

1. This course shall make a student competent in designing a drilling rig system including the various system employed to drill a well optimally.

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.

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.

Separation System: Classifications, Working and Applications; Specification Of Optimum Separation Process; Design of 2 – Phase and 3 – Phase Horizontal and Vertical Separators.

Surface and Sub-surface Sucker Rod Pumping System: Working Principle, Application Considerations; Design of sucker-rod pumping production system: Theoretical Analysis of Rod Motion, Effective Plunger Stroke Length, Polished Rod Load Calculations, Counterbalance, Torque on the Gearbox, Prime Mover Pump Requirements; Dynagraph Analysis and its Applications.

Gas Lift System: Classifications, Working Principle and Application Considerations; Design of gas-lift production system for continuous and intermittent gas-lift systems: Point of Gas Injection, Injection Rate, Valve Mechanics, Spacing of Valves, Injection Gas Breakthrough, Fluid Recovery Per Cycle for Intermittent Gas Lift Operations and Maximum Daily Production.

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 abe able to select, design, operate Artificial lifts and its components.

1. Michael Golan, Curtis H. Whiteson; Well Performance; Norwegian university of science and technology; 1995.
2. Kermit E. Brown and H. Dale Beggs; The Technology of Artificial Lift Methods; PennWell Company; 1977.

1. H. Dale Beggs; Production optimization; OGCI and Petroskills publications; 2003.
2. Adam T. Bourgoyne Jr.; Applied Drilling Engineering; SPE; 1986.

			4		DC				VI

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.

Basic Concepts of process control, Why process control, Modeling for process dynamics-mathematical tools for modeling, Laplace transform of simple functions, transforms of derivatives. Solution of differential equations, inversion by partial fractions.Physical examples of first-order systems.Response of first-order systems.Response of first- order systems in series. Higher order systems: Second-order and transportation lag.

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

Concept of stability, definition of stability, stability criterion. Stability for linear system: Routh-Hurwitz stability criterion. Root locus diagram. Design of control system using frequency response: Bode diagram-stability criterion, phase and gain margins. Tuning of controller settings: Ziegler Nichols controller settings.

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.

Principles of measurements and classification of process control instruments.Temperature measuring instruments.Liquid-level measuring instruments.Pressure measuring instruments, Composition measuring instruments, Measurements of viscosity, pH, concentration, thermal conductivity and humidity of gases.

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.

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

---

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.

---

1. Singh, S.K.; Instrumentation and Process Control; Tata McGraw Hill; 2009.
2. Stephanopolous, G; Chemical Process Control: An Introduction to Theory and Practice; Prentice Hall of India; 2009.
3. Donald R. Coughanowr., Steven E. LeBlanc., "Process system Analysis & Control", 3rd edition., McGraw Hill, New york, 2009.

1. Liptak, B.; Instrument Engineer's Handbook. Vol. 1 and Vol.2; CRC Press; 1969.
2. Mian, M.A.; Petroleum Engineering Handbook; Penwell Publishing Company; 1992.
3. Eckman, D.P.; Industrial Instrumentation; Wiley Eastern; 1952.

			3		DC				VI

The primary objective of this course is to inculcate the safety culture in personal and professional life.

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)

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.

Environment Health and Safety Management: Oil-spill control. Environmental impact assessment.Waste disposal and treatment in land and offshore environment, produced water disposal, accidental discharge, drilling waste, OSPAR, regulatory control and policies.

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.

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.

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

Comprehend different industry hazards and plane safety.

Recognize modes of transportation of oil and gas, and safety measures in transportation

Realize procedure of safety auditing and prepare safety reports

Apply concepts of risk analysis to develop probabilistic assessment.

Be aware of the waste treatment and disposal.

1. OrzuOrszulik; Environmental Technology in oil Industry; Springer; 1996.
2. Reis, J.C.; Environmental control in Petroleum Engineering; Gulf publications;1998.

1. Boyce, A., “Introduction to Environmental Technology”, John Wiley and Sons, 1996.
2. C V Efobi; Site safety handbook for the petroleum industry; Partridge Publishing; 2015.

			2		DE				VI

1. To develop good understanding of various offshore drilling and production operations along with the challenges associated with it.

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.

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

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.

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.

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.

A good understanding of this subject will assist in analysis of environmental loads on different platform and suitable platform selection.

The well control and rheological challenges associated with offshore.

The application of riser system and well head selection for different platforms.

Production monitoring through SCADA.

Transportation and storage of hydrocarbons in offshore.

1. G G Speight; Hand Book Of Offshore Oil and Gas Operations; Gulf Professional Publishing; 2015.
2. William L,Leffler,RichardPattarozzi,Gordon Sterling; Deepwater petroleum Exploration and Production; PennWell Books; 2011.
3. Amanda Barlow; Offshore Oil and Gas PEOPLE: Overview of Offshore Drilling Operations; Create Space Independent Publishing Platform; 2017.

1. Mohamed A El-Reedy; Offshore Structures: Design Construction and Maintenance; Gulf professional Publication;1968.
2. Chakraborty S.K.; Handbook of Offshore Engineering Volume I and II; Elsevier; 2006.
3. SukumarLaik; Offshore Petroleum Drilling and Production; CRC Press; 2018.

			2		DE				VI

1. To understand the geographic distribution of unconventional hydrocarbon resources and to understand characterization of source and reservoir rocks.

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

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.

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

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.

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.

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.

1. Rafiqul Islam; Unconventional Gas Reservoirs: Evaluation, Appraisal, and Development; Gulf Professional Publishing; 2014.

2. Farooqi Ali, S M, Jones S A and Meldau R F; Practical Heavy Oil Recovery; SPE; 1997.
3. Pramod Thakur, Steve Schatzel and KashyAminian; Coal Bed Methane: From Prospects to Pipeline; Elsevier; 2014.

1. James T. Bartis, Frank Camm, David S. Ortiz; Producing Liquid Fuels from Coal, Prospects and Policy Issues. NETL; 2008.
2. Carrol John; Natural Gas Hydrates: A guide for engineers; Gulf Publications; 2003.

			2		DE				VI

1. To disseminate knowledge about various modes of transportation of Oil and Gas, Challenges associated with transportation.

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

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

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.

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.

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

.

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.

1. Henry Liu; Pipeline engineering; Lewis Publishers CRC Press; 2003.
2. M. Mohitpour, H. Golshan and A. Murray; Pipeline design and construction A practical approach; ASME; 2006

1. George A. Antaki; Piping and pipeline engineering; Marcel Dekker Inc.; 2003.
2. J. Vincent Genod ; Fundamentals of pipeline engineering; Technip; 2003.

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

	HS304		Aptitude and Soft Skills IV						
	3 0 0		0		AC		III		VI

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

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

1. Understanding grammar, number system and basic arithmetic, analytical reasoning concepts, covered in Aptitude and Soft Skills III
2. Professional profile building and Self introduction

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

Basic concepts (relationship between men, days and work); Understanding group efficiency; Alternate work; Negative work; Wages; Pipes and Cisterns.

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

Introduction, various types of events; Classical definition of probability; Random and Discrete variables; Bayes' Theorem and question types.

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

Intricacies of cloze test, correct use of specific adjectives, concept of sentence improvement, writing concept, auxiliaries and modals.

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

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

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

Various test taking skills in accordance with the placement papers.

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

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

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.

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

Importance, Do’s & Don’ts, Personality Traits, Tips and Strategies, Types of Group Discussions.

Mock Group Discussions (on basic topics), with feedback sharing and error analysis.

Importance, Do’s & Don’ts, Personality Interview, Tips and Strategies, Etiquette Rules.

Mock Personal Interviews (contd.) with feedback sharing and error analysis.

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.

1. Arun Sharma; Quantitative Aptitude How to prepare for Quantitative Aptitude; McGraw Hill; 2018.
2. R.S. Aggarwal; Logical Reasoning A Modern Approach to Logical Reasoning; S Chand Publishing; 2018.
3. Chetanand Singh; Verbal Aptitude: English is Easy; BSC Publication; 2018.
4. P. N. Joshi; Soft Skills: Group Discussion on Current Topics; UpkarPrakashan; 2010.

1. R.S. Agarwal; Quantitative Aptitude:Quantitative Aptitude for Competitive Examinations; S. Chand Publications; 2017.
2. Saurabh Rawat&AnushreeSahRawatQuantitative Aptitude:Quantitative Aptitude; Savera Publishing House; 2016.
3. Nisit K SInha; Logical Reasoning: Logical Reasoning and Data Interpretation for the CAT; 2016.
4. P AAnand; Logical Reasoning: Wiley's Verbal Ability and Reasoning; Wiley; 2016.
5. Suzanne W. Woodward; Verbal Aptitude: Fun with grammar; Pearson Education ESL; 1996.
6. S. Hundiwala; Soft Skills: AComplete Kit for Group Discussion; Arihant publications; 2018.
7. Raymond L. Gorden; Soft Skills: Basic Interviewing Skills; Waveland Press, Inc.; 1998.

			4		DC				VII

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

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.

Model Equations: Black oil and composition models. Data Preparation: Rock, fluid, Mechanical, Production and Validation.

Solution Techniques: Analytical and Numerical methods, Explicit and Implicit methods of discretization, Finite difference and Linearization, Solution of simultaneous equations.

Stability criteria, Iterative methods, IMPES & IMPIS methods, Numerical dispersion, Grid and time step size selection, History matching, Manual and automated system Reservoir performance using simulation approach.

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.

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.

1. T. Ertenim, J.H Abou-kassem and G.R. King; Basic Applied Reservoir Simulation; SPE Text book series; 2001.
2. Crichlow, Henry B.; Modern Reservoir Engineering: a simulation approach; Prentice Hall, 1977.

1. Notes on reservoir simulation, Institute of Petroleum Engineering, Herriot-watt University; 2011.
2. J.R.Fanchi; Principles of Applied Reservoir Simulation; Gulf Publication; 2006.

			3		DE				VII

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

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.

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.

Flow Geometry: Linear Flow, Radial Flow, Spherical Flow, Cylindrical Flow and Elliptical Flow; Generalized radial diffusivity equation; Initial and Boundary Conditions; Modification of Diffusivity Equation for Gases and Multiphase Flow, Pressure Squared and Pressure Approximations; Non- Darcy Flow.

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.

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.

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.
4. Determination of fluid density using Pycnometer and hydrometer methods.
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.

1. Helium Porosimeter
2. BET Surface analyser
3. Pycnometer
4. Capillary tube viscometer
5. Capillary Pressure cell
6. Goniometer/contact angle measuring device

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

---

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 tounderstand the flooding mechanism.
4. To understand the flow conditions in the reservoir.
5. To be able to flooding patterns and its applications.

---

1. Tarek Ahmed; Reservoir Engineering Handbook; Gulf Publications; 2001.
2. John Lee; Well Testing; SPE of AIME Vol. 1; 1982.

Craft & Hawkins; Applied Petroleum Reservoir Engineering; Prentice Hall; 2014.
L P Dake; Fundamentals of Reservoir Engineering; Elsevier; 1978.

			3		DE				VII

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.

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

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.

Algebraic & Transcendental Equations Bisection method, Iteration method, False Position method, Newton-Raphson method, Rate of convergence of methods, Solution of simultaneous equations by Gauss-Seidel's method.

Numerical Differentiation & Integration Introduction, Numerical differentiation, Numerical integration by Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule, Boole's & Weddle's rule, Euler-Maclaurin's formula.

Solution of Ordinary Differential Equations Taylor's series method, Euler's method, Modified Euler's method, Runge-Kutta method.

After studying this course, you should be able to:

Understand of common numerical methods.

To understand their uses to obtain approximate solutions to otherwise intractable mathematical problems.

Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations.

Analyze and evaluate the accuracy of common numerical methods.

1. Sastry; Introductory Method of Numerical Analysis; PHI; 2008.
2. Balaguruswamy; Numerical Methods; TMH; 2013.

1. Q.S. Ahmad, S.A.Khan; Numerical and Statistical Techniques, Ane Books Pvt. Ltd; 2004.
2. Jain, Iyengar; Numerical Methods for Scientific & Engineering Computations; New Age International Publication; 2002.

			3		DE				VII

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.

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.

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.

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.

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

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

After studying this course, you should be able to:

Apply the methods and practices followed in the design of process equipment's and draw the process equipment's used in chemical industries

Improve the ability of solving process design problems

Expose to the concept of detailed design and drawing of chemical process equipment.

Understand the codes of equipment design.

To know the operation and maintenance of equipment.

Kern D. Q.; Process Heat Transfer; Mc-Graw Hill; 2008.

Bhattacharya B. C.; Introduction of Chemical Equipment Design; CBS Publisher; 2013.

Sinnott R. K.; Coulson and Richardson's Chemical Engineering Series; Vol. VI; Butterworth-Heinemann; 1977.

1. Dutta B.K.; Heat Transfer: Principles and Applications; PHI; 2001.
2. F. Kreith, R.M. Manglik, M.S. Bohn; Principles of Heat Transfer; Cengage Learning; 2011.

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

			3		DE				VII

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.

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.

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

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

Polymer Solution: Solubility Parameter; Properties of Dilute Solutions.

Nature and Structure of Polymers: Structure Property Relationships; Molecular Weight of Polymers; Molecular Weight Distribution; Determination of Molecular Weight.

After studying this course, you should be able to:

Isolate the key design features of a product which relate directly to the materials used in its construction.

Indicate how the properties of polymeric materials can be exploited by a product designer.

Describe the role of rubber-toughening in improving the mechanical properties of polymers

Identify the repeat units of particular polymers and specify the isomeric structures which can exist for those repeat units

Estimate the number- and weight-average molecular masses of polymer samples given the degree of polymerisation and mass fraction of chains present.

1. G. Odian; Principles of polymerization; Wiley – Inter science; 1981.
2. Seymour R. B. and Kirshenbaum G. S.; High performance polymers, their origin and development; Elsevier; 1986.
3. Fred W. Billmeyer; Textbook of Polymer Science; Wiley publication; 1994..

1. Paul C. Painter and Michael M. Coleman, Essentials of Polymer Science and Engineering, Destech Publications, Inc., 2008.
2. K. J. Saunders; Organic polymer chemistry; Chapman and Hall, London; 1973.

			2		Elective				VII

- 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.

Three Stages – Self awareness, Self acceptance and Self realization; Exploration through JOHARI Window; Development of Self-Mead & Cooley

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

Achieving Success: Creativity &Innovation ; Role of attitude; Role of competence; Role of Self-confidence; Time management; Role of Human Values

Stress & Coping Strategies: Meaning, Types, Sources, Effects of stress on health, and coping strategies; Characteristics of a healthy personality

- 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

1. R. Bayne, and I. Horton, *Applied Psychology*, Sage publications, 2003.
2. A. Furnham, *The Psychology of Behaviour at Work*, Psychology Press, 1997.
3. D. Harris, *Engineering Psychology and Cognitive Ergonomics*, Aldershot: Ashgate, 1997

- Baron, R.A. and Misra, G., Psychology (Indian Subcontinent Edition). Person Education Ltd. (2014).
- Ciccarelli, S.K. & Meyer, G.E., Psychology (South Asian Edition). New Delhi: Tata Mc Graw Hill. (2008).
- Passer, M.W., Smith, R.E., Holt, N. and Bremmer, A., Psychology: The Science of Mind and Behavior, McGraw-Hill Education, UK. (2008).
- R. Gifford, (Ed.), Applied psychology: Variety and opportunity, Allyn and Bacon, 1991.
- M.L. Blum, and J.C. Naylor, Industrial Psychology, CBS Publishers & Distributors, 1984.
- D.M. Pestonjee, Stress and Coping: The Indian Experience, 2nd ed., Sage Publications, 1999.

			2		Elective				VII

- 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

Public Funded Research and Its Implications in an Economy; Public Funded Research and Economic Development; Research & Development and Industrial Development

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

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

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

- 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

Cornish, W.R. and L. David. 2010. 7th Edition. Intellectual Property: Patents, Copyrights, Trademarks and Allied Rights. Sweet and Maxwell.

Narayan, P. 2002. Intellectual Property, Law in India, 3rd Ed. New Delhi, Delhi Law House.

Ganguli, P. 2001. Intellectual Property Rights: Unleashing the Knowledge Economy. Tata McGraw Hills.

Watal, J. 2001. Intellectual Property Rights in the WTO and Developing Countries. New Delhi: Oxford University Press.

- Singh A.K., Ashraf S.N. and Acharya S.R. 2017. Viability of Bayh Dole Act of USA in the context of India: Critical evidence from review of literature, in SasiMisra, Sunil Shukla and GanapathiBatthini (Eds). Proceedings of the 12th Biennial Conference on Entrepreneurship Organized by EDII Ahmedabad (pp. 235-252). Bookwell Publishing House: New Delhi.

			2		Elective				VII

- 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.

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

Definition of Society, Units of Society, and Social Consciousness. Concepts & Principles of Interdependence, Conceptualizing 'Good Society' and 'Social Goods' and Corporate Social Responsibility, Role of Material Values in promoting Human Well-being. Role of Science and Technology; Problems of Material Development, Case Studies Case Studies on the above aspects

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

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

- 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

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

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

			2		Elective				VII

- 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.

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

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

R.N.Tagore: Kabuliwala
R.K. Narayan: An Astrologer's Day
Mulk Raj Anand: Duty
Nayantara Sehgal: Martand

Ruskin Bond: Flights of Pigeons

:

- 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.

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

- Bond, Ruskin. Flights of Pigeons, Penguin Books, 2003

- Tagore, Rabindra. *Nationalism*. Delhi: Rupa Publications, 1992.Print.
- Chinhade, Sirish. *Five Indian English Poets*. New Delhi: Atlantic Publishers and Distributors, 1996.Print.
- Naik, M.K. *A History of Indian English Literature*. New Delhi: SahityaAkademi, 2004.Print.
- Agrawal, K.A. Ed. *Indian Writing In English: A Critical Study*. Atlantic Publishers &Dist, 2003.Print.

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

	CS481		Software Quality Engineering						
	3 0 0		3		DE/OE		4th		VII

Defining Software Quality, Software Quality Attributes and Specification, Cost of Quality, Defects, Faults, Failures, Defect Rate and Reliability, Defect Prevention, Reduction, and Containment, Overview of Different Types of Software Review, Introduction to Measurement and Inspection Process, Documents and Metrics.

Product Quality Metrics: Defect Density, Customer Problems Metric, Customer Satisfaction Metrics, Function Points, In-Process Quality Metrics: Defect Arrival Pattern, Phase-Based Defect Removal Pattern, Defect Removal Effectiveness, Metrics for Software Maintenance: Backlog Management Index, Fix Response Time, Fix Quality, Software Quality Indicators.

Modeling Process, Software Reliability Models: The Rayleigh Model, Exponential Distribution and Software Reliability Growth Models, Software Reliability Allocation Models, Criteria for Model Evaluation, Software Quality Assessment Models: Hierarchical Model of Software Quality Assessment.

Quality Planning and Control, Quality Improvement Process, Evolution of Software Quality Assurance (SQA), Major SQA Activities, Major SQA Issues, Zero Defect Software, SQA Techniques, Statistical Quality Assurance, Total Quality Management, Quality Standards and Processes.

Verification and Validation, Evolutionary Nature of Verification and Validation, Impracticality of Testing all Data and Paths, Proof of Correctness, Software Testing, Functional, Structural and Error-Oriented Analysis & Testing, Static and Dynamic Testing Tools, Characteristics of Modern Testing Tools.

1. Jeff Tian, Software Quality Engineering (SQE), Wiley-Interscience, 2005; ISBN 0-471-713457.

2. Stephen H. Kan, Metrics and Models in Software Quality Engineering, Addison-Wesley (2002), ISBN: 0201729156

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

2. Taz Daughtrey, Fundamental Concepts for the Software Quality Engineer, ASQ Quality Press.

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

	IT353								
	3 0 0		3		DE/OE		4th		VII

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.

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

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.

: 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.

(

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.

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.

Data types in cluster analysis, Overview of basic clustering methods, Partitioning methods: K-Means and K-medoids technique, Hierarchical Clustering: Agglomerative and Divisive, Density Based Methods :DBSCAN and OPTICS, Grid Based Methods: STING and CLIQUE, Outlier Analysis.

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.

---

1. Jiawei Han, MichelineKamber, "Data Mining Concepts & Techniques" Elsevier.

---

1. M.H.Dunham,"DataMining :Introductory and Advanced Topics" Pearson Education
2. Mallach,"Data Warehousing System" ,McGraw –Hill

	IT356								
	3 0 0		3		DE/OE		4th		VII

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 now days as a part of IT generation.
3. To make students learn clear understanding of multimedia projects.
4. To make students learn different compression techniques.

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

Text, Sound MIDI, Digital Audio, audio file formats, MIDI under windows environment Audio & Video Capture.

Introduction to data compression, Compression ratio, loss less & 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.

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.

Video Conferencing, Elements of (immersive/non-immersive) Virtual Reality, Augmented Reality, Tele presence, Mobile technologies.

Overview- Multimedia Systems, Secured Multimedia, Digital Rights Management Systems and Technical trends, Multimedia Encryption and Digital Watermarking, Security Attacks and Multimedia Authentication.

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

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.

1. Tay Vaughan “Multimedia, Making IT Work” Osborne McGraw Hill,7th edition
2. Khalid sayood “Introduction to data compression” Morgan Kaufmann Publishers,3rd edition

1. Buford “Multimedia Systems” Addison Wesley.,4th edition
2. Mark Nelson “Data Compression Book” BPB.,3rd edition
3. Sleinreitz “Multimedia System” Addison Wesley,5th edition

	EC383								
	3 0 0		3		DE/OE		4th		VII

The students will learn

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

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

Video Systems and Displays: Monochrome TV, Colour TV standards and systems, TFT, Plasma, HDTV, Digital TV, Video Telephone and Video Conferencing

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

Recording and Reproduction Systems: Disc recording and reproduction, Magnetic recording and reproduction, Video tape recording and reproduction, Video disc recording and play back, Distortion and Noise reduction in Audio and Video System

Power Supplies and other systems: SMPS, UPS and Preventive Maintenance, Set Top Boxes, Remote controls, Bar codes, ATM

1. Consumer Electronics S P Bali Pearson ed 2005

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.

	EC385								
	3 0 0		3		DE/OE		4th		VII

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.

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

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).

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

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

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.

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.

1. Boylestad and Nashelsky, 'erlectronic Decvices and circuits' PHI, 6e, 2001.
2. A Mottershead, 'Electronic devices and circuits'. PHI, 2000.
3. Morris Mano, 'Digital Computer Design', PHI, 2003.
4. R.K. Singh & Ashish, Basic Electronics Engg. Laxmi Publication, 2007.

5. Milman & Halkias, Integrated electronics Electronics, PHI, 2005.

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.

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

					Open Elective				VII

- To introduce fundamentals of various renewable energy source
- 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.

I 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.

: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.

Usable forms of Bio Mass, Biomass energy resources, biomass energy conversion technologies, ethanol blended petrol and diesel, biogas plants. Energy farming.

Wind Power: Energy estimation, Power extraction, lift and drag forces, horizontal axis wind turbine, vertical axis wind turbine, wind energy conversion and control schemes, environmental aspects.

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.

1. B.H. Khan, Non conventional Energy Resources, 2nd edition, 2009.

1. G.D. Rai, Non Conventional Sources of Energy, (Khanna Publishers).
2. J.W. Twidell& A.D. Weir, Renewable Energy Resources, (ELBS / E. & F.N. Spon., London).
3. Godfrey Boyle, Renewable Energy, Oxford, 2nd edition 2010.

-
-
-

	ME342								
	0 0		3		DE/OE				VII

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

Strength of Materials, Materials Engineering

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

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

Composite mechanics Terminology, Behaviour of unidirectional composites, Behaviour of short fiber composites Analysis of orthotropic ply. Hook's Law for orthotropic lamina, Relation between Engg. constants and Elements of matrices for orthotropic ply, Transformation of Engg. constants, Failure in isotropic materials

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, .

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.

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.

1. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.
2. Hyer M.W., Stress Analysis of Fiber- Reinforced Composite Materials, McGraw Hill, 1998.

F. L. Matthews, Rees D. Rawlings , Composite Materials: Engineering and Science Woodhead Publishing, 1999 - Composite materials.
Autar K. Kaw Mechanics of Composite Materials,CRC Press, 30-May-1997

	ME445								
	3 0 0		3		DE/OE		4th		VII

To facilitate the understanding of total quality management principles and processes.

Manufacturing Process, Industrial Engineering and Management

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.

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.

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.

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.

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.

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.

1. Besterfield D.H. et al., Total quality Management, 3rd ed., Pearson Education Asia, 2006.

1. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
2. SubburajRamasamy, McGraw-Hill Education, 2012 - Total quality management.

1. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
2. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.

	MA541								
	3 0 0		3		Open Elective		4th		VII

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.

Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, absolute moments, factorial moments, skewness and kurtosis, Sheppard's corrections.

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

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.

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

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.

1. Gupta, S.C. and Kapoor, V.K. (2007): Fundamental of Mathematical Statistics, 11thEdition. (Reprint), Sultan Chand & Sons.
2. Y.P. Agarwal (2012) Statistical Methods: Concepts, Application and Computation, 3rd edition; Sterling Publishers.

1. Freund E F John, Mathematical statistics, 6th edition, Prentice Hall International, 1999.
2. Hogg, R. V. and Craig, T. T. (1978) Introduction to Mathematical Statistics (Fourth Edition) (Collier-McMillan).
3. Rohatgi, V. K. (1988) Introduction to Probability Theory and Mathematical Statistics (Wiley Eastern).

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

	AR-481								
	3 0 0		3		OE		4th		VII

To introduce the various aspects og graphics design and important stages of product design and development.

Introduction and importance of graphics and product design.Principles and elements of design. History of Design.Colour Theory. Techniques and processes to communicate graphically.

Stages of product development. Introduction to ergonomics

Introduction to concept. Concept development. Role of sketching in concept development. Implementation stages of concept for product development

Customer needs identification, Market research essentials. Advertising and marketing tools.

Introduction to various design tools.

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.

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

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

	ME381								
	2 0 2		3		UC		4th		VII

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.

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

Conceptual definition of entrepreneurs, entrepreneurship and start up.Historical development of entrepreneurship.Entrepreneurship in economic theory.Entrepreneurial practice.Impact of Entrepreneurship on society.The role of entrepreneurship in economic development.Role of innovation in entrepreneurship.

Entrepreneurial economy.Entrepreneurship and Economic Development.Type of Entrepreneurship.Entrepreneur and small business.Features and types of entrepreneurs.Terms of entrepreneurship.Sources of business ideas.Technical and technological analysis of entrepreneurial projects.Designing a business investment.Angel Investor and Venture capitalist – Roles and Importance.

Forms of entrepreneurial organization.Entrepreneurial process.Entrepreneurial and start-up strategies.Role of Government agencies in Entrepreneurship development. Entrepreneurial project: entrepreneurial venture and entrepreneurial development chain. Knowledge of business economy.Group based strategies development.

Sources of capital. Market Research, Understanding the Market need for your concept. Defining the business concept and formulating a business plan for startup. Fundamentals of entrepreneurial management. Business process: product design, operational art, stock management.

Entrepreneurbiographies - the actual successes and failures. Exit strategies for entrepreneurs. Case studies of : Successful Entrepreneurial Ventures, Failed Entrepreneurial Ventures and Turnaround Ventures. Some case studies related to Product & Technology.

1. S.S.Khanka, “Entrepreneurial Development”. S.Chand& Co. Ltd.,10th edition, 2014.
2. Kuratko& Hodgetts, “Enterprenuership –Theory, process and practices”, Thomson learning 6th edition, 2016.
3. Donald F Kuratko, “Entreprenuership – Theory, Process and Practice”, 9th Edition, Cengage Learning 2014.

:

1. Hisrich R D and Peters M P, "Entrepreneurship". Tata McGraw-Hill. 9th Edition, 2014.
2. Rabindra N. Kanungo "Entrepreneurship and innovation", Sage Publications, 1998.
3. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development" Institute of India, Ahmadabad, 1986.
4. Rajeev Roy, 'Entrepreneurship' 2nd Edition, Oxford University Press, 2011.
5. Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis" 2nd Edition Dream
   Tech, 2005.

:

- 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.

:

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

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

			3		DE				VIII

1. The objective of this course is make students familiar with the principles and applications material balance mathematical equation in petroleum reservoir.

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.

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

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

Immiscible displacement process: Fractional flow and fractional displacement process in linear reservoir, Buckeley and Leverett treatment Reservoir; Decline curve analysis.

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.

The candidate will be able to solve petroleum engineering problems by integrating different types of data used in the oil industry.

Identify, formulate, and solve petroleum engineering problems using real world engineering tools.

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.

Develop a field development plan.

Analyze the techno-commercial aspects of field development.

1. Craft & Hawkins' Applied Petroleum Reservoir Engineering by Ronald E Terry and J Brandon Rogers, Third Edition, Prentice Hall, 2014.
2. J P Nguyen; Fundamentals of Exploration & Production: Oil and Gas field development techniques; Technip; 1996.

Tarek Ahmed; Reservoir Engineering Handbook; Gulf publication; 2001.
James.W. Amyx; Petroleum Reservoir Engineering; McGraw Hills; 1960.

			3		DE				VIII

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.

Introduction: The development of Oil & Gas Industry, Structure of Oil & Gas Industry, India Hydrocarbon vision 2025; Petroleum Resource classification, Analysis of resource management.

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.

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

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

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.

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

Understand the structure and classification of oil and gas industry.

Understand planning of development activities in managerial aspect of oil & gas industry.

Understand the background of oil & gas industry and able to analyze the market trends of crude oil pricing.

Understand the oil and gas regulatory bodies and their roles.

Understand the bidding system and fiscal regimes.

1. Abdel A. A., Bakr A. B, and Al Sahlawi M. A;Petroleum Economics and Engineering by;Decker Publications; 1992.
2. IFP; Oil and Gas Exploration and Production, Reserves, Costs and Contracts; Technip; 2007.

1. Silvana Tordo and D Johnston; Petroleum Exploration and Production Rights; World Bank Working Paper; 2010.
2. K. Abdel-Alal and Mohamed A; Petroleum and Gas Field devepolment; Marcel Dekker Inc.; 2003.

			3		DE				VIII

1. The course shall enable students to impart the knowledge of planning and developing a field throughout the economic life of the well.

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.

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.

Production Operations and Maintenance: Objectives, Input to Final Development Plan; Project and Contract Management: Phasing and Organisation, Planning and Control, Cost Estimation and Budgets, Reasons for Contracting and Types of Contract.

Petroleum Economics: Basic Principles of Development Economics, Constructing Project Cashflow, Discounted Cashflow, Project Screening and Ranking, Sensitivity Analysis; Managing Producing Fields: Sub-surface and Surface Facilities, Internal and External Factors.

Managing Decline: Infill Drilling, Workover Activity, Enhanced Oil Recovery, Production Debottlenecking, and Incremental Development; Decommissioning: Legislation, Economic Life and Decommissioning Methods.

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.

1. AbdusSatter, Ganesh C. Thakur; Integrated Petroleum Resrvoir Management; Pennwell Books; 1994.
2. J. Frank, C. Mark and G. Mark; Hydrocarbon Exploration and Production; Elsevier; 1998.

1. K. Abdel-Alal and Mohamed A; Petroleum and Gas Field devepolment; Marcel Dekker Inc.; 2003.
2. IFP; Oil and Gas Exploration and Production, Reserves, Costs and Contracts; Technip; 2007.

			3		DE				VIII

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

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.

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.

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.

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

Global Scenario Of Shale Gas/ Oil Production; Nature, Origin And Distribution Of Shale Gas/ Oil; Characterization Of Shale For Production Of Shale Gas/ Oil; Extraction Methods Of Shale Gas/ Oil: Development Of Current Practices; Location And Size Of Production Areas: Estimated Reserves And Economics; Environmental Issues In Shale Gas Exploration; Markets And Globus Impact On Energy Scenario; Economic Factor Of Shale Gas/ Oil Production.

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

3. U. Ahmed and D. Nathan Meehan; Unconventional Oil and Gas Resources: Exploitation and Development;; Baker Hughes, 2016.
4. Shahab D. Mohaghegh; Shale Analytics- Data Driven Analytics in Unconventional Resources; Springer; 2012.

1. Shale Gas: A Practitioner's Guide to Shale Gas & Other Unconventional Resources; V. Bakshi; Globe Law and Business, 2012.
2. Rafiqul Islam, M; Unconventional Gas Reservoirs: Evaluation, Appraisal, and Development, Gulf Professional Publishing; 2014.

			3		DE				VIII

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

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

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.

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.

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.

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.

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

1. Robert D Grace; Advanced Blowout and Well Control; Gulf Publishing Company; 1994.
2. David Watson, Terry Brittenham, and Preston L. Moore; Advanced Well Control; Society of Petroleum Engineers; 2003.

1. Neel Adams; Well Control Problems and Solutions, Petroleum Publishing company; 1983.
2. IWCF manual, 2007.
3. IADC, Well Control Manual, 2009.

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

			3		DE				VIII

1. The objective of this course is make students familiar with the principles and applications of Directional drilling in petroleum operations.

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.

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.

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.

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.

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

This course will assist students in developing the principles of directional drilling.

To understand the applications and limitations of directional drilling.

Good knowledge of this course will assist in drilling Extended Reach wells and horizontal wells.

To understand the tools and methods used to create a directional well.

To understand the concept of sidetracking, multilateral drilling and combating problems.

1. J A Short; Introduction to Directional and Horizontal Drilling; PennWell Books; 1993.
2. Neal J. Adams; Drilling Engineering-A complete well planning approach; PennWell publishing Company; 1995.

1. S D Joshi; Horizontal Well Technology; PennWell Books; 1991.
2. T.A Inglis; Directional Drilling; Graham &Trotman; 1987.

			2		DE				VIII

The course shall familiarize students to contracts and policies followed in oil and gas industry.

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.

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.

Pre-N.E.L.P era, Pre N.E.L.P joint venture, N.E.L.P-petroleum exploration license and exploration under N.E.L.P, O.A.L.P.- Open Acreage Licensing Policy, Hydrocarbon Exploration and Licensing Policy (H.E.L.P).

Petroleum Contracts: Petroleum Sharing Contracts, License Agreements, Service Contracts, Joint Ventures & Hybrid Contracts in Petroleum Industry and their Comparison with Possible Equivalence. Petroleum Fiscal Regime; Program and budget; Disposal of petroleum.

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.

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.

1. Rudolf Dolzer; Petroleum contracts and International law; Oxford university press; 2018.
2. John A P Chandler; Petroleum Resource Management; Algar; 2018.

9. D Johnston; Petroleum fiscal systems and production sharing contracts; PennWell Books; 1994.
10. Muhammed Mazel; Petroleum Fiscal Systems and Contracts; Diplomica; 2010.

			2		DE				VIII

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

Natural Gas Industry: Size And Direction Of Development; Properties Of Natural Gases: Typical Compositions. Equations Of State: General Cubic Equations, Specific High Accuracy Equations. Use Of Equation Of State To Find Residual Energy Properties; Thermal Properties.

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

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

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

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

After completing the course student will be able to

Understand the properties of natural gas.

Apply different measures in the recognition of reservoir performance.

Understand and apply flow behavior of gas in production tubing.

Conversant with different methods of processing of gas.

Understand and apply gas compression fundamentals.

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

1. B. Guo and A. Ghalambor, Natural Gas Engineering Handbook, Gulf Publishing Company, 2005.
2. D.L. Katz and R.L. Lee, Natural Gas Engineering, McGraw_Hill, 1990.

1. B. Guo, W.C. Lyons and A. Ghalambor, Petroleum Production Engineering: A Computer Assisted Approach, Elseveir, 2007.
2. T. Ahmed and P. D. McKinney, Advanced Reservoir Engineering, Elseveir, 2005.

			2		DE				VIII

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

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

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.

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.

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

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.

To be able to diagnose the well and create proper integrity management system.
To be able to understand the fundamentals of well barriers.
To be able to understand the abandonment and plugging techniques of wells.
To understand well barrier management and control.
To understand onshore and offshore abandonment regulations.

1. British Standards Institute Staff; Well Integrity for the Operational Phase; B S I Standards; 1916.
2. Dwight K. Smith; Handbook on Well Plugging and Abandonment; PennWell Books; 1993.

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.
3. Oak Ridge, Tennessee; Monitoring Well Plugging and Abandonment Plan; United States. Department of Energy; 1998.

			2		DE				VIII

Togainknowledgeonthevarious process plant utilities and their efficient use.

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.

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.

Refrigeration system and their characteristics, load calculation and load calculation and humidification and de humidification equipments, drying and cooling tower, air blending, exhaust, ventilation, cryogenics, their characteristics and production of liquid N_2 and O_2

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.

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,

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.

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

1. S.C.Arora&S.Domkumdwar; A course in refrigeration and air conditioning; Dhanpat Rai Publication; 1980.
   Tryebal, R.E., “Mass Transfer Operations”, McGraw-Hill III Edition, 1980.

Humanities Electives IV

			2		Elective				VIII

- 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.

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.

Evolution of script and languages in India: Harappan Script and Brahmi Script;Short History of the Sanskrit literature: The Vedas, The Brahmins and Upanishads & Sutras, Epics: Ramayana and Mahabharata &Puranas.

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 *Performing Arts:* Divisions of Indian classical music: Hindustani and Carnatic, Dances of India: Various Dance forms: Classical and Regional, Rise of modern theatre and Indian cinema.

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

- 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.

1.Chakravarti, Ranabir: Merchants, Merchandise & Merchantmen, in: Prakash, Om (ed.): The Trading World of the Indian Ocean, 1500-1800 (History of Science, Philosophy and Culture 361 in Indian Civilization, ed. by D.P.Chattopadhaya.
2. Chaudhuri, Kirti N.: Trade and Civilisation in the Indian Ocean, CUP, Cambridge, 1985.
3.Malekandathil, Pius: Maritime India: Trade, Religion and Polity in the Indian Ocean, Primus Books, Delhi, 2010.
4. McPherson, Kenneth: The early Maritime Trade of the Indian Ocean, in: ib.: The Indian Ocean: A History of People and The Sea, OUP, 1993, pp. 16-75.
5. Christie, J.W., 1995, State formation In early Maritime Southeast Asia, BTLV

			2		Elective				VIII

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

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

Panchkosha, Triguna, Tridosh, Macrocosm-Microcosm

Lord Buddha, Mahaveer, Gandhi, Vivekanand, Aurovindo-The Life Divine, Pt. Sri Ram Sharma Acharya, Vinoba& Acharya Rajneesh Osho, ParamhansYogananda-Autobiography of a Yogi

Identifying human prakriti, Using Trigun inventory, Understanding self

- 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”.

Chattejee,S.G. and Datta, D.M. (1960) An Introduction to Indian Philosophy, Calcutta: University of Calcutta Press

- 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)
- Acharya, Pt. Shri Ram Sharma (2015). GayatriMahavigyan. Mathura:AkhandJyotiPrakashan.
- Vinoba, Acharya (2011). VicharPothi. Pawnar: ParamdhamPrakaashan.
- Gandhi, M.K. (2013). The story of my experiments with truth. Varanasi: SarvodayaPrakashan.

			2		Elective				VIII

- 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.

Industrial Sociology: Nature, Scope and Importance, Origin and Development, Industry as a social, System,Development of Industry in Post-Independence period, Evolution of Working Class, Changing nature of work, Growth of unorganized informal sector., Dynamics of Industrial Relations: Approaches to the study of Industrial Relations, Collective Bargaining,– Concepts, Types, Scope and Importance.

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

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.

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

- 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)

Davis, Keith, 1984. Human Behaviour at work, New Delhi. Mcgraw Hill.
Gisbert, Ascual S J 1972. Fundamentals of Industrial Sociology, New Delhi, Tata Mc Graw-Hill.
Ramaswamy, E. A, 1978. Industrial Relations in India. Delhi. MacMillian
Pascal Gilbert: Fundamental of Industrial Sociology; Orient-Longman.
E.V.Schneider – Industrial sociology
Baviskar et al - Social Structure and Change [Vol.IV] Sage Publishers

- Sheth, N R, 1979, Industrial Sociology in India, Jaipur Rawat.
- Dutt and Sundharam 2007. Indian Economy, S Chand Publications. New Delhi: Publications.
- P. Subha Rao: Human Resource Management and Industrial Relations – Himalaya Publishing House

			2		Elective				VIII

- 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.

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.)

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

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

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

- 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.

The Sustainability Revolution: Portrait of a Paradigm Shift by Edwards, Andres R., New Society Publishers, 2005.

1. The Sustainability Revolution: Portrait of a Paradigm Shift by Edwards, Andres R., New Society Publishers, 2005.
2. Sustainable development in India: Stocktaking in the run up to Rio+20: Report prepared by TERI for MoEF, 2011.

	CS482		Human Computer Interaction						
	3 0 0		3		DE/OE		4th		VIII

: 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.

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

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.

–New and Navigation schemes selection of window, selection of devices based and screen based controls.

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

–Specification methods, interface–Building Tools.

– Keyboard and function keys –pointing devices –speech recognition digitization and generation – image and video displays – drivers.

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale Human Computer Interaction, 3rd Edition Prentice Hall, 2004.
2. Jonathan Lazar Jinjuan Heidi Feng, Harry Hochheiser, Research Methods in Human Computer Interaction, Wiley, 2010.

1. Ben Shneiderman and Catherine Plaisant Designing the User Interface: Strategies for Effective Human-Computer Interaction (5th Edition, pp. 672, ISBN 0-321-53735-1, March 2009), Reading, MA: Addison-Wesley Publishing Co.

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

	3 0 0		3		DE /OE		4th		VIII

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

1. Vision and Introduction to IoT.
2. Understand IoT Market perspective.
3. Data and Knowledge Management and use of Devices in IoT Technology.
4. Understand State of the Art – IoT Architecture.
5. Real World Design Constraints, Industrial Automation and Commercial Building Automation in IoT.

Wireless Sensor Networks

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

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.

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.

Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model
IoT Reference Architecture: Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints-Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.

Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things Commercial Building Automation: Introduction, Case study: phase one-commercial building automation today, Case study: phase two- commercial building automation in the future.

- 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.

Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.

1. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014.
2. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013

	3 0 0		3		DE /OE		4th		VIII

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.

Mobile computing with functions & devices, Networks, Middleware & gateways, Application & services, Developing mobile computing applications, Security & standards why it necessary, Architecture for mobile computing.

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

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

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

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

Information security, Security techniques & algorithms, public key infrastructure,

---

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.

- Jochen H. Schiller: Mobile Communications - Second Edition, Pearson
- Asoke K Talukder & Roopa R Yavagal: Mobile Computing Technology, Applications and Service Creation – Tata McGraw-Hill Publishing Company Limited

- William Stallings: Wireless Communications & Networks - Second Edition, Pearson
- Theodore S. Rappaport : Wireless Communications Principles & Practice - Second Edition, Pearson

	3 0 0		3		DE /OE		4th		VIII

- 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.

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.

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

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

MAC protocols- Aloha, CSMA, collision free protocols, Ethernet, IEEE 802.3 standard, IP protocols, IP addressing, OSPF, IPv4, IPv6. Transmission media and channel impairments, multiplexing, digital channels, switching. Repeaters, bridges, routers and gateways.

1. Forouzan, B.A., “Data Communication and Networking”, 4th Ed., Tata McGraw-Hill.
2. Tanenbaum, A.S, “Computer Networks”, 4th Ed., Pearson Education.
3. Stallings W., “Data and Computer Communication”, 8th Ed., Prentice-Hall.
4. Simon Haykins, ‘Communication Systems’, John Wiley,5th edition

1. Kurose, J.F. and Ross, K.W., "Computer Networking: A Top-Down Approach Featuring the Internet", 3rd Ed., Addison Wesley.

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.

The course provides an understanding of:

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

	3 0 0		3		DE /OE		4th		VIII

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.

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.

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.

:
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.

:
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.

1. Joseph J. Carr & John. M. Brown, 'Introduction to Biomedical Equipment technology'
2. R.S. Khandpur, 'Handbook of Biomedical Instrumentation', McGraw Hill.

1 J.G. Webster, 'Medical instrumentation application and design', Houghton Miffin Co., Boston USA.
2 Mohan Murali H, 'Monograph on Biomedical engineering', O.U. Press 1985.
3 Geddes L. A. & L. E. Baker, 'Principles of Applied Biomedical Instrumentation', Wiley, 1989.
4 Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer, 'Biomedical Instrumentations and Measurements' (2nd edition), PHI, 1991.

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.

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.

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

					Open Elective				VIII

- 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.

Definition, advantages of electrical transducers, classification, characteristics, factors affecting the choice of transducers, Potentiometers, Strain guages, Resistance thermometer, Thermistors, Thermocouples, LVDT,RVDT

, Piezoelectric Hall effect and opto electronic transducers.

Measurement of Motion, Force pressure, temperature, flow and liquid level.

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.

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, storage oscilloscope, spectrum analyser, strip chart & x-y recorders, magnetic tape & digital tape recorders.

Principle, elements of process control system, process characteristics, proportional (P), integral (I), Derivative (D), PI, PD and PID control modes. Electronic, Pneumatic & digital controllers.

1. A.K.Sawhney, “Advanced Measurements & Instrumentation”, Dhanpat Rai & Sons
2. B.C. Nakra&K.Chaudhry, “Instrumentation, Measurement and Analysis”, Tata Mc Graw Hill 2nd Edition.
3. Curtis Johns, “Process Control Instrumentation Technology”, Prentice Hall

1. E.O. Decblin, “Measurement System – Application & design”, Mc Graw Hill.
2. W.D. Cooper and A.P. Beltried, “Electronics Instrumentation and Measurement Techniques” Prentice Hall International

3.RajendraPrasad,”Electronic Measurement and Instrumentation Khanna Publisher
4. M.M.S. Anand, “Electronic Instruments and Instrumentation Technology” PHI Learning.

-
-
-

	ME382								
	3 0 0		3		DE/OE		4th		VIII

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

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)

Muscle structure, metabolisms, circulatory and respiratory systems, energy expenditure and workload

: 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)

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.

: 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.

: 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.

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

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

1. Lakhwinder Pal Singh, "Work Study and Ergonomics:Cambridge University Press,2018.
2. Value Engineering : A Systematic Approach by Arthur E. Mudge - McGraw Hill 2010

The Power of Ergonomics as a Competitive Strategy By Gross & Right (Productivity Press) 2010.
2. MartandTelsang, Industrial Engineering and Production Management,S. Chand &Compagny Limited, 2006.
3. Value Engineering A how to Manual S.S.Iyer, New age International Publishers 2009.

	ME366								
	3 0 0		3		DE /OE				VIII

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.
Manufacturing Process, Industrial Engineering and Management

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.

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

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.

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.

Intellectual Property: Elements and outline, patenting procedures, claim procedure.
Design for Environment: Impact, regulations from government, ISO system, case studies.

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.

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.

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development", Tata McGraw-Hill Education, 4th Edition, 2009.
2. Kevin Otto, Kristin Wood, "Product Design", Pearson Education, Indian Reprint 2004.

1. Yousef Haik, T. M. M. Shahin, "Engineering Design Process Cengage Learning, 2010", 2nd Edition Reprint.
2. Kevin Otto, Kristin Wood, "Product Design", Pearson Education Indian Reprint 2004.
3. Clive L.Dym, Patrick Little, "Engineering Design: A Project-based Introduction", John Wiley & Sons, 3rd Edition 2009.

Course Structure & Syllabus of B.Tech – Petroleum Engineering (Batch: 2018-2022)

	ME452								
	3 0 0		3		DE/OE		4th		VIII

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.

Basic Thermodynamics, Heat Transfer

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.

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.

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.

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.

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.

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.

1. B. H. Khan, "Non-Conventional Energy Resources", 3rd edition (2017), McGraw Hill Education (India) Private Limited, Chennai.
2. S. P. Sukhatme& J. K. Nayak,"Solar Energy", 4th edition (2018), McGraw Hill Education (India) Private Limited, Chennai.

1. G. N. Tiwari & M. K. Ghosal, "Renewable Energy Resources – Basic Principles and Applications", 2005, Narosa Publishing House, New Delhi.
2. D.P. KOTHARI, K. C. SINGAL, RAKESH RANJAN, Renewable Energy Sources And Emerging Technologies, PHI Learning Pvt. Ltd., 25-Nov-2011.

	CE483								
	3 0 0		3		DE/OE		4th		VIII

The course provides wide knowledge about basics of GIS and its applications in various fields

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,

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;

Attribute database: scale and source of inaccuracy; GIS functionality; data storage and data retrieval through query, generalization, classification, containment search within a spatial region;

Overlay: arithmetical, logical and conditional overlay, buffers, inter visibility, aggregation; Network analysis;

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.

- 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

1. Geographic Information Systems: A Management Perspective, by Stan Arnoff, WDL Publications.
2. Fundamentals of Spatial Information Systems by Robert laurini and Derek Thompson, Academic Press.

3. Geographical Information Systems, Vol. I and II edited by Paul Longely, M.F. Good child, et.al, John Wiley and Sons, Inc. 1999

	MA452								
	3 0 0		3		Open Elective		4th		VIII

Operation Research approach, general methods for Operation Research models, methodology and advantages of Operation Research.

Introduction to LPP and formulation of Linear Programming problems, Graphical solution method, alternative or multiple optimal solutions, Unbounded solutions, Infeasible solutions, Maximization – Simplex Algorithm, Minimization – Simplex Algorithm using Big-M method, Two phase method, Duality in linear programming.

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.

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

1. S.S. Rao, "Engineering Optimization: Theoryand Practice", New Age International P)Ltd.,New Delhi, 2000.
2. G. Hadley, "Linear programming", NarosaPublishing House, New Delhi, 1990.3.
3. H.A. Taha, "Operations Research: AnIntroduction", 5th Edition, Macmillan, New York, 1992.4.
4. K. Deb, "Optimization for Engineering Design-Algorithms and Examples", Prentice-Hall ofIndia Pvt. Ltd., New Delhi, 1995.
5. S.D. Sharma, “Operations Research”, Kedar Nath Ram Nath Publishers, 2009.

	AR-485								
	3 0 0		3		OE		4th		VIII

To create an overview and understanding of various art forms that exists from ancient to modern times.

Understanding various art forms in society and in different cultures.

Relationship between art, culture and society. Influence of art forms on people.

Understanding and appreciating films/ documentaries from past to present timesand between east and west

Understanding and appreciating painting and sculptures from past to present times and between east and west

Understanding and appreciating Indigenous/ Folk art from past to present times and between east and west.

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.

3. Creative Authenticity: 16 Principles to Clarify and Deepen Your Artistic Vision, Ian Roberts

The Writer: A Concise Complete and Practical Text Book of Rhetoric. Designed to Aid in The Appreciation, George Lansing Raymond

	PY481								
	3 0 0		3		DE/OE		4th		VIII

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.

Nanomaterials synthesis techniques; top-down and bottom-up techniques, ball milling, PVD, CVD, self-assembly.

Nanomaterials characterization; XRD, SEM, TEM, AFM, UV-VIS.

Nanomaterials and their properties: carbon based nano materials, metal based nano materials, quantum dots, biological nano materials.

Applications of nanotechnology in engineering, solar energy conversion, nanomedicine.

1. Poole, Jr. CP and Owens, FJ, “Introduction to Nanotechnology”, Wiley India. 2006.
2. Cao, G., Nanostructures and Nanomaterials: Synthesis, Properties and Applications, Emperial College Press (2004).
3. Edward L. Wolf: Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience, 2nd ed., Wiley-VCH, 2006.