Program Syllabus Booklet

Bachelor of Technology in Petroleum Engineering
(B. Tech PE-106)

Session: 2017-18

Guru Gobind Singh College of Engineering and Technology
Guru Kashi University, Talwandi Sabo

ਇਹ ਹੈ ਪ੍ਰਗਟ ਹਮਾਰੀ ਕਾਸ਼ੀ
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GURU KASHI UNIVERSITY
PUNJAB - INDIA

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Annexure -1

Program Name: Bachelor of Technology in Petroleum Engineering (B Tech PE)
Program Code: 106

Bachelor of Technology in Petroleum Engineering offers job oriented degree course for the young talents aspiring for challenging career and to meet the present and future demand of trained and skilled manpower in Downstream, Upstream and Chemical Process Industries. Students will have the opportunity to get employment in downstream and upstream sectors. Additionally have good opportunities in famous industries like Trident Group, IOCL, Chemicals and Pharmaceuticals Ltd., Bathinda Chemicals Ltd., National Fertilizers Ltd., HMEL Refinery, PRAJ, HONEYWELL, TOYO, ESSAR, RELIANCE, GAIL, THERMAX, GSPC and CAIRN. This program is not just about education, you also learn about personality development.

Annexure-2

Semester: 1st (Chemistry Group)										
Sr.	Course Code	Course Name	Type of Course T/P	(Hours Per Week)			No. of Credits	Internal Marks	External Marks	Total Marks
				L	T	P				
1	100102	Engineering Chemistry	T	4	1	0	5	50	50	100
2	100103	Engineering Mathematics -I	T	4	1	0	5	50	50	100
3	103101	Basic Electrical Engineering	T	4	1	0	5	50	50	100
4	105101	Elements of Mechanical Engineering	T	4	1	0	5	50	50	100
5	105102	Engineering Graphics & Drawing	T/P	1	0	6	4	50	50	100
6	100106	Engineering Chemistry Laboratory	P	0	0	2	1	60	40	100
7	103102	Basic Electrical Engineering Lab	P	0	0	2	1	60	40	100
8	105103	Computer Graphics Lab	P	0	0	2	1	60	40	100
Total No. of Credits				17	4	12	27			

Semester: 2nd (Physics Group)										
Sr.	Course Code	Course Name	Type of Course T/P	(Hours Per Week)			No. of Credits	Internal Marks	External Marks	Total Marks
				L	T	P				
1	100101	Communicative English	T	3	0	0	3	50	50	100
2	100201	Engineering Mathematics-II	T	4	1	0	5	50	50	100
3	100104	Engineering Physics	T	3	1	0	4	50	50	100
4	102101	Fundamental of Computer Programming & Information Technology	T	3	0	0	3	50	50	100
5	104101	Basic Electronics & Communication	T	3	1	0	4	50	50	100
6	100105	Communicative English Laboratory	P	0	0	2	1	60	40	100
7	100107	Engineering Physics Laboratory	P	0	0	2	1	60	40	100
8	102102	Fundamental of Computer Programming & Information Technology Lab	P	0	0	4	2	60	40	100
9	104102	Basic Electronics & Communication Lab	P	0	0	2	1	60	40	100
10	105104	Manufacturing Practice	P	0	0	6	3	60	40	100
Total No. of Credits				16	3	16	27			

Semester: 3rd										
Sr.	Course Code	Course Name	Type of Course T/P	(Hours Per Week)			No. of Credits	Internal Marks	External Marks	Total Marks
				L	T	P				
1	A100302	Environmental Science	T	3	0	0	3	50	50	100
2	A106301	Petroleum Chemistry	T	4	0	0	4	50	50	100
3	A106302	Mechanical Operations and Particle Mechanics	T	3	1	0	4	50	50	100
4	A106303	Elements of Reservoir Engineering and Ground Survey	T	4	0	0	4	50	50	100
5	A106304	Strength of Materials	T	3	1	0	4	50	50	100
6	A106305	Material and Energy Balance	T	3	1	0	4	50	50	100
7	A106306	Petroleum Chemistry Laboratory	P	0	0	2	1	60	40	100
8	A106307	Strength of Materials Laboratory	P	0	0	2	1	60	40	100
9	A106308	Institutional Training *	P	0	0	0	2	60	40	100
Total No. of Credits				20	3	4	27			

*Institutional Training will be imparted in the Institute at the end of 2nd Semester for 6-weeks duration. It is not applicable for Leet students.

Semester: 4th									
Sr.	Course Code	Course Name	Type of Course T/P	(Hours Per Week)			No. of Credits	Internal Marks	External Marks	Total Marks
				L	T	P				
1	A106401	Heat Transfer	T	3	1	0	4	50	50	100
2	A106402	Mass Transfer – I	T	3	1	0	4	50	50	100
3	A106403	Fluid Flow	T	3	1	0	4	50	50	100
4	A106404	Geology of Petroleum	T	4	0	0	4	50	50	100
5	A106405	Drilling Technology	T	3	1	0	4	50	50	100
6	A106406	Chemical Engineering Thermodynamics	T	3	1	0	4	50	50	100
7	A106407	Heat Transfer Laboratory	P	0	0	2	1	60	40	100
8	A106408	Mechanical Operations Laboratory	P	0	0	2	1	60	40	100
9	A106409	Fluid Flow Laboratory	P	0	0	2	1	60	40	100
Total No. of Credits				19	5	6	27			

Semester: 5th									
Course Code	Course Name	Type of Course T/P	(Hours Per Week)			No. of Credits	Internal Marks	External Marks	Total Marks
			L	T	P				
A106501	Mass Transfer – II	T	3	1	0	4	50	50	100
A106502	Chemical Reaction Engineering – I	T	3	1	0	4	50	50	100
A106503	Drilling Fluids and Cements	T	4	0	0	4	50	50	100
A106504	Process Instrumentation and Control	T	3	1	0	4	50	50	100
A106505	Petroleum Refining Engineering	T	4	0	0	4	50	50	100
A106506	Industrial Pollution Abatement	T	3	1	0	4	50	50	100
A106507	Mass Transfer Laboratory	P	0	0	2	1	60	40	100
A106508	Process Control Laboratory	P	0	0	2	1	60	40	100
A106509	Industrial Pollution Abatement Laboratory	P	0	0	2	1	60	40	100
A106510	Industrial Training (6 Weeks)	P	0	0	0	4	60	40	100
Total No. of Credits			20	4	6	31			

Semester: 6th										
Sr.	Course Code	Course Name	Type of Course T/P	(Hours Per Week)			No. of Credits	Internal Marks	External Marks	Total Marks
				L	T	P				
1	A106601	Petrochemical Technology	T	4	0	0	4	50	50	100
2	A106602	Chemical Reaction Engineering – II	T	3	1	0	4	50	50	100
3	A106603	Transport Phenomena	T	3	1	0	4	50	50	100
4	A106604	Process Utilization and Industrial Safety	T	3	1	0	4	50	50	100
5	A106605	Offshore Drilling and Production Practices	T	4	0	0	4	50	50	100
6	A106606	Numerical Methods	T	3	1	0	4	50	50	100
7	A106607	Process Equipment Design	P	0	0	4	2	60	40	100
8	A106608	Chemical Reaction Engineering Laboratory	P	0	0	2	1	60	40	100
9	A106609	Numerical Methods Laboratory	P	0	0	2	1	60	40	100
Total No. of Credits				20	4	8	28			

Semester: 7th										
Sr.	Course Code	Course Name	Type of Course T/P	(Hours Per Week)			No. of Credits	Internal Marks	External Marks	Total Marks
				L	T	P				
1	A106701	Process Economics and Management	T	4	0	0	4	50	50	100
2	A106702	Process Modelling and Simulation	T	4	0	0	4	50	50	100
3	A106703	Oil and Gas Transportation System	T	4	0	0	4	50	50	100
4	A106704	Natural Gas Engineering	T	4	0	0	4	50	50	100
5	A106705 - A106709	Elective	T	4	0	0	4	50	50	100
6	A106710	Process Plant Design	P	0	0	4	2	60	40	100
7	A106711	Major Project	P	0	0	4	2	60	40	100
Total No. of Credits				20	0	8	24			

Elective:

Sr. No.	Course Code	Course Subject
1	A106705	Modern Separation Processes
2	A106706	Optimization Techniques
3	A106707	Advanced Transport Phenomena
4	A106708	Energy Engineering
5	A106709	Petroleum Engineering System Design

Semester: 8th										
Sr.	Course Code	Course Name	Type of Course T/P	(Hours Per Week)			No. of Credits	Internal Marks	External Marks	Total Marks
				L	T	P				
1	A106801	Industrial Training	T/P	NA	NA	NA	20	500	500	1000
Total No. of Credits							20			

Annexure-3

Course Name: Engineering Chemistry
Course Code: 100102
Semester: 1st

	L	T	P
Credits: 05	**4**	**1**	**0**

Course Content

Module 1: Spectroscopy and its Applications:
An introduction UV / Visible Spectroscopy: Selection rules; Line widths and intensity of spectral lines; Principle and instrumentation; Electronic Transitions; Chromophores & auxochromes; Factors affecting λ_{Max}& intensity of spectral lines; Franck-Condon principle; Applications.IR Spectroscopy: Principle and instrumentation; Vibrational frequency; Fundamental modes of vibrations and types; Anharmonics; Factors affecting vibrational frequency; Applications.NMR Spectroscopy: Principle & instrumentation; Chemical shift; Spin-Spin Splitting; High resolution NMR spectrum (PMR only).

Module 2: Photochemistry:
Introduction; Photo-physical & photochemical processes; Light sources in photochemistry; Beer-Lambert Law; Laws of Photochemistry; Quantum yield (primary and overall); Primary and secondary photochemical reactions; Jablonski diagram, Photovoltaic cells.

Module 3: Water and its Treatment:
Boiler feed water: Boiler feed problems; Specification, Scales and sludge formation; Priming & foaming; Caustic embrittlement; Boiler corrosion; Different methods of the water purifications and softening; Desalination of water; Water for domestic use: Specification; Disinfection of water.

Module 4: Green Chemistry and its Applications:
Introductory overview – Definition and concepts of Green chemistry; Emergence of Green chemistry; Twelve principles of Green Chemistry with emphasis on the use of alternative feedstock (bio-fuels); Use of innocuous reagents in natural processes; Alternative solvents; Design of safer chemicals; Designing alternative reaction methodology, Minimizing energy consumption.

Module 5: Corrosion and its Prevention:
Introduction; Different types of corrosion – Wet, Dry corrosion and other forms of corrosion; Mechanisms of wet corrosion; various methods of corrosion control.

Module 6: Catalysis and Polymers:
Introduction; Catalysis and general characteristics of catalytic reactions; Homogenous catalysis; Enzyme catalysis including their mechanism; Classification of polymers; Mechanism of addition and condensation polymerization; Phenol formaldehyde resin; Urea formaldehyde resin.

Module 7: Nanochemistry:
Introduction; Materials self-assembly; Molecular vs. materials self-assembly; Self-assembling materials; Two dimensional assemblies; Mesoscale self assembly; Nanoscale materials; Future perspectives, Nanocrystals.

Module 8: Petrochemicals:

Introduction; First, second & third generation petrochemicals; Primary Raw Materials for Petrochemicals. Natural gas: Natural gas treatment processes; Natural gas liquids; Properties of natural gas; Crude oil: Composition of crude oil- Hydrocarbon compounds, Non-hydrocarbon compounds, Production of ethylene and propylene. Metallic crystals, Crude oil classification, Physical separation processes, Conversion processes.

References:

1. Kemp,W.(1991). *Organic Spectroscopy* ,Palgrave Foundations.
2. Skoog, d.A. & Holler, F.J.(1998). *Principles of Instrumental Analysis*.Saunders College Publishing, Philadelphia.
3. Castellan, G. W.(1995). *Physical Chemistry*(3rd Edition)Narosa
4. Poole, C.P. Jr. & Owens, F. J. (2003).*Introduction to Nanotechnology*. Wiley Interscience,.

Course Name: ENGINEERING MATHEMATICS – I
Course Code: 100103
Semester: 1st

	L T P
Credits: 05	**4 1 0**

Course Content

Module 1: Ordinary Differential Equations of first order

Exact Differential equations, Equations reducible to exact form by integrating factors; Equations of the first order and higher degree.

Module 2: Linear Ordinary Differential Equations of second & higher order

Solution of linear Ordinary Differential Equations of second and higher order; methods of finding complementary functions and particular integrals. Special methods for finding particular integrals: Method of variation of parameters. Cauchy's homogeneous and Legendre's linear equation,

Module 3: Partial Derivatives:

Function of two or more variables; Partial differentiation; Homogeneous functions and Euler's theorem; Composite functions; Jacobians. Curvature of Cartesian curves; Curvature of parametric and polar curves.

Module 4: Applications of partial differentiation:

Equation of tangent and normal to a surface; Taylor's and Maclaurin's series for a function of two variables; Errors and approximations; Maxima and minima of function of several variables.

Module 5: Infinite Series:

Comparison test, Integral test, Ratio test, Rabee's test, Logarithmic test, Cauchy's root test. Convergence and absolute convergence of alternating series.

Suggested Readings / Books

1. Kreyszig, E.(1998)*Advanced Engineering Mathematics*; Eighth Edition, Johnwiley and sons.
2. Grewal, B.S.(1965) *Higher Engineering Mathematics* ; Khanna Publishers, NewDelhi.
3. Babu Ram(2009) *Advance Engineering Mathematics*; First Edition;PearsonEducation.
4. Richard Courant and Fritz John (2012) ***Introduction to Calculus and Analysis,*** **Volume II , V** Springer Publication
5. Harold M. Edwards (2013)*Advanced Calculus: A Differential Forms Approach*, Birkhauser.

Course Name: BASIC ELECTRICAL ENGINEERING
Course Code: 103101
Semester: 1st

L T P
Credits: 05 **4 1 0**

Course Content

Module 1: DC NetworkTheorems

Circuit elements and related terminology, Illustration and Limitations of ohm's Law , Kirchhoff's Laws statements & Illustration, Method of solving circuits by Kirchhoff's Laws, Star-Delta conversions, Computation of resistance in constant temperature, Resistance at different temperatures, Units, Work, Power and Energy (Electrical, Thermal and Mechanical) DC transients –for R-L and R-C series circuits.

Theorems

Thevenin's theorem, Superposition theorem, Norton Theorem, Maximum Power transfer theorem, Reciprocity theorem,

Module 2: AC Fundamental

Production of alternating voltage, Waveforms, Average and RMS values, Peak factor, form factor, Phase and phase difference, Phasor representation of alternating quantities, Phasor diagram, Behavior of AC series, Parallel and series parallel circuits, Power factor, Power in AC circuit, Effect of frequency variation in RLC series and parallel circuit, Q factor, Band width of resonant circuit.

Module 3: Electromagnetism

Magnetic circuits, Analogous quantities in magnetic and electric circuits, Faradays' law, self and mutual inductance, Energy stored in magnetic field, Hysteresis and Eddy current losses, and Electromechanical Energy conversion

Module 4: DCMachines

Construction, Types of armatures winding (Lap and wave)

DC generator: Principle of operation, EMF equation, Applications.

DC motors: Principle of operation, Speed-torque Characteristics (shunt and series machine).

Module 5: Single PhaseTransformer

Principle of Operation, Construction, EMF equation, Losses of a transformer, Open and short circuit tests & efficiency.

Module 6: Three Phase InductionMotor

Types, Construction, Production of rotating field, Principle of operation, Applications.

References:

1. Muthusbramanian, R. & Salivahanan, S. *Basic Electrical and Electronics and Computer Engg.* Tata McGrawHill.
2. Theraja, B.L. & Theraja , A.K. *A Text Book of Electrical Tech*..S. Chand.
3. Deltoro, V. *Fundamentals of Electrical Engg*. Prentice Hall.
4. Sawhney, A.K. *A Course in Electrical and Electronics Measurements & Instrumentation*, Dhanpat Rai & Co.

Course Name: ELEMENTS OF MECHANICAL ENGINEERING
Course Code: 105101
Semester: 1st

L T P
Credits: 05 **4 1 0**

Course Content

Module 1.Fundamentals of Thermodynamics:

Definition, Concept of thermodynamic system, boundary and surroundings, Type of System Open, Closed and isolated systems, State, Property, Process and cycle,Reversible, Quasi-static and irreversible processes and conditions for reversibility, Energy and its forms energy transfer across system boundaries, Heat and work, property and energy as point and path functions, Ideal gas and characteristic gas equation, Zeroth law of thermodynamics, Concept of thermal equilibrium and principle ofthermometry.

Module 2. First Law of Thermodynamics and ItsApplications:

Essence and corollaries of the first law, Analytical expressions applicable to a process and cycle internal energy, Enthalpy and specific heats first law analysis of steady flow, applications of steady flow energy equation to various engineering devices, Closed and opensystems,Analysisofnon-flow(CloseSystem)andflow(OpenSystem)processesfor an ideal gas under constant volume (Isochoric), Constant pressure (Iso baric), Constant temperature (Isothermal), Adiabatic and polytropic conditions, Analysis of free expansion and throttlingprocesses.

Module 3.Second Law ofThermodynamics:

Limitations of first law, Need of second law of thermodynamics, Various statements of secondlawandtheirequivalence,Applicationsofstatementsofsecondlawtoheatengine, Heat pump and refrigerator, Philosophy of Carnot cycle and its consequences, Carnot theoremforHeatenginesandheatpump,Claussiusinequality,Conceptand;philosophyof entropy and entropy changes during various processes, Temperature entropy chart and representation of various processes onit.

Module 4: Gas Power Cycles:

Concept and philosophy of Air Standard Cycle and Air standard Efficiency, Some basic definitions of Piston-Cylinder arrangement, Working of Otto cycle, Diesel cycle, Dual cycle and Brayton cycle their representation on P-V and T-S Charts, Comparison of Otto cycle, Diesel cycle, Dual cycles, Mean Effective Pressure, Introduction to constructional features and working of two stroke and four stroke petrol and diesel engines and their comparison.

Module 5 : Classification of EngineeringMaterials:

Introduction Materials and Engineering, Classification of Engineering Materials, Significance of various Mechanical Properties of Materials e.g., Elasticity, Plasticity, strength, Ductility, Brittleness, Malleability, Toughness, Resilience hardness, Mach inability, Formability, Weld ability, Properties, Composition, and Industrial Applications of materials metals (ferrous- cast iron, tool steels, stainless steels and non ferrous- Aluminum, brass, bronze), Polymers (natural and synthetic, thermoplastic and thermosetting), Ceramics (glass, optical fibre glass, cements), Composites (fibre reinforced, metal matrix), Smart materials (piezoelectric, shape memory, Thermo chromic, Photo chromic, Magneto rheological), Conductors, Semi-conductors and

Insulators, Organic and Inorganic materials, Selection of materials for engineering applications.

Module 6 Mechanics of Solids:

Concept of stress strain curve, Yield point, Elastic limit, Ductility, Elongation, True stress and true strain, Strain energy and resilience, Tension, Compression, Torsion, Bending, Hardness, Fatigue, Creep, Impact, Concept and philosophy of stress and strain, Normal, Shear and Temperature stresses longitudinal and lateral strain, Poisson's ration, Sudden and impact load, Stresses in composite bar due to application of load and temperature, Elastic constants and their significance , Relations between Elastic constants (Without Proof); Young modulus of Elasticity, Poisson's ratio, Modulus of rigidity, and Bulk modulus, Moment of inertia and centre of gravity of section I,T & C.

References Books:

1. Nag, P.K., *Engineering Thermodynamics*.Tata McGrawHill.
2. Yadav, R. *Thermodynamics and Heat Engines*. Central PublishingHouse.
3. Rogers, G. & Mayhew, Y. *Engineering Thermodynamics*. PearsonEducation.
4. Rao,Y.V.C.,*An Introduction to Thermodynamics*.New Age International P Limited.
5. Cengel, Y.A. & Boles, M.A. *Thermodynamics – An Engineering Approach*;.Tata McGrawHill.

Course Name: ENGINEERING GRAPHICS & DRAWING
Course Code: 105102

Semester: 1st

L T P
Credits: 05 **4 1 0**

Course Content

Module 1. Basic Concepts of Drawing &Projections:
Various types of lines, Principles of dimensioning, Size and location dimensions, Symbols, Conventions, Scales (plane and diagonal) and lettering as per IS code of practice (SP-46) for general Engg. Drawing. Exercises on lettering techniques free hand; Printing of letters and numerals in 3,5,8 and 12mm sizes, Vertical and inclined at 75^{o} Instrumental lettering in single stroke. Relevance of projection, Type of projections, Perspective, Orthographic, Axonometric and their basic principles, System of orthographic projection: in reference to quadrants and octants, Illustration through simple problems ofprojection.

Module 2. Projection of Points:
Different methods of angle of projections; Projection of points on Plane and projection of point on Auxiliaryplanes.

Module 3. Projection ofLines:
Projection of lines, True lengths of lines and their horizontal and vertical traces. Rotation method and auxiliary plane method and traces of line.

Module 4. Projection ofPlanes:
Difference between plane and lamina. Projection of lamina Parallel to one and perpendicular to other, Perpendicular to one and inclined to other, Inclined to both reference planes and Lamina oblique to three reference planes. Application of auxiliary planes, and trace ofplanes.

Module 5. Projection of Solids:
Definition of solids, Types of solids: Right and oblique solids; solids of revolution and polyhedrons etc. and their auxiliary views. Visible and invisible details in the projection. Use rotation and auxiliary plane method to draw the projections.

Module 6 Section of Solids:
Definition of Sectioning and its purpose. Principle and Procedure of Sectioning, Types of sectional planes. Illustration through their practice on projection of solids, sectioning by auxiliary planes.

Module 7. Intersection of Surfaces/Solids:
Purpose of intersection of surfaces, Intersection between the two cylinder, Two prisms, Prism and pyramid, Pyramid and pyramid, Cylinder and prism, Cone and cylinder, Sphere and cylinder etc., Use of cutting plane and line method.

Module 8. Development ofSurface:
Concept of development, Parallel line, Radial line and triangulation method. Development of prism, Cylinder, Cone and pyramid surface for both right angled and oblique solids and development of unique surfaces like hopper, Tray, sphereetc.

Module 9 .Isometric Projection:
Classification of pictorial views, Basic Principle of Isometric projection, Difference between isometric projection and isometric drawing. Isometric projection of solids.

Module 10 .OrthographicProjection:
Concept of Orthographic Projection, Drawing missing lines and missing view in

orthographic projections. Interpretation of production drawings.

References Books:

1. Gill, P.S.(2001).*Engineering Drawing*. S.K; Kataria and Sons,Ludhiana.
2. Bhatt, N.D.(2012).*Engineering Drawing*. Charotar Book Stall, Tulsi Sadan, Anand.
3. French, T.E. and Vierck. C.J.(1993).*Graphic Science*. McGraw-Hill, New York.
4. Zozzora, F.(1958).*Engineering Drawing*.McGraw Hill, NewYork.

Course Name: ENGINEERING CHEMISTRY LABORATORY
Course Code: 100106
Semester: 1st

L T P
Credits: 01 **0 0 2**

Course Content

1. **Analysis ofEffluents**
   a) Determination of water by EDTAmethod.
   b) Determination of H_2O by dissolved oxygenanalyzer.
   c) Determination of turbidity byNephelometer
   d) Determination of ResidualChlorine.
2. **Analysis of Fuels andLubricants**
   a) Determination of Moisture, Volatile and ash content by proximateanalysis.
   b) Determination of Flash &Fire point byAbee‟s Apparatus
   c) Determination of theviscosity.
   d) Determination of Acid Value and Aniline point ofoil
   e) Determination of refractive index foroils.
3. **InstrumentalAnalysis**
   a) Determination λ-max by spectrophotometer and determination of unknown conc of binary mixture of twoliquids.
   b) Determination of the surface tension bystalagmometer.
   c) Determination of the concentration of a solutionconductometerically.
   d) Determination of the strength of a solution pHmeterically.
   e) Distinction between acid, ester, ketone using IRspectrophotometer.
   f) Determination of bathochromic shifts, hypsochromic and hyperchromic, hypochromic shift of benzene and itsderivatives
4. **Chromatography**
   a) Determination of Rf value of amino acid by TLC and identification of the amino acidpresent.
   b) Separation of metallic ions by paper chromatography. Separation of Ions by using complexingagents
   c) Separation of plant pigments, Chlorophyll and carotenoids by column chromatography.
   d) Determinationoftheionexchangecapacityofthegivenionexchanger.
   e) Separation of ions by ion-exchangemethod.
5. **Synthesis &Green Chemistryexperiments**
   a) Preparation of a polymer phenol/urea formaldehyde resin or hexamethylenediamine adipic acid polymer and determination of carbonyl value or acidvalue.
   b) Preparation ofaspirin.
   c) Preparation of ethyl-2-cyano-3-(4‟‟-methoxyphenyl)-propeonate (Microwave assisted reaction)

d) Base catalyzed aldol condensation by GreenMethodology
e) Acetylation of primary amines using ecofriendlymethod.

Note: Each student is required to perform two experiments from each of the 5 titles (presented bold) depending on his/her Branch and Aptitude.

Course Name: BASIC ELECTRICAL ENGINEERING LAB
Course Code: 103102
Semester: 1st

	L	T	P
Credits: 01	**0**	**0**	**2**

Course Content

List of Experiments:

1. To verify ohm'slaw.
2. To find voltage and current relationship in R-L seriescircuit.
3. To study resonance of R-L-Ccircuits.
4. Open circuit and short circuit test of a single phasetransformer.
5. Startingand reversingofspeed ofaD.C.shuntmotorbychangingconnections.
6. Measurementofpowerinathreephasecircuitbytwowattmetermethod.
7. No load characteristics of D.C. shuntGenerators.
8. Tomeasurepowerandpowerfactorinasingle–phaseAC-circuit.
9. To verify Kirchhoff'sLaw.
10. To connect 3 identical single phase transformers for three phase power transformations through following connections (a) star-delta (b) star-star (c) delta-star (d) delta-delta and to find phase and line voltageratio.
11. To start and reverse the direction of I-Q a.c.motor.
12. To verify superpositiontheorem.
13. To verify Norton'stheorem.
14. To verify thevein'stheorem.
15. To verify maximum power transformertheorem.

Course Name: COMPUTER GRAPHICS LABORATORY
Course Code: 105103
Semester: 1st

	L T P
Credits: 01	**0 0 2**

Course Content

List of Experiments:

1. Practice related to 2-D computer sketching. Different command used in computer graphics software and theirapplications.
2. Study and draw 2-D sketching entities like lines, Rectangle, Parallelogram polygon, circle etc., Using three coordinates systemlike
   (a) Link
   (b) Gasket
   (c) BasePlate
   (d) Bracketsetc.
3. Draw the different type of 3D modeling entries using viewing commands to view them (Isometric projection). Practice of various commands available for 3D drawing like extrude, revolveetc.

Course Name: COMMUNICATIVE ENGLISH
Course Code: 100101
Semester: 2nd

	L T P
Credits: 03	**3 0 0**

Course Content

Module 1. Developing Habits of Independent and FastReading

Students will be required to read a prescribed prose. The essays in the anthology will be read by students at home with the help of glossary given in the book. Progressing from one lesson to another, they should learn to read fast. Students are supposed to keep a record of their reading in the form of notes, difficulties, summaries, outlines and reading time for each essay. Class teacher may use this record for awards of internal assessment (ifany)

Module 2. Developing Comprehension Skills

Teacher will provide guided comprehension of the prescribed texts in the class and help students in answering the questions given at the end of each lesson. Teacher can construct more questions of factual and inferential nature to enhance the comprehension skills of the students. The teacher shall also guide students to do the grammar exercise given at the end of eachlesson.

Module 3. Developing skills in PersonalWriting

Students will be required to learn short personal write-ups involving skills of description and narration. The types of composition task may include personal letter writing, telegram writing. Notice writing, diary writing etc. The teacher shall instruct the students about the appropriate format and usual conventions followed in such writings. The teacher may also prescribe composition /writing book if so required.

Module 4. Business writing:

Business letters; elements of business writing; kinds of business letters – office order memorandum, report, purchase order, quotations and tenders, job application letters, personal resume and curriculum vitae etc.

Module 5. Development of Speaking Skills: Public speaking – formal speaking- audience analysis – effective use of voice & body language – importance of confidence building – group discussion – presentation skills- seminar – interview skills development – telephone etiquettes – opinion basedspeaking.

Suggested Readings / Books

1. Singh, V.R. *The Written Word*. Oxford University Press, NewDelhi.
2. Ramchandran,, K.K. *Et al Buisness Communication*. Macmilan, NewDelhi
3. Samantaray, S.*Business Communication and Communicative English*.Sultan Chand, NewDelhi.
4. Dhanavel, S.P. *English and Communication Skills for Students of Science and Engineering*.
5. Gimson, A.C., *An Introduction to the Pronunciation of English*.ELBS.

Course Name: ENGINEERING MATHEMATICS – II
Course Code: 100201
Semester: 1st

	L T P
Credits: 05	**4 1 0**

Course Contents

Module 1. Matrices:
Linear dependence of vectors and rank of matrices. Elementary transformation, Gauss-Jordan method to find inverse of a matrix, Consistency and solution of algebraic equations, Linear transformations, Eigen values, Eigen Vectors, Cayley Hamilton Theorem,

Module 2. IntegralCalculus:
Rectification of standard curves; Areas bounded by standard curves; Volumes and surfaces of revolution of curves. **D**ouble and triple integration, Change of order of integration, Change of variable. Application of double integration to find areas. Application of double & triple integration to find volumes, Beta and gamma functions.

Module 3. Application of VectorCalculus:
Flux, Solenoid and irrotational vectors. Gauss Divergence theorem. Green's theorem in plane. Stoke's theorem.

Module 4. Statistics:
Discrete and continuous probability distributions. Binomial, Poisson and Normal distribution.

Module 5. ComplexNumbers:
De-Moivre's theorem and applications, Exponential & logarithmic complex functions, Circular and hyperbolic functions of complex variables, Summation of trigonometric series.

Suggested Readings / Books

1. Kreyszig, E.(1998)*Advanced Engineering Mathematics*; Eighth Edition, Johnwiley and sons.
2. Grewal, B.S.(1965) *Higher Engineering Mathematics* ; Khanna Publishers, NewDelhi.
3. Babu Ram(2009) *Advance Engineering Mathematics*; First Edition;PearsonEducation.
4. Richard Courant and Fritz John (2012) ***Introduction to Calculus and Analysis,*** **Volume II , V** Springer Publication
5. Harold M. Edwards (2013)*Advanced Calculus: A Differential Forms Approach*, Birkhauser.

Course Name: ENGINEERING PHYSICS
Course Code: 100104
Semester: 2nd

	L T P
Credits: 03	**3 1 0**

Course Content

Module 1. Electrostatics anddielectrics:
Divergence and curl of a vector and their physical meaning, electric flux, Relation between electric field and potential, Charge distribution, Gauss law, Dielectric polarization, Types of polarization, Introduction to Maxwell equations and their importance, Equation of EM waves in free space, Velocity of EM waves.

Module 2. Magnetic Materials andsuperconductivity:
Basic ideas of Dia, Para, Ferro and ferri magnetic materials, Magnetic anisotropy, Magnetostriction, Introduction to superconductors, Critical temp, Critical field, Type1 and type2 superconductors, Meissner effect, B.C.S theory of superconductivity, Londons equations.

Module 3.Laser:
Spontaneous and stimulated emission, Einstien coefficient, Population inversion, pumping, Components of laser, Three level and Four level laser, Ruby laser, He-Ne laser, Semiconductor laser, Holography.

Module 4.Optical Fibrecommunication:
Introduction, Optical communication (block diagram), Optical fiber physical structure, Basic theory of propagation of light, Modes of propagation, Acceptance angle, Numerical aperture, Normalized frequency, Losses in optical fibre, (scattering losses, Macro bending and Micro bending losses, material and pulse dispersion), Fiber connectors, Splices, Couplers, Applications of opticalfibre.

Module 5.Theory of relativity:
Concept of ether, Michelson Morley experiment, Einstiens postulates of theory of relativity, Gallilian transformation, Lorentz transformation equations, Length contraction, Time dilation, Simultaneity in relativity, Variation of mass with velocity, Mass energy and Energy momentumrelation.

Module 6Modernphysics:
Need of quantum theory, Wave particle duality, De Broglie concept, Wave and gp velocity, Heisenberg uncertainty principle and its applications (particle in a box), normalization wave function, Orthogonal wave function, Schrodinger wave equation, applications of S.W.E Particle in a box, eigen value, eigen function.

Module 7Elements ofcrystallography:
Unit cell, Basis, Space lattice, Crystal system, Introduction, Production of x rays, Hard and soft x rays, Continuous and characteristic x rays, Braggs law in crystals, Absorption of x rays.

Module 8Nanophysics:
Nanoscale, Surface to volume ratio, Electron confinement, Nanoparticles, nanomaterials, Unusual properties of nano-materials, Synthesis of nanomaterials, Ball

milling and sol-gel techniques, Carbon nano tubes, Applications of nanomaterials.

Suggested Readings / Books

1. David, J. *Introduction to Electrodynamics*. PrenticeHall.
2. Sikri,A.K. Introduction to Modern Physics.
3. Dogra,R. *Essentials of Physics.*

Course Name: FUNDAMENTALS OF COMPUTER & PROGRAMMING AND INFORMATION TECHNOLOGY
Course Code: 102101
Semester: 2nd

L T P
Credits: 03 **3 0 0**

Course Content

Module 1.Introduction toComputers
Define a Computer System, Block diagram of a Computer System and its working, Associated peripherals, Memories, RAM, ROM, Secondary storage devices, Computer Software and Hardware.

Module 2.Working Knowledge of ComputerSystem
Introduction to the operating system, Its functions and types, Working knowledge of GUI based operating system, Introduction to word processors and its features, Creating, Editing, Printing and saving documents, Spell check, Mail merge, Creating power point presentations, Creating spreadsheets and simple graphs, Evolution of Internet and its applications and services.

Module 3.Problem Solving & ProgramPlanning
Need for problem solving and planning a program; program design tools – algorithms, flow charts, and pseudo code; illustrative examples.

Module 4.Overview of C++Language
Introduction to C++ language, Structure of a C++ program, Concepts of compiling and linking, IDE and its features; Basic terminology - Character set, Tokens, identifiers, Keywords, Fundamental data types, Literal and symbolic constants, Declaring variables, Initializing variables, Type modifiers, Operators in C++, precedence and associatively of operators, Expressions and their evaluation, Type conversions.

Module 5.Beginning with C++program
Input / output using extraction (>>) and insertion (<<) operators, Writing simple C++ programs, Comments in C++**,** Stages of program execution.

Module 6.ControlStructures
Decision making statements: If, Nested if, If – else. Else if ladder, Switch, Loops and iteration: While loop, For loop, Do – while loop, Nesting of loops, Break statement, Continue statement, Go to statement, Use of control structures through illustrative programming examples.

Module 7.Functions
Advantages of using functions, Structure of a function, Declaring and defining functions, Return statement, Formal and actual arguments, Const argument, Default arguments, Concept of reference variable, Call by value, Call by reference, Library functions, recursion, Storage classes. Use of functions through illustrative programming examples.

Module 8.Arrays andStrings
Declaration of arrays, Initialization of array, Accessing elements of array, I/O of arrays, Passing arrays as arguments to a function, Multidimensional arrays. String as array of characters, Initializing string variables, I / O of strings, String manipulation functions (strlen, strcat, strcpy, strcmp), Passing strings to a function. Use of arrays and strings through illustrative programming examples.

Module 9.Concepts of Object OrientedProgramming
Introduction to Classes, Objects, Data abstraction, Data encapsulation, Inheritance and

polymorphism.

Module 10.Classes andObjects

Defining classes and declaring objects, Public and private keywords, Constructors and destructors, Defining member functions inside and outside of a class, Accessing members of a class, Friend function. Use of classes and objects through illustrative programming examples.

Module 11.Basics of FileHandling

Opening, reading, and writing of files, Error handling during files operation

Suggested Readings / Books

1. E. Balaguruswamy, E. *Object-Oriented Programming with C++*,Tata McGrawHill.
2. Sinha,P. K. & Sinha,P. *Computer Fundamentals*,BPBPublications.
3. Lafore R., *Object Oriented Programming in C++*.WaiteGroup.
4. Stroustrup,B. *The C++ Programming Language*.AddisonWesley.
5. Lippman F. B, *C++ Primer*. Addison Wesley.

Course Name: BASIC ELECTONICS & COMMUNICATION ENGINEERING LAB

Course Code: 104102

Semester: 2nd

	L	T	P
Credits: 01	**0**	**0**	**2**

Course Content

1. Familiarization of electronics component and equipments like C.R.O., Function Generator and power suppliesetc.
2. To study the V-I characteristics of PN-Junction diode and determine static resistance and dynamic resistance.
3. To study the characteristics of zener diode and hence determine the dynamic resistance form thecharacteristics
4. Determine the voltage regulation of zener diodestabilizer.
5. To study and plot the wave form of half wave and full wave rectifier with and without capacitorfilter.
6. To study and plot the input and output characteristics of common emitter transistor and calculate its input and outputresistance.
7. To study and plot the input and output characteristics of common base transistor and calculate its input and outputresistance.
8. To study the characteristics of FET (Field effect transistor) and hence calculate dynamic (r_d), mutual conductance (g_m) and amplification factor.
9. To study the frequency response of single stage CE amplifier and hence calculate the band width(3dbBW).
10. To study the transistorresponse.
11. To analysis the truth tables of various basic digitalgates.

Course Name: MANUFACTURING PRACTICES
Course Code: 105104
Semester: 2nd

L T P

Credits: 03 **0 0 6**

Course Content

Module 1.Carpentry and PatternMaking:
Various types of timber and practice boards, Defects in timber, Seasoning of wood; tools, Wood operation and various joints; Exercises involving use of important carpentry tools to practice various operations and makingjoints.

Module 2.FoundryShop:
Introduction to moulding materials; Moulds; Use of cores; Melting furnaces; Tools and equipment used in foundry shops; Firing of a cupola furnace; Exercises involving preparation of small sand moulds andcastings.

Module 3.ForgingPractice:
Introduction to forging tools; Equipments and operations; Forgebility of metals; Exercises on simple smithy; Forging exercises.

Module 4.MachineShop:
Machines, Grinders etc; Cutting tools and operations; Exercises involving awareness.

Module 5.WeldingShop:
Introduction to different welding methods; Welding equipment; Electrodes; Welding joints; Welding defects; Exercises involving use of gas /electric arc welding.

Module 6.Electrical and ElectronicsShop:
Introduction to electrical wiring; Preparation of PCBs involving soldering applied to electrical and electronic applications; Exercises preparation of PCBs involving soldering applied to electrical and electronicapplications.

Module 7.SheetMetal:
Shop development of surfaces of various objects; Sheet metal forming and joining operations, Joints, Soldering and brazing; Exercises involving use of sheet metal forming operations for small joints.

Module 8.Fitting Shop:
Introduction of fitting practice and tools used in fitting shop; Exercise involving marking, Cutting, Fitting practice (Right Angles), Male-Female mating parts practice, trappingpractice.

References Books:-

1. Raghuwanshi, B.S.(2009*). A Course in Workshop Technology, Vol 1 & II*.Dhanpat Rai &Sons.
2. Jain, R.K.(2010*).Production Technology*.Khanna Publishers.
3. Singh, S.(2003).*Manufacturing Practice*.S.K. Kataria &Sons.

Course Name: Environmental Science
Course Code: A100302
Semester: 3rd

Credits: 03 **L T P**
3 0 0

Course Content

Module 1: The Multidisciplinary nature of environmental studies **2 hrs**
Definition, scope and importance
Need for public awareness.

Module 2: Natural Resources: **8 hrs**
Renewable and non-renewable resources:
Natural resources and associated problems
a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction,mining, dams and their effects on forests and tribal people.
b) Water resources: Use and over-Utilization of surface and ground water, floods, drought, conflicts and water, dams-benefits and problems.
c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
e) Energy resources: Growing energy needs, renewable and non renewable energy sources, useof alternate energy source, Case studies.
f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
• Role of an individual in conservation of natural resources.
• Equitable use of resources for sustainable lifestyles.

Module 3: Ecosystems **8 hrs**
• Concept of an ecosystem.
• Structure and function of an ecosystem.
• Producers, consumers and decomposers.
• Energy flow in the ecosystem.
• Ecological succession.
• Food chains, food webs and ecological pyramids.
• Introduction, types, characteristic features, structure and function of the following ecosystem:-
a. Forest ecosystem
b. Grassland ecosystem
c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

(6 lectures)

Module 4: Biodiversity and its conservation 6 hrs

• Introduction – Definition: genetic, species and ecosystem diversity.
• Bio-geographical classification of India
• Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values
• Biodiversity at global, National and local levels.
• India as a mega-diversity nation
• Hot-spots of biodiversity.
• Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.
• Endangered and endemic species of India
• Conservation of biodiversity: In-situ conservationof biodiversity.

Module 5: Environmental Pollution 8 hrs

Definition
• Causes, effects and control measures of:-
a. Air pollution
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards
• Solid waste Management: Causes, effects and control measures of urban and industrial wastes.
• Role of an individual in prevention of pollution.
• Pollution case studies.
• Disaster management: floods, earthquake, cyclone and landslides.
(8 lectures)

Module 6: Social Issues and the Environment 8 hrs

• From Unsustainable to Sustainable development
• Urban problems related to energy
• Water conservation, rain water harvesting, watershed management
• Resettlement and rehabilitation of people; its problems and concerns, case studies.
• Environmental ethics: Issues and possible solutions.
• Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies.
• Wasteland reclamation.
• Consumerism and waste products.
• Environment Protection Act.
• Air (Prevention and Control of Pollution) Act.
(7 lectures) • Water (Prevention and control of Pollution) Act
• Wildlife Protection Act
• Forest Conservation Act
• Issues involved in enforcement of environmental legislation.
• Public awareness.

Module 7: Human Population and the Environment 4 hrs

• Population growth, variation among nations.
• Population explosion – Family Welfare Programme.
• Environment and human health.

• Human Rights.
• Value Education.
• HIV / AIDS
• Women and Child Welfare.
• Role of Information Technology in Environment and human health.
• Case Studies.

Module 8: Field work **4 hrs**

• Visit to a local area to document environmental and river forest grassland Hill Mountain.
• Visit to a local polluted site – Urban / Rural / Industrial / Agricultural
• Study of common plants, insects, birds.
• Study of simple ecosystems-pond, river, hill slopes, etc. (Field work Equal to 5 lecture hours)

Suggested Text/Reference Books

1. Agarwal, K. C. (2001). *Environment Biology*.Bikaner: Nidi Publications Limited.
2. Jadhav, H.& Bhosale, V.M. (1995). *Environment Protection and Laws*. Delhi: Himalaya Publication House.
3. Rao, M. N. & Datta, A.K. (1987). *Waste Water Treatment*. Oxford & IBH Publications Co. Pvt. Ltd.

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Course Name: Petroleum Chemistry
Course Code: A106301
Semester: 3rd

Credits: 04

L T P
4 0 0

Course Content

Module1:- **10 hrs**

Properties and General Characteristics of Hydrocarbon, Composition, Molecular types in Petroleum.

Module2:- **16 hrs**

Characterization and Analytical Techniques for Crude Oil: Physical properties, Thermal properties, Electrical properties, Optical properties, Chromatographic techniques, Spectroscopic methods (Principles and Applications of UV Visible, IR, and NMR Spectroscopy), test properties, Characterization of formation water. SARA Separation methods, Metals and Hetero-atoms in heavy crude oil.

Module3:- **16 hrs**

Processing and Refining of crude oil: Processing and Refining of crude oil: Distillation, Sweetening and Cracking (basic concepts), Desalting and dehydration of crudes, Reforming, Isomerization, Isomerization processes air blowing of bitumen, Alkylation processes, Polymerization processes, Solvent process, Knocking, Octane number and Cetane number, Additives to improve the quality of Diesel and Petrol, Catalysis and Applications of Catalysts (like Zeolite and other catalysts) in separation processes and also in petroleum industries.

Module4:-

Instability and incompatibility of petroleum products **6 hrs**

Suggested Text/Reference Books

1. Speight, J. (1998).*Petroleum Chemistry and Refining*. Taylor and Francis.
2. Simanzhenkov, V.&Idem, R. (2003) *Crude oil Chemistry*. Marcel Dekker Inc.

Course Name: Mechanical Operations and particle mechanics
Course Code: A106302
Semester: 3rd

Credits: 04 **L T P**
3 1 0

Course Content

Module1: Characterization and Handling of Solids (8 hrs)

Characterization of solid particles: Shape, size, specific surface, Particle size distribution
Properties of particulate masses: Major distinctive properties, pressures in masses of particles, angle of internal friction, angle of repose.
Conveying of bulk solids: Basic idea of conveyor, conveyor selection, screw, belt, vibrating, continuous flow and pneumatic conveyors
Storage and weighing: bulk storage, bin storage, feeders (vibrating hopper, screw feeder, belt feeder), batch and continuous weighing.

Module2: Screening (4 hrs)

Capacity and Effectiveness of a screen, calculation of average size of particles in mixture by screen analysis, types of screens.

Module3: Agitation and Mixing (8 hrs)

Agitation of low viscosity particle suspensions: axial flow impellers, radial flow impellers, close-clearance stirrer, un-baffled tanks, baffled tanks, basic idea for designing agitators. Power number, Froude number, power consumption in agitation
Mixing of Solids: Types of mixers, various mixers for cohesive solids, power requirements, mixing index, axial mixing
Mixers for free flowing solids: ribbon blenders, screw mixers, tumbling mixers import wheels, mixing index in blending granular solids, mixing index at zero time, rate of mixing.

Module4: Size Reduction (6 hrs)

Principles of Comminution: Criteria for comminution, characteristics of products, Energy and Power requirements, Bond's, Rittinger's and Kick's Law and Work Index
Size Reduction Equipment: Crushers, Grinders, and ultrafine grinders cutting machines, equipment operation.

Module5: Filtration (8 hrs)

Classification of filters, various types of cake filters, principles of cake filtration, clarifying filters: liquid clarification, Gas cleaning, principles of clarification.
Filtration Equipment and centrifuges and their selection, Cross flow Filtration, micro filtration

Module 6: Settling (8 hrs)

Motion of particles through fluids: Terminal velocity, hindered settling, Stoke's law,
Gravity settling processes: Classifiers, clarifiers, thickeners, flocculation, rate of sedimentation
Centrifugal Settling processes: Cyclones, hydro-clones, decanters, tubular, disk and nozzle discharge centrifugal sludge separators, Centrifugal class fitters, principles of centrifugal sedimentation.

Module7: Fluidization (6 hrs)

Fluidization and fluidized bed, conditions for fluidization, Ergun equation and Kozeny - Carman equation, minimum fluidization velocity, types of fluidization, expansion of fluidized beds and particulate fluidization, continuous fluidization; industrial applications.

Suggested Text/Reference Books

1. McCabe, W. L., Smith, J. C., & Harriot, P. (2005).*Module Operations of Chemical Engineering (7th Edition).* McGraw Hill.
2. Foust, A.S., Wenzel, L.A., Clump, C.W., Maus. L., & Anderson, L. B. (2008).*Principles of Module Operations (2nd Edition).* John Wiley.
3. Harker, J. H., Richardson, J. F.,& Backhurst, J. R.(2003). *Chemical Engineering (Volume 2, 5th Edition)*. Butterworth-Heineman.
4. Badger, W.L. & Banchero, J.T. (1955). *Introduction to Chemical Engineering*. McGraw Hill.
5. Perry,R.H. & Green, D. W. (2008).*Chemical Engineers' Handbook (8th Edition)*. Mc-Graw Hil.

Course Name: Elements of Reservoir Engineering and Ground Survey
Course Code: A106303
Semester: 3rd

Credits: 04 **L T P**
4 0 0

Course Content

Part A – Elements of Reservoir Engineering

Introduction: **2 hrs**

Fundamentals of Reservoir Engineering and Classification of petroleum reservoir

Reservoir Rock Properties: **6 hrs**

Porosity, permeability determination, combination of permeability in parallel & series beds, porosity permeability relationship, fluid Saturation determination and significance, effective and relative permeability, wet ability, capillary pressure characteristics, measurements and uses.

Reservoir Fluids: **8 hrs**

Phase behavior of hydrocarbon system, ideal & non ideal system, equilibrium ratios, reservoir fluid sampling, PVT properties determination, different correlations and laboratory measurements, data reduction, evaluation and application.

Flow of Fluids through Porous Media: **6 hrs**

Darcy's law, single and multiphase flow, linear, radial & spherical flow, steady state & unsteady state flow, flow through fractures, GOR, WOR equations, Water and gas coning, Principles of Fluid Flow for steady state, semi steady state & non steady state conditions.

Reservoir Drives: **2 hrs**

Reservoir drive mechanics and recovery factors

Reserve estimation: **4 hrs**

Estimation of petroleum reserve, resource & reserve concept, latest SPE/ WPC/ IS classification, volumetric material balance.

Part B – Ground Survey

Module 1.Introduction: Different types of surveys.**2 hrs**

Module 2.Chain Surveying **4 hrs**

Principal of chain surveying, description of different equipment, Methods of chaining & booking, selection of base line and stations, obstacles in chaining, Location of inaccessible points by chain, tape & ranging rods.

Module 3: Prismatic compass survey **4 hrs**

Description of Prismatic & surveyors compass methods of traversing, local attraction and its elimination adjustment of closing error by graphical method.

Module4: Plane Table Survey **4 hrs**

Description of different equipment, different methods of plane tabling, Strength of Fix, Two point and three point problems and their solutions

Module5: Leveling 3 hrs

Description of Dumpy and Tilting levels & leveling staves, methods of leveling sensitivity of bubble tube, setting out grade lines permanent adjustment of above mentioned leveling instruments.

Module6: Contouring: **3 hrs**

Setting out contour gradient, different methods of contouring, simple earth work calculations of areas and volumes.

Suggested Text/Reference Books

Part A:

1. Ahmed, T. (2006). *Reservoir Engineering Hand book*. Elsevier, 3rd Edition.
2. Slip Slider, H.C. (1983). *World Wide Practical Petroleum Reservoir Engineering Method*. Penn Well Publishing Company.
3. Gianluigi, C. (1994). *Principles of Petroleum Reservoir Engineering*. Elsevier.

Part B:

1. Kanetkar, T.P, &Kulkarni. (2006), *Surveying and Leveling*.New Delhi: Laxmi Publications.
2. Punmia, B.C., Jain, A.K., & Jain, A.K. (2016). *Surveying - 1& 2*, New Delhi: Laxmi Publications.
3. Agor, R. (1980).*A Textbook of Surveying and Levelling*. Khanna Publishers.
4. Singh, G. & Singh, J. (2008). *Surveying*. New Delhi: Khanna Publishers.

Course Name: Strength of Materials
Course Code: A106304
Semester: 3rd

Credits -4

L	T	P
3	1	0

Course Content

Module1: Mechanical Properties and Testing (6 hrs)

Concept of strength, yield strength, ultimate strength hardness, impact strength, ductility, brittleness, tensile, compressive, bending, torsion, hardness and impact tests.

Module 2: Theory of Bending (6 hrs)

Review of bending moment, shear force, bending and shear stresses, bending & shear stresses in composite beams.

Module 3: Unsymmetrical Bending (6 hrs)

Principal axes, analytical and graphical methods, stresses due to unsymmetrical bending 7-polygen deflections of beams under unsymmetrical bending.

Module4: Slopes and Deflections of Beams (6 hrs)

Slopes and deflections in beams and cantilevers, calculation of slopes and deflections using double integration moment area theorems and Macaulay's method.

Module5: Theories of failure (6 hrs)

Strain energy, various theories of failure, their necessity and significance, graphical representation of theories of failure.

Module6: Torsion of shafts and springs (6 hrs)

Torque, angle of twist and shear stresses in hollow and solid shafts with in elastic limit, assumptions intrusion, power transmitted by a shafts, analysis of close coil spring subjected to axial load couple. Shafts subjected to torsion.

Module7: Thin Cylinders/ spheres (6 hrs)

Thin cylinders subjected to internal pressure, circumferential and longitudinal stress and strains, maximum shear stress, increase in diameter and volume, thin spheres subjected to internal pressure.

Module 8: Columns (6 hrs)

Columns under Uniaxial loads, buckling of columns slenderness ratio and conditions, derivations of Euler's formula for elastic – buckling load, equivalent length, Rankin – Garden empirical formula.

Suggested Text/Reference Books

1. Timoshenko, S. (2002).*Strength of Materials Vol-I: Elementary Theory and Problems*. CBS Publishers, 3rd Edition.
2. Vazirani V.N. & Ratwani. (2016). *Analysis of Structures Vol. I*. Khanna Publishers.
3. Bansal, R.K. (2010). *Strength of Materials*. Luxmi Publishers, 4th Edition.

4. Popov, E. P. (1999).*Engineering Mechanics of Solids*. Prentice Hall, 2nd Edition.

Course Name: Material and Energy Balance
Course Code: A106305
Semester: 3rd

Credits: 04 **L T P**
3 1 0

Course Content

Module 1: Introduction 2 hrs

Role of chemical engineering in industry, Schematic flow sheets including symbols, Unit operations and unit processes with reference to MEB calculations

Introduction to units systems, Units and dimensions, mole, Specific gravity, Specific volume, Concentrations, Stoichiometry of chemical equations, Mole fraction and weight fraction, Degrees of freedom.

Module 2: Behavior of gas and liquid mixtures 14 hrs

Real gases, Bubble point and dew point temperatures, Henry's law, Duhring's plot, Saturation, Partial saturation, Relative saturation, Clausius Clapeyron equation, Cox chart and Duhring's plot.

Module 3: Material balance calculations 16 hrs

Law of conservation of mass and component, Simple mass balances, Material balance calculations without chemical reactions, Material balance calculations involving chemical reactions, Recycling, Bypass, Purge, Analysis of degree of freedom for material balance problems.

Module 4: Energy balance calculations 16 hrs

Internal energy, Enthalpy, Heat capacity of gases, liquids, and solids, Latent heats, Heats of formation, combustion, reaction and dissolution, Enthalpy-concentration chart, Fuel heating value, Theoretical flame temperature, Energy balance calculations in unit operations and systems with and without chemical reactions, Humidity and humidity chart, Energy balance calculations in humidification and adiabatic cooling. Computer aided case studies of material and energy balances of various operations.

Suggested Text/Reference Books

1. Hougen, P.A., Watson, K.M., &Ragatz R.A. (2018) *Chemical Process Principles Part–I: Material and Energy Balances*. CBS Publishers and Distributors Pvt Ltd.
2. Himmelbleau, D.M. & Riggs J.B. (2004).*Basic Principles and Calculations of Chemical Engineering*. Prentice Hall, 7th Edition.
3. Bhatt B.L.& Vora, S.M. (2004).*Stoichiometry*. Tata McGraw Hill Publishing Co. Ltd.
4. Felder, R. M. & Rousseau, R.W. (2004) Elementary *Principles of Chemical Processes*. John Wiley, 3rd Edition.
5. Reklaitis, G.V. (1983).*Introduction to Material and Energy Balances*. John Wiley.
6. Lewis, W.K., Radasch, A.H., &Lewis, H. C. (1954).*Industrial Stoichiometry Chemical Calculations of Manufacturing Processes*. McGraw Hill.

7. Hougen, O.A., Watson, K.M. & Ragatz, R.S. (2004). *Chemical Process Principles (Vol-I, 2nd Edition)*. CBS Publishers and Distributors Pvt Ltd.

Course Name: Petroleum Chemistry Laboratory
Course Code: A106306
Semester: 3rd

Credit: 01 **L T P**
0 0 2

Course outcomes: On successful completion of this course, the students will be able to:

CO	Statement
CO1	Find the quality control of lubricating oils and explore its application.
CO2	Know about the Petroleum Products and their applications in quality control.
CO3	Get knowledge about Physical and thermal properties of crude oil.
CO4	Get knowledge about crude oil distillation.

Course Content

1. Determination of viscosity of given petroleum fraction using Say bolt viscometer.
2. Determination of vapor pressure of gasoline using Reid Vapor pressure apparatus.
3. Determination of Aniline Point of given petroleum fraction.
4. Determination of Smoke Point of Kerosene.
5. Determination of Flash and fire Point of given petroleum fraction using Abel's flash point apparatus.
6. Determination of Flash and fire Point of given petroleum fraction using Pansy Martine's apparatus.
7. Determination of Cloud and pour Point of given petroleum fraction.
8. Determination of Carbon Residue of given petroleum fraction using Rams Bottom Carbon Residue apparatus.
9. Determination of Calorific value of given petroleum fraction using Bomb Calorimeter.
10. Distillation of crude oil or mixture of petroleum fractions.

Course Name: Strength of Materials Laboratory
Course Code: A106307
Semester: 3rd

Credit: 01 **L T P**
0 0 2

Course Content

1. Determination of yield points, tensile strength and ultimate strength of mild steel specimen.
2. Determination of compressive strength of mild steel specimen.
3. Bending test of mild steel specimen.
4. Tensile test of a specimen of brittle material.
5. Torsion test of a mild steel specimen.
6. Determination of Brinell hardness of ductile and brittle materials.
7. Determination of Rockwell Hardness of a hard material.
8. Performance of Vickers's Hardness test.
9. Determination of Impact strength of a specimen.

Course Name: Heat Transfer
Course Code: A106401
Semester: 4th

Credits: 04 **L T P**
3 1 0

Course Content

Module 1: Modes of Heat Transfer:

Conduction (8 hrs)

Fourier's law, one dimensional heat conduction through plane and composite structures having plane wall, spherical & cylindrical geometry; Steady state heat flow with heat source through plane wall and cylindrical surface, Thermal conductivity of materials, Insulating materials and critical thickness of insulation, Unsteady-state conduction; Lumped heat capacity system, semi-infinite solid and Heisler chart.

Convection (10 hrs)

Free and forced convection, Concept of thermal boundary layer, concept of overall heat transfer coefficient for laminar and turbulent flow, Heat transfer inside & outside tubes with significance of Nusselt, Prandtl, Reynolds, Biot, Fourier and Peclet numbers, Modelling of convective heat transfer coefficient by using dimensional analysis for natural convection.

Radiation (6 hrs)

Distribution of radiant energy, Definition of emissivity, absorptivity, Reflectivity and transmissivity, concept of Black and Grey bodies, Planck's law of monochromatic radiation, Kirchhoff's law, Wien's displacement law, Stefan-Boltzmann law, definition of intensity of radiation. Radiation formula for radiation exchange between simple bodies, two parallel surfaces and between any source and receiver, radiation shields

Module 2: Condensation and Boiling Heat Transfer (6 hrs)

Drop wise and Film wise condensation of pure and mixed vapors, Convective, Nucleate & Film boiling, Theory and correlations, critical boiling flux

Module 3: Heat exchangers (10 hrs)

Shell-and- Heat exchangers - double pipe heat exchanger Tube heat exchangers, plate type heat exchanger, concept and calculation of log mean temperature difference, temperature correction factor for shell & tube exchangers, fouling factors, overall heat transfer coefficient Theory of Fins and their applications. Re-boiler and Condensers, counter current dry contact Condenser, parallel current- wet contact Condenser.

Module 4: Evaporators (8 hrs)

Various types of evaporators- Standard vertical tube evaporator, basket type vertical evaporator, forced circulation evaporator and horizontal tube evaporators, Single effect evaporators and multi-effect evaporators and its various types of feed arrangements, boiling point elevation, capacity and economy of evaporators, Evaporation under vacuum.

Suggested Text/Reference Books

1. Holman, J.P. (2010). *Heat Transfer*. McGraw Hill, 10th Edition.
2. McAdams, W.H. (1985). *Heat Transmission*. Kreiger Publishing Co, 3rd Edition.
3. Backhurst, J.R., Harker, J.H., Coulson, J.F., & Richardson J.M. (1999). *Chemical Engineering, Volume 1*. Butterworth Heinemann, 6th Edition.

4. McCabe, W. L., Smith, J.C., & Harriot, P. (2005). *Module Operations of Chemical Engineering*. McGraw Hill, 7th Edition.
5. Kern, D.Q. (1983). *Process Heat Transfer*. McGraw Hill.
6. Kreith, F., Manglik, R.M., &Bohn, M.S. (2010). *Principles of Heat Transfer*. Brooks Cole Thomson Learning Publication, 7th Edition.
7. Incopera, F.P., DeWitt,D.P., Bergman, T.L., & Lavine, A.S. (2011).*Fundamentals of Heat and Mass Transfer*. John Wiley, 7th Edition.
8. Geankopolis, C J. (2004). *Transport Processes and Separation Process Principles*. Prentice Hall of India, 4thEdition (Eastern Economy Edition).
9. Coulson, J. M.& Richardson, J. F. (1999). *Chemical Engineering, Volume 1*. Pergamon Press.

Course Name: Mass Transfer-I
Course Code: A106402
Semester: 4th

Credits: 04 **L T P**
3 1 0

Course Content

Module 1: Introduction (2 hrs)
Importance and classification of mass transfer operations in Chemical Engineering such as distillation, diffusion, gas adsorption, drying, crystallization etc.

Module 2: Diffusion (6hrs)
Diffusion in gases and liquids, Fick's First law of diffusion, Mass balance in simple situations - with and without chemical reaction
Diffusion in solids, diffusion through porous solids and polymers, unsteady state diffusion

Module 3: Interphase Mass transfer (10 hrs)
Theories of Mass transfer, Individual and overall mass transfer coefficients, Convective mass transfer
Mass balance in concurrent and counter-current continuous contact equipment, Concept of operating line, Multi-stage counter current operations, Concept of ideal stage, Stage efficiencies, Design of continuous contact equipments, HTU and NTU concepts.

Module 4: Gas absorption (10 hrs)
Design of plate and packed absorption columns, Scrubbers, Non-isothermal absorption, Simultaneous heat and mass transfer

Module 5: Drying of solids (6 hrs)
Rate of drying curves through circulation drying, Continuous drying, Types of dryers.

Module 6: Humidification operations (8 hrs)
VLE & Enthalpy, Reference substance plots, vapor gas mixtures, concept of adiabatic saturation, psychometric charts, adiabatic operations-humidification operations and water cooling operations.
Dehumidification Equipments: water cooling towers & spray chambers.

Module 7: Membrane Separations (6hrs)
Types of membranes, permeate flux for ultra filtration concentration polarization, partial rejection of solutes, microfiltration, Reverse Osmosis and Electro-dialysis.

Suggested Text/Reference Books:

1. Treybal, R.E. (2001). *Mass Transfer Operations (3rd Edition)*. McGraw Hill.
2. Sherwood, T. K., Pigford, R.L., &Wilke, C.R. (1975).*Mass Transfer, Chemical Engineering Series*. McGraw Hill.
3. Backhurst, J.R., Harker, J.H., Coulson, J.F., & Richardson, J.M., (1999). *Chemical Engineering- Volume 1 (3rd Edition)*. Butterworth Heinemann.
4. Skelland, A.H.P. (1985). *Diffusional Mass Transfer*. Kreiger Publishing Co.
5. McCabe, W.L., Smith, J.C., & Harriot, P. (2005).*Module Operations of Chemical Engineering (7th Edition)*. Mc Graw Hill.

Course Name: Fluid Flow
Course Code: A106403
Semester: 4th

Credits: 04 **L T P**
3 1 0

Course Content

Module 1: Introduction **2 hrs**

Concept of fluid, difference between solids, liquids and gases; ideal and real fluids, Introduction to fluid statics and fluid flow

Module 2: Fluid Statics
4hrs

Normal forces in fluids, Manometers of different types, Forces on submerged bodies, Buoyancy and stability

Module 3: Fluid Properties **6 hrs**

Concept of capillarity, vapor pressure, compressibility and bulk modulus, Newtonian and non- Newtonian Fluids, Nature of turbulence, Eddy Viscosity, Flow in Boundary Layers

Module 4: Basic Equation of Fluid Flow **10 hrs**

Momentum Balance, Continuity equation, Bernoulli's Equations, Navier Stokes Equations, Derivation and Application Dimensional Analysis of Fluid Flow Problems using Rayleigh method and Buckingham π method, Dimensionless numbers and their significance

Module 5: Flow of Incompressible Fluids **10 hrs**

Concept of boundary layer, Laminar and Turbulent flow in pipes, Velocity distribution in pipes, Frictional Losses in pipes and fittings, effect of roughness, Fanning Equation, Estimation of Economic Pipe Diameter, Derivation of Hagen Poiseuille's equation and f =16/ Re.

Module 6 .Flow of compressible fluids **4 hrs**

Compressible flow, basic equation, Mach number and its significance and isentropic flow through nozzles

Module 7.Flow Measurement **6 hrs**

In closed channels - Pitot tube, Orifice meter, venturimeter, Rotameter
In open channels- Notches, Weirs

Module 8 .Fluid Machinery **6 hrs**

Classification and performance of Pumps, Positive displacement pumps and its types, Centrifugal pumps: characteristic curves, Net positive Suction Head and cavitation, Turbines, Compressors, Blowers, Selection and specification.

Suggested Text/Reference Books:

1. McCabe, W.L., Smith, J.C., & Harriot, P. (2005). *Module Operations of Chemical Engineering (7th Edition)*. McGraw Hill.
2. Backhurst, J.R., Harker, J.H., Coulson, J.F.,& Richardson, J.M. (1999).*Chemical Engineering (Volume 1, 6th Edition)*. Butterworth Heinemann, 6th Edition.
3. Foust, A.S., Wenzel, L.A., Clump C.W. Maus L., & Anderson, L.B. (2008).*Principles of Module Operations (2nd Edition)*. John Wiley & Sons.
4. Raju, K.S. (2011).*Fluid Mechanics, Heat Transfer, and Mass Transfer: Chemical Engineering Practice*. John Wiley.

Course Name: Geology of Petroleum
Course Code: A106404
Semester: 4th

Credits: 04 **L T P**
4 0 0

Course Content

Module1. Minerals: **8 hrs**
General properties, Classification of minerals and properties of common rock forming minerals

Module2. Petrology: **8hrs**
Rocks; Classification and description of some common rocks

Module3. Stratigraphy: **14 hrs**
Principles of Stratigraphy; Concepts of paleontology; Fossils, their mode of preservation and significance as indices of age and climate; Concept of index fossils; Broad stratigraphic subdivisions and associated rock types of important coal belts and oil fields of India.

Module 4. Structural Geology: **10 hrs**
Interpretation of topographic maps, Attitude of planar and linear structures, Effects of topography on outcrops, Unconformities, folds, faults and joints - their nomenclature, classification and recognition, Forms of igneous intrusions - dyke, sill and batholiths, Effects of folds and fractures on strata and their importance in exploration activities.

Module 5. Exploration: **8 hrs**
Meaning, methods of exploration, surface geological methods-gravity methods, magnetic methods, geophysical methods-electrical resistivity methods, seismic methods, radiometric surveying

Suggested Text/Reference Books:

1. Rutely, H.H. (2005). *Element s of Mineralogy*. Mc Graw Hill.
2. Krishnan, M. S. (2006). *Geology of India (6th Edition)*. CBS Publishers &Distributors Pvt Ltd.
4. Mukherjee, P.K. (2013).*Introduction to Geology*. World Press Private Limited.
5. Billings, M.P. (1972). *Structural Geology (3rd Edition)*. Prentice Hall.
6. Kearey, P. & Brooks, M. (1991). *An Introduction to Geophysical Exploration (2nd Edition).* Wiley- Blackwell.

Course Name: Drilling Technology
Course Code: A106405
Semester: 4th

Credits: 04 **L T P**
3 1 0

Course Content

Module 1: Well Planning 4 hrs
Introduction to oil well drilling and drilling planning approaches.

Module 2: Rotary Drilling Method 6 hrs
Rig parts, selection and general layout

Module 3: Drilling Operations & Practices 6 hrs
Hoisting, circulation, Rotation, power plants, Power transmission, Rig wire line system handling & storage.

Module 4: Casing Design 6 hrs
Design of casing string, Liner Design, Setting, Casing landing practices, Buckling criteria, Calculation of well head loads and Casing while drilling

Module 5: Drill String 6 hrs
Parts function and design.

Module 6: Drill Bits 4 hrs
Classification and design criteria of drag, rotary, roller, diamond and PDC bits

Module 7: Coring 4 hrs
Different methods of core drilling

Module 8: Well Problems and Solutions 8 hrs
Fatigue failure, Pipe sticking, lost circulation, Sloughing shales, Swabbing, surge, gas cap drilling, Blow out and kick control.

Module 9: Oil well fishing 4 hrs
Fish classification, tools and techniques

Suggested Text/Reference Books:

1. Gatlin, C. (1960). *Petroleum Engineering: Drilling and Well Completion*. Prentice Hall.
2. Bourgoyane, A.T. (1986).*Applied Drilling Engineering*. (Spe Textbook Series, Vol 2). Society of Petroleum Engineers.
3. Adam, N.J. (1985). *Drilling Engineering: A complete Well Planning and Approach*. PennWell Books.
4.Rabia, H. (1986).*Oil Well Drilling*. Kluwer Law International.

Course Name: Chemical Engineering Thermodynamics
Course Code: A106406
Semester: 4th

Credits-04 **L T P**
3 1 0

Course Content

Module 1: Brief review: 8 hrs

Review of First,Second and Third Law of Thermodynamics: First law of Thermodynamics, Thermodynamics state and state functions, enthalpy, the steady state steady flow process, equilibrium, phase rule, reversible processes, Second law of thermodynamics, Heat engines, Entropy, Entropy changes of an ideal gas, Third law of thermodynamics.

Module 2: Volumetric properties of pure fluids 6 hrs

PVT behavior for an ideal gas, Virial equation of state, Applications of Virial equations, Cubic equation of state, Generalized correlations, Acentric factors.

Module 3: Heat effect 8 hrs

Sensible Heat Effects, Internal Energy of ideal gases, Latent heat of pure substances, Standard heat of reaction, formation, combustion, Heat of reaction at higher temperature, Heat effects of Industrial reactions.

Module 4: Thermodynamic Properties of fluid 6 hrs

Maxwell relations, Residual properties, two phase system, Thermodynamic diagram

Module 5: Equilibrium and Stability 6 hrs

Criteria of equilibrium, Chemical Potential, Application of equilibrium criteria, Clausius Clapeyron equation

Module 6: Phase Equilibria 6 hrs

Fugacity, Determining of fugacity of pure substances, Fugacity in mixture, Ideal solution, Excess properties, and Liquid phase properties from VLE data, Activity coefficients, and coefficient equations

Module 7: Chemical Reaction Equilibria 8 hrs

Reaction ordinate for single & multiple reactions, condition of equilibrium for a chemical reactions, Standard states and G, Temperature dependence of the equilibrium constant , Estimation of equilibrium rate constant , Homogeneous gas phase reactions, Heterogeneous chemical equilibrium.

Suggested Text/Reference Books:

1. Smith, J.M., Van Ness, H.C.,& Abbott, M.M. (2003). *Introduction to Chemical Engineering Thermodynamics (6th Edition).*McGraw Hill.
2. Rao, Y.V.C. (1997). *Chemical Engineering Thermodynamics (1st Edition).* Hyderabad: Universities Press (India) Ltd.
3. Kyle, B.G. (1999). Chemical and Process Thermodynamics (3rd Edition). Prentice Hall.

4. Denbigh, K.G. (1981). *Principles of Chemical Equilibrium (4th Edition*). Cambridge University Press.
5. Pitzer, K.S. (1995). *Thermodynamics (3rd Edition)*. Mc Graw Hill.

Course Name: Heat Transfer Laboratory
Course Code: A106407
Semester: 4th

Credit: 1 **L T P**
0 0 2

Course Content

1. Determination of heat transfer coefficient for different types of heat transfer equipments.
2. Wilson Plots for unsteady state heat transfer in jacketed vessels.
3. Developing correlation of instantaneous heat transfer coefficients with time for steady deposition of scale on a heating surface.
4. Determination of heat losses from insulated pipes.
5. Performance characteristics of a shell and tube heat exchanger and an induced draft cooling tower.
6. Study and operation of long tube forced circulation and multiple effect evaporators.
7. Duhring's plot for solutions involving non-volatile solutes
8. To find the heat transfer coefficient of heat loss from a vertical cylinder by natural convection.
9. To find heat transfer coefficient for parallel flow and counter flow for double pipe heat exchanger.
10. To find heat transfer coefficient for heat loss.

Course Name: Mechanical Operations Laboratory
Course Code: A106408
Semester: 4th

Credit: 01 **L T P**
0 0 2

Course Content

1. Verification of Stokes Law.
2. Screen analysis of given sample for its particle size distribution.
3. Determination of average size (different averages) from screen analysis.
4. Determination of variation in pressure drop & bed height With respect to superficial velocity for a bed of solids.
5. Determination of minimum fluidization velocity for a bed of solids.
6. Operating characteristics of crushing and grinding equipments (Jaw crusher, Roll crusher, Ball mill).
7. Evaluation of the filtration constants for $CaCO_3$ slurry in water and cake compressibility.
8. Determination of %age recovery of coal in froth from coal and sand mixture.
9. Determination of thickener capacity using batch sedimentation.
10. Determination of characteristics of centrifuge as a filter.
11. Determination of the separation efficiency of the classifier.

Course Name: Fluid Flow Laboratory
Course Code: A106409
Semester: 4th

Credit: 01

L T P
0 0 2

Course Content

1. Characteristic curves of a centrifugal pump.
2. Determination of stability of a floating body.
3. Verification of Bernoulli's equation for flow process.
4. Measurement of flow by a venturimeter
5. Measurement of flow by an orifice meter.
6. Measurement of flow by a rotameter
7. Measurement of flow by a V-notch in an open channel.
8. Measurement of losses in various fitting and valves.
9. Measurement of losses due to contraction and expansion.
10. Measurement of losses due to variation in cross section/ shapes
11. Verification of laminar/ turbulent flow regime in a flow process
12. Study of valves and fittings

Course Name: Mass Transfer –II
Course Code: A106501
Semester: 5th

Credit: 04 **L T P**
3 1 0

Course Content

Module 1: Distillation (18 hrs)

Roult's law, ideal solutions, x-y & H-x-y diagrams, Flash vaporization and condensation, Differential distillation, Batch distillation, Rayleigh equation, Steam distillation, Binary distillation, McCabe-Thiele and Ponchon- Savarit method, Total reflux, minimum and optimum reflux ratios, Efficiency – local, overall and Murphree efficiency, Introduction to distillation column design, Design of distillation columns with open steam, partial condensers and total condensers. Approximate plate to plate calculations for multi-component distillation.

Module 2: Liquid-liquid extraction (10 hrs)

Extraction equipment, equilibrium diagram, choice of solvent, single stage and multistage counter-current extraction with/without reflux, continuous contact extractors

Module 3: Leaching (8 hrs)

Leaching equipment and equilibrium, single stage and multistage cross current and counter current leaching

Module 4: Adsorption (7 hrs)

Types, nature of adsorbents, Adsorption equilibria- single species- Langmuir, Freundlich isotherms, Adsorption operations –single stage and multi stage, Adsorption column sizing

Module 5: Crystallization (5 hrs)

Equilibria and yields, Methods of forming nuclei in solution and crystal growth, equipments- vacuum crystallizer, Draft tube-baffle crystallizer.

Suggested Text/Reference Books:

1. Treybal, R.E. (2001). *Mass Transfer Operations (3rd Edition)*. McGraw Hill.
2. Sherwood, T. K., Pigford, R.L., & Wilke, C.R. (1975). *Mass Transfer, Chemical Engineering Series.* McGraw Hill.
3. Backhurst, J.R., Harker, J.H., Coulson, J.F., & Richardson, J.M., (1999). *Chemical Engineering, (Volume 1, 6th Edition).* Butterworth Heinemann.
4. Skelland, A.H.P. (1985). *Diffusional Mass Transfer*. Kreiger Publishing Co.
5. McCabe, W.L., Smith, J.C., & Harriot, P. (2005). *Module Operations of Chemical Engineering (7th Edition).* McGraw Hill.
6. Harker, J.H., Richardson, J.F., & Backhurst, J.R. (2003). *Chemical Engineering, (Vol 2., 5th Edition).*Butterworth-Heinemann.
7. King, C.J. (1982). *Separation Process.* Tata McGraw Hill.

8. Holland, D.C. (2016). *Fundamentals and Modelling of Separation Processes*. Prentice Hall.

Course Name: Chemical Reaction Engineering - I
Course Code: A106502
Semester: 5th

Credits: 04 **L T P**
3 1 0

Course Content

Module 1: Introduction **(8 hrs)**

Introduction & Importance of Chemical Reaction Engineering, Kinetics of homogeneous reactions, Concepts of reaction rates, rate equation, rate constant, order & molecularity, Mechanism for Elementary & Non-elementary reaction.

Module 2: Design for Single Reactions **(16 hrs)**

Material balance equation for ideal batch reactor and its use for kinetic interpretation of data and isothermal reactor design for simple & complex rate equation.
Performance equations for CSTR and PFR and their use for kinetic interpretation and design
Comparison of batch reactor, CSTR & PFR, Recycle reactor, concept of yield & selectivity
Reactor combinations of CSTR and PFR

Module 3: Design for Multiple Reactions **(8 hrs)**

Quantitative treatment of Series & parallel multiple reaction in a batch reactor, CSTR & PFR, Concept of Product distribution for multiple reactions.

Module 4: Temperature & Pressure effects **(8 hrs)**

Concept of adiabatic & non-isothermal operations, Energy balance equation for Batch, CSTR & PFR and their application to design of reactors, optimal temperature progression, multiple steady states in CSTR.

Module 5: Non –Ideality **(8 hrs)**

Basics of non-ideal flow, residence time distribution, States of segregation
Measurement and application of RTD, E-Age distribution function & F-curve and inter-relationship between them, Conversion in non-ideal reactors

Suggested Text/Reference Books:

1. Levenspiel, O. (2004).*Chemical Reaction Engineering (3rd Edition*). John Willey.
2. Smith, J.M. (1981).*Chemical Engineering Kinetics (3rd Edition).* McGraw Hill.
3. Peacock, D.G.&Richardson, J.F. (1994). *Chemical Engineering,(Volume 3, 3rd Edition*). Butterworth Heinemann.
4. Walas, S.M. (1959).*Reaction Kinetics for Chemical Engineers (3rd Edition).* Tata McGraw Hill.
5. Denbigh, K.G. & Turner, J.C.R. (1984). *Chemical Reactor Theory - An Introduction (3rd Edition).* Cambridge University Press.
6. Fogler, H.S. (2006).*Elements of Chemical Reaction Engineering (4th Edition).* Prentice Hall.

Course Name: Drilling Fluids and Cements
Course Code: A106503
Semester: 5th

Credits: 04 **L T P**
4 0 0

Course Content

A. Drilling Fluids:

Module 1: Overview of Drilling Fluids: 6 hrs

Clay chemistry and its application to drilling fluids, Types of clays, hydration, flocculation, aggregation and dispersion

Module 2: Classification, Types and applications of Drilling Fluids: 8 hrs

Water based, oil based, emulsion based, polymer based, Surfactant based, Foam based and Aerated drilling fluids.

Module 3: Drilling Fluid Characteristics: 6 hrs

Basic functions, properties, maintenance and treatments of drilling fluids

Module 4: Drilling fluid calculations.

Module 5: Rotary Drilling Hydraulics: 6 hrs

Rheology of drilling fluids, Pressure loss calculations and Rig hydraulics.

B. Cements:

Module 1: Cementing, Cements & cement slurry: 10 hrs

Objectives of cementing, oil well cements, Classification of cement, Slurry design, Slurry additives, Factors influencing cement slurry design, Cementing equipments.

Module 2: Cementing Methods: 12 hrs

Primary cementing, Stage cementing, Liner cementing, Plugging, Squeeze Cementing techniques in practice, Deep well cementing, Characteristics of good quality cementation, Cementing calculations.

Suggested Text/Reference Books:

1. Gatlin, C. (1960). *Petroleum Engineering: Drilling and Well Completion*. Prentice Hall.
2. Azar, J. J.& Samuel, G.R. (2007). *Drilling Engineering.* Penn Well Corporation.
3. French Oil and Gas Industry Assn. (1982), *Drilling Mud and Cement Slurry Rheology Manual.* Gulf Publishing Company.
4. Smith, P.K. (1976).*Cementing (2nd Edition).* SPE Pulications.
5. Caenn, R. &Darley, H.C.H. (2011).*Composition and Properties of Drilling and Completion Fluids.*Gulf Professional publishing.
6. ASME Shale Shaker Committee. (2004). *Drilling Fluids Processing Handbook.*Gulf Professional publishing.
7. Azar, J.J, & Lummas, J.L. (1986). *Drilling Fluids Optimization: A Practical Field Approach.* Pennwell Books

Course Name: Process Instrumentation and Control
Course Code: A106503
Semester: 5th

Credits: 04 **L T P**
3 1 0

Course Content

Instrumentation **4 hrs**

Classification of measuring instruments, Elements of measuring instruments, Static and dynamic
Characteristics of instruments, Error analysis, Instruments for the measurement of temperature,
Pressure, Liquid level, and moisture content, Instruments and sensors for online measurements.

Process Control

Introduction: **2 hrs**

General Principles of process control, Time domain, Laplace domain and frequency domain Dynamic and control

Linear Open loop Systems: **12 hrs**

Laplace domain analysis of first and second orders systems, linearization,
Response to step, pulse, impulse and ramp inputs, Physical examples of first and second order systems such as thermocouple, level tank, U-tube manometer etc., Interacting and non-interacting systems distributed and lumped parameter systems, dead time.

Linear Closed-loop Systems: **10 hrs**

Controllers and final control elements, Different types of control valves and their characteristics, Development of block diagram, Transient response of simple control systems, Stability in Laplace domain, Root locus analysis.

Frequency Response: **8 hrs**

Frequency domain analysis, Control system design by frequency response, bode stability criterion, Different methods of tuning of controllers.

Process Applications: **12 hrs**

Introduction to advanced control techniques as feed forward, feedback, cascade, ratio, Smith predictor, Internal model control, Digital computer control, Direct digital control and supervisory control and data acquisition, Multivariable control, Applications to equipments such as heat exchangers, distillation columns, reactors etc.

Suggested Text/Reference Books:

1. Eckman, D.P. (1974). *Industrial Instrumentation.*Wiley Eastern.
2. Harriott, P. (2001).*Process Control*, McGraw Hill.
3. Patranabis, D. (2001).*Principles of Process Control (2nd Edition)*. McGraw Hill.

4. Pollard. (1971).*Process Control for Chemical and Allied Industries.* Butterworth Heinnemann.
5. Weber, T.W. (1988).*An Introduction to Process Dynamics & Control.* Kreiger Publishing Co.
6. Coughanour, D. R. (2009).*Process System Analysis & Control.* McGraw Hill.
7. Coughanour, D. R. & Leblanc, S. (2009).*Process System Analysis and Control (3rd Edition).* Mc Graw Hill.
8. Stephanopoulos, G. (1990).*Chemical Process Control - An Introduction to Theory and Practice (1st Edition).* Prentice Hall of India.
9. Peacock, D.G. & Richardson, J.F. (1994). Chemical Engineering,(Volume 3, 3rd Edition). Butterworth Heinemann.
10. Bequette, B.W. (2003).*Process Dynamics: Modeling, Analysis and Simulation.* Prentice Hall.

Course Name: Petroleum Refining and Engineering
Course Code: A106505
Semester: 5th

Credits: 04 **L T P**
4 0 0

Course Content

Module 1: Introduction to petroleum industry: 2 hrs

World petroleum resources, petroleum industry in India, Origin, exploration, drilling and production of petroleum crudes, Transportation of crudes and products

Module 2: Crude pre treatment: 16 hrs

Composition and classification of crudes, methods of evaluation: ASTM, TBP and EFV distillation. Properties and specifications of petroleum products such as LPG, gasoline, naphtha, kerosene, diesel oils, lubricating oils, waxes and the like.

Testing of petroleum products:

(i) Physical test: Density and specific gravity, viscosity.

(ii) Chemical test: Organic and inorganic constituents.

(iii) Flammability Test: Flash point, volatility.

(iv) Knock Rating Test: For Gasoline Octane Number.

Module 3: Separation Processes: 16 hrs

Design and operation of topping and vacuum distillation units, Tube still furnaces, Solvent extraction processes for lube oil base stock and for aromatics from naphtha and kerosene steams, solvent de-waxing.

Module 4: Conversion Process: 14 hrs

Thermal cracking, visbreaking and coking processes, Catalytic cracking, reforming, hydro processing, alkylation, polymerization and isomerisation, safety and pollution considerations in refineries.

Suggested Text/Reference Books:

1. Nelson, W.L. (1985).*Petroleum Refinery Engineering (5th Edition).*McGraw Hill.

2. Hobson, G.D. & Pohl. W. (1984). *Modern Petroleum Technology (5th Edition).* John Wiley.

3. Guthrie, V.B. (1960).*Petroleum Products Handbook*. Mc Graw Hill.

4. Rao, B.K. (2009).*Modern Petroleum Refining Processes (5th Edition).*Oxford & IBH Publishing Co.

Course Name: Industrial Pollution Abatement
Course Code: A106506
Semester: 5th

Credits: 04 **L T P**
3 1 0

Course Content

Module 1: Introduction **2 hrs**

Ambient air and water standards, principle sources of pollution, Inter relationship between energy and environmental pollution, Prevention of environmental pollution through conservation

Module 2: Air Pollution **16 hrs**

Principal air pollutants and their usual sources, Effects of air pollution on human health, animals and vegetation and materials, Atmospheric dispersion of air pollutants, Temperature inversions,

Ambient air sampling, dust fall jar and high volume sampler, stack sampling

Air pollution control techniques: Process and equipment's used for the control of gaseous pollutants- equipment efficiency, gravity settler, cyclone separator, fabric filters, Electrostatic precipitators, scrubbers

Module 3: Water Pollution **16 hrs**

Types of water pollutants, their sources and effects,BOD and COD, BOD5, oxygen sag curve, waste water sampling- grab and composite sample

Waste water treatment: Primary Treatment through settling techniques and equipments like flocculation, skimming, flotation.

Secondary Treatment: aerobic and anaerobic digestion, activated sludge process, trickle filter and oxidation ponds.

Module 4: Solid Waste **8 hrs**

Control and disposal, sanitary landfill, incineration, pyrolysis gasification and recycling

Module 5: Environmental Management System **6 hrs**

Environment impact assessment, its concept and constituents, Environmental audit, ISO-14000 system

Suggested Text/Reference Books:

1. Perkins, H.C. (1974). *Air Pollution.*McGraw Hill.
2. Liptak, B.G. & Liu, D.H.F. (1999).*Environmental Engineers Handbook (2nd Edition).*CRC Press.
3. Willisamson, S.J. (1973).*Fundamentals of Air Pollution.* Addison Wesley Co.
4. Nemerow, N.L. (1971).*Liquid Wastes of Industry: Theory, Practices and Treatment.* Addison Wesley Co.
5. Rao, C.S. (2006).*Environmental Pollution Control Engineering (2nd Edition).* New Age International Pvt. Ltd.
6. Metcalf & Eddy. (2007).*Waste-Water Engineering.*Tata McGraw Hill.
7. Mahajan, S. P. (2008).*Pollution Control in Process Industries.* Tata McGraw Hill.
8. Sincero, A.P.& Sincero, G.A. (1999).*Environmental Engineering.* Prentice-Hall of India.

Course Name: Mass Transfer Laboratory
Course Code: A106507
Semester: 5th

Credit: 01 **L T P**
0 0 2

Course Content

1. To find out the critical moisture content of the given material and to find out the equations for constant and falling rate period of drying.
2. Determination of liquid holds up in a packed column.
3. To find the mass transfer coefficient for the vaporization of organic vapor to air.
4. To verify the Rayleigh's equation for batch distillation.
5. To find the height equivalent to a theoretical plate and height of a transfer Module for the packed distillation column under total reflux.
6. To find the yield of crystals using batch crystallizer
7. To find the efficiency of rotary drier using a granular solid
8. To find the efficiency of a distillation column.
9. To study the adsorption characteristics and plot adsorption isotherm.
10. To find the yield of a natural oil by leaching from biomass.
11. To study liquid-liquid extraction in a packed column.
12. To determine mass transfer coefficient from a wetted wall column.

Course Name: Process Control Laboratory
Course Code: A106508
Semester: 5th

Credit: 01 **L T P**
0 0 2

Course Content

1. Calibration of temperature, pressure, flow and composition measuring instruments.
2. Study of process dynamics of a liquid level tank
3. Study of process dynamics of interacting / non-interacting tank
4. Study of process dynamics of some processes.
5. Investigation of the operation of pneumatic and electronic controllers with proportional integral derivative action.
6. To determine the best setting of a controllers with controlling an actual process.
7. To solve first order or higher order differential equations with the help of an analog computer/ computer and to study control problems by simulation.
8. To control the level of liquid in the process tank using multi process trainer for different controller settings.
9. Study of control valve characteristics.
10. Study of Programmable Logic Control system.

Course Name: Industrial Pollution Abatement Laboratory
Course Code: A106509
Semester: 5th

Credit: 01 **L T P**
0 0 2

Course Content

1. Analysis of gaseous pollution as SO_2, H_2S, NO-NOX, CO-CO_2, O_3, NH_3.
2. Characterization of waste water: pH, nitrate, phosphate, hardness, alkalinity, DO.
3. Determination of TDS, SS, dissolved solids of a water sample
4. Determination of COD of a water sample
5. Determination of BOD of a water sample
6. Domestic effluent Analysis.
7. Gas analysis with Orsat apparatus.
8. Determination of sludge volume index.

Course Name: Petrochemical Technology
Course Code: A106601
Semester: 6th

Credits: 04 **L T P**
4 0 0

Course Content

Part - A

Module 1: 2 hrs

Introduction- Application of various components of Hydro Carbon, Major Industrial Application- Fertilizer, Power generation, Petrochemicals, Sponge iron, glass Industry, Ceramic Industry

Module 2: 4 hrs

Gas For Fertilizer Plant- use of Methane; Reforming of Methane; shift Conversion of Synthesis gas; Air Separation (Making Oxygen and Nitrogen); Ammonia Synthesis.

Module 3: 6 hrs

Urea Reaction in presence of Catalyst, G as for Petrochemicals, Use of Ethane, Cracking of Ethane to Ethylene

Module 4: 10 hrs

Polymerization; Properties, applications and production technologies of the following commodity polymers - Polyethylene, LLDPE, HDPE, polypropylene, polystyrene, PVC; Propane cracking; Market for polymers and application of polymer

Part – B

Module 5: 8 hrs

C_3, C_4 and higher hydrocarbons C_3derivatives: Propane, propylene, Isopropyl alcohol, Acetone, Propylene oxide, Propylene glycol, Acrylonitrile, Acrylic acid C_4 derivatives: Butane, Butylene, Butylene oxide-glycol, Acetic acid from butane Higher Hydrocarbon derivatives: Separation of paraffins (Wax cracking)

Module 6: 8 hrs

Petroleum Aromatics BTX Production: Naptha reforming, Paraxylene from Naptha Benzene derivatives: Phenol, Aniline, Benzoic acid, Styrene, Maleic anhydride. Toluene derivatives: Caprolactum, DMT, Terephalic acid, phthalic anhydride. Xylene derivatives: Cumene, Naphthalene

Module 7: 10 hrs

Dyes and pigments: Classification and production Synthetic Detergents: Classification, Manufacture of sulfonates: Keryl Benzene sulfonates (Surf)

Suggested Text/Reference Books:

Part – A

1. Chaudhary, U.R. (2011). *Fundamentals of Petroleum and Petrochemical Engineering*. CRC Press.

2. Mall, I.D. (2007). *Petrochemical Processes Technology*. Macmillan India.
3. Maiti, S. (1992). Introduction to Petrochemical. Oxford & IBH Publishing Company.
4. Rao, B.K.B. (2009). *Modern Petroleum Refining Processes.* Oxford & IBH Publishing Company.

Part – B

1. Waddams, A.L. (1980). *Chemicals from Petroleum (4th Edition).* Gulf Publishing Company.
2. Lewis, F.H. &Matar, S. (1981).*From Hydrocarbon to Petrochemicals.* Gulf Publishing Co.
3. Rao, B.K.B. (1998). *A Text on Petrochemicals (2nd Edition).* Khanna Publishers.
4. Mall, I.D. (2007). *Petrochemical Process Technology.*Macmillan India Limited.
5. Lowenheim, F.A. &Moran, M.K. (1975). *Industrial Chemicals (4th Edition).*John Wiley.

Course Name: Chemical Reaction Engineering – II
Course Code: A106602

Semester: 6th
Credits: 04 **L T P**
3 1 0

Course Content

Module 1: Kinetics of heterogeneous reactions **10 hrs**
Introduction to catalysts & their classification, Concepts of physical absorption and Chemisorption, Preparation of solid catalysts, Deactivation of Catalysts, Synthesis of rate law, mechanism & rate limiting step for catalytic reactions, Langmuir Hinshelwood rate equations and parameter estimation.

Module 2: Diffusion through porous catalyst particles **12 hrs**
Effectiveness factor for pore diffusion resistance through a single cylindrical pore, Significance of Thiele modulus, Heat effects during reaction, Performance equations for solid- gas reactions for different reactor types & determination of controlling resistance

Module 3: Kinetics of Fluid-Particle Reactions **8 hrs**
Modelling of gas-solid non-catalytic reactions and determination of parameters, Combination of resistances & determination of rate controlling step

Module 4: Kinetics & Design of Fluid-Fluid Reactions **10 hrs**
Interface behavior for liquid-phase reaction, Regimes for different reaction kinetics for liquid-liquid reactions, Determination of reaction rate & tower height based on film and penetration theories, Concept of Enhancement factor & Hatta Number.

Module 5: Design of heterogeneous reactors **8 hrs**
Analysis of rate data design outline and selection of fixed bed, fluid bed and slurry reactors, Reactor systems and design for gas-liquid-solid non-catalytic system.

Suggested Text/Reference Books:

1. Smith, J.M. (1981). Chemical Engineering Kinetics (3rd Edition). McGraw Hill.
2. Levenspiel, O. (2004). Chemical Reaction Engineering (3rd Edition). John Willeyion.
3. Peacock, D.G. & Richardson, J.F. (1994). *Chemical Engineering (Volume 3, 3rd Edition).* Butterworth Heinemann.
4. Walas, S.M. (1959).*Reaction Kinetics for Chemical Engineers (3rd Edition).* McGraw Hill.
5. Denbigh, K.G. & Turner, J.C.R. (1984). *Chemical Reactor Theory - An Introduction (3rd Edition).* Cambridge University Press.
6. Fogler, H.S. (2006).*Elements of Chemical Reaction Engineering (4th Edition).*Prentice Hall.
7. Carberry, J.J. (1976). *Chemical and Catalytic Reaction Engineering.* McGraw Hil.
8. Hill, C.G. (1977). *Chemical Engineering Kinetics and Reactor Design*. John Wiley.
9. Coulson, J.M. & Richardson, J.F. (1999). *Chemical Engineering, Volume 3.*Pergamon Press.

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Course Name: Transport Phenomena
Course Code: A106603
Semester: **6th**

Credits: 04 **L T P**
3 1 0

Course Content

Module 1: Review **8 hrs**
Transport of momentum, heat and mass by molecular motion-Newton's law of Viscosity, Fourier's law of heat conduction, Fick's law of diffusion

Module 2: Transport properties **10 hrs**
Viscosity, thermal conductivity and mass diffusivity, Emphasis on the analogy between momentum, heat and mass transfer with respect to transport mechanism and governing equations

Module 3:
Development of mathematical models of transfer process by shell momentum balance 12 hrs
Shell energy balance and shell mass balance for solving specific problems of transport of momentum, heat and mass in laminar flow or in solids in one dimension.

Module 4: Development of general differential equations of fluid flow **8 hrs**
Heat transfer and mass transfer and their applications in solving one dimensional steady state and unsteady state problems of momentum, heat and mass transfer

Module 5: Interphase transport **5 hrs**
Interphase transport of Momentum, heat and mass and dimensionless correlations for each one of them.

Module 6: Transport Analysis **5 hrs**
Momentum, heat and mass transfer analysis and analogies

Suggested Text/Reference Books:
1. Bird R.B., Stewart, W.E., & Lightfoot, E.N. (2005).*Transport Phenomena.* JohnWiley.
2. Geankoplis, C.J. (2003).*Transport Processes and Separation Process Principles (Includes Module Operations) (4th Edition).*Prentice Hall.
3. Weity, J.R., Wilson, R.E., & Wicks, C.E. (2001).*Fundamentals of Momentum Heat and Mass Transfer (4th Edition).* John Wiley.
4. Bennett, C.O. & Myres, J.E. (1982).*Momentum Heat and Mass Transfer (3rd Edition).* McGraw Hill.

Course Name: Process Utilization and Industrial Safety
Course Code: A106604
Semester: 6th

Credits: 04 **L T P**
3 1 0

Course Content

Module 1: Water **8 hrs**
Water resources, Storage and characterization, Conditioning

Module 2: Steam **12 hrs**
Boilers, Steam Handling and distribution, Steam nozzles, Condensate utilization, Steam traps, Flash tank analysis, Safety valves, Pressure reduction valves, Desuperheaters.

Module 3: Air **12 hrs**
Air compressors, Vacuum pumps, Air receivers, Piping systems, Different types of ejectors, Air dryers.

Module 4: Hazards and Safety **16 hrs**
Classifications and assessment of various types of hazards, Risk assessment methods, General principles of industrial safety, Hazards due to fire, explosions, Toxicity and radiations, Industrial hygiene, Maximum allowable concentration and threshold limit value, Protective and preventive measures in hazards control, Introduction to industrial safety regulations.
Case studies of hazardous incidents in industries using HAZOP.

Suggested Text/Reference Books:
1. Vasandhani, V.P. & Kumar, D.S. (2009). *Heat Engineering*. Metropolitan Book Co. Pvt. Ltd.
2. Crowl, D.A. & Louvar, J.F. (2002).*Chemical Process Safety-Fundamentals with Applications.* Prentice Hall.
3. Peavy, H.S. & Rowe, D.R. (1985). *Environmental Engineering.* McGraw Hill.
4. Banerjee, S. (2003).*Industrial Hazards and Plant Safety.* Taylor & Francis.
5. Lees, F.P. (1996).*Prevention in Process Industries.* Butterworth.
6. Sanders, R.E. (2005),*Chemical Process Safety-Learning from Case Histories.* Oxford.
7. Perry, R.H. & Green, D.W. (1997). *Chemical Engineer's Handbook.* McGraw Hill.

Course Name: Offshore Drilling and Production
Course Code: A106605
Semester: 6th

Credits: 04 **L T P**
4 0 0

Course Content

Module I: Sea states and weather: **6 hrs**
Meteorology, oceanography, Sea-bed soil condition, Wave condition, Wave structure interaction

Module II: Off-shore structures: **12 hrs**
Fixed platform, jack-up rig: design and operational features mobile Modules; semi-submersible, floating structures, description and installation, station keeping, mooring and dynamic positioning system.

Module III: Off-shore drilling: **12 hrs**
Well head and sea floor connection; conductor and riser. Off-shore well completion: Platform and sub-sea completion system, well control and work-over system.

Module IV: **10 hrs**
Sub-sea technology in deep water: use of divers and robots, Off-shore production: Platform oil and gas processing, water and gas injection system.

Module V: **8 hrs**
Storage for oil: SPM & SBM system, Deep water technology: use of remote operating vehicle (ROV)

Suggested Text/Reference Books:
1. El-Reedy, M.A. (2012).*Offshore Structures: Design, Construction and Maintenance.* Gulf professional Publication.
2. Chakraborty, S.K. (2006).*Handbook of Offshore Engineering, Volume-I and II.* Elsevier.

Course Name: Numerical Methods
Course Code: A106606
Semester: **6th**

Credits: 04 **L T P**
3 1 0

Course Content

Module 1: Introduction & Error analysis 5hrs
Introduction to Numerical methods and its significance in engineering, classification of errors, significant digits and numerical stability

Module 2: Linear Algebraic Equations 7 hrs
Cramer's rule, Gauss Elimination and LU Decomposition, Gauss-Jordan elimination, Gauss-Seidel and Relaxation Methods

Module 3: Non Linear Algebraic Equations 10 hrs
Single variable successive substitutions (Fixed Point Method), Multivariable successive substitutions, single variable Newton-Raphson Technique, Multivariable Newton-Raphson Technique.

Module 4: Eigen values and Eigen vectors of Matrices 6 hrs
Faddeev Leverrier's Method and Power Method.

Module 5: Function Evaluation 12 hrs
Least squares curve-fit (Linear Regression), Newton's interpolation formulae (equal intervals), Newton's Divided Difference Interpolation Polynomial, Lagrangian Interpolation Unequal intervals).
Numerical Differentiation, Numerical Integration or Quadratures (Trapezoidal, Simpson's 1/3 and 3/8 rules), Extrapolation Technique of Richardson and Gaunt

Module 6: Ordinary Differential Equations (ODE-IVPs) and partial differential Equations 8 hrs
The Finite difference Technique, Runge-Kutta method

Suggested Text/Reference Books:

1. Gupta, S.K. (2009). *Numerical Methods for Engineers (2nd Edition).* New Age International Publishers.
2. Jain, M.K., Iyengar, S.R.K., &Jain, R.K. (2012).*Numerical Methods for Scientific and Engineering Computation.* New Age International.
3. Finlayson, B.A. (1980).*Nonlinear Analysis in Chemical Engineering.* MCGraw Hill
4. Villadsen, J. and Michelsen, M.L. (1978).*Solution of Differential Equation Models by Polynomial Approximation.* Prentice Hall.
5. Rice, R.G. & Do Duong, D. (1995).*Applied Mathematics and Modelling for Chemical Engineers.* John Wiley.
6. Sastry, S.S. (2005).*Introductory Methods of Numerical Analysis (4th Edition).* Prentice Hall of India.

Course Name: Process Equipment Design
Course Code: A106607
Semester: 6th

Credits: 02 **L T P**
0 0 4

Course Content

1. Process Design of Shell and Tube Heat Exchanger
2. Process Design of Condensers
3. Process Design of Agitated vessels. Introduction to plate heat exchangers and its design
4. Specification sheet for Heat exchangers.
5. Design of Sieve Tray Column and column internals
6. Design of Bubble Cap Column and column internals
7. Design of Packed Column and column internals
8. Specification sheet for fractionating column
9. Design of Homogeneous Reactors
10. Design of Heterogeneous reactors – Fixed bed
11. Design of Heterogeneous reactors – fluidized bed
12. Types of Flow Sheets
13. Overview of plant layout

Note: Student has to perform at-least 10 experiments.

Suggested Text/Reference Books:

1. Coulson, Richardson & Sinnott, R.K. (2005). *Chemical Engineering Volume-6– An Introduction to Chemical Engineering Design (4th Edition).*Elseveir Butterworth Heinemann.
2. Perry, R.H. & Green, D.W. (2008).*Chemical Engineers' Handbook (8th Edition).* Mc-Graw Hill.
3. Coker, A.K. (2007),*Ludwig's Applied Process Design in Chemical & Petrochemical Plants- Vol 1 (4th Edition).*Gulf Publication- Butterworth Heinemann.
4. Siddiqui, S. (2010).*Ludwig's Applied Process Design in Chemical &Petrochemical Plants – Volume 2 (4th Edition).* Gulf Publication.
5. Ludwig, E.E. (2001).*Applied Process Design in Chemical & Petrochemical Plants- Vol 3 (3rd Edition).*Gulf Publication- Butterworth Heinemann.
6. Vilbrandt, F.C. & Dryden, C.E. (1959). *Chemical Engineering Plant Design (4th Edition).* McGraw Hill. Peters, M.S. & Timmerhaus, K.D. (2003).*Plant Design and Economics for Chemical Engineering (5th Edition).* McGraw Hill.
8. Molyneux, F. (1963).*Chemical Plant Design-I.* Butterworth Heinemann.

Course Name: Chemical Reaction Engineering Laboratory
Course Code: A106608

Semester: **6th**
Credit: 01

L T P
0 0 2

Course Content

1. Kinetic studies in a Batch reactor
2. Kinetic studies in a Plug Flow reactor
3. Kinetic studies in a PFR followed by a CSTR
4. RTD studies in a PFR
5. RTD studies in a Packed Bed Reactor.
6. RTD studies in CSTRs in series
7. Studies on micellar catalysis
8. Study of temperature dependence of rate constant using CSTR.
9. Kinetic studies in sono-chemical reactor
10. Batch reactive distillation
11. Kinetics of photochemical reaction
12. Demonstration of heterogeneous catalytic reaction
13. Demonstration of gas-liquid reaction

Books referred: Levenspiel, O. (2004). *Chemical Reaction Engineering (3rd Edition)*. John Willey.

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Numerical Methods Laboratory
Course Code: A106609
Semester: 6th

Credit: 01 **L T P**
0 0 2

Course Content

1. Solution of a system of linear equations in unknowns by Gaussian elimination.
2. Gauss-Seidel iterative method to solve a linear system of equations.
3. To find the inverse of matrix by Gauss-Jordan method.
4. Application of Faddeev-Leverrier's method.
5. Method for finding dominant Eigen value and corresponding Eigen vectors by power method.
6. Solution of nonlinear equation by Newton Raphson method.
7. Application of Newton's formulae for interpolation.
8. Application of Lagrange polynomial interpolation formula.
9. Application of Newton's formula for numerical differentiation.
10. Numerical integration by Trapezoidal rule.
11. Numerical integration by Simpson's rules.
12. Solution of an O.D.E. by Runge-Kutta Methods.
13. Application of finite difference technique.

Suggested Text/Reference Books:

1. Gupta, S.K. (2009). *Numerical Methods for Engineers (2nd Edition).* New Age International Publishers.
2. Jain, M.K., Iyengar, S.R.K., & Jain, R.K. (2012). *Numerical Methods for Scientific and Engineering Computation.* New Age International.
3. Finlayson, B.A. (1980). *Nonlinear Analysis in Chemical Engineering.* MCGraw Hill
4. Villadsen, J. and Michelsen, M.L. (1978). *Solution of Differential Equation Models by Polynomial Approximation.* Prentice Hall.
5. Rice, R.G. & Do Duong, D. (1995). *Applied Mathematics and Modelling for Chemical Engineers.* John Wiley.
6. Sastry, S.S. (2005). *Introductory Methods of Numerical Analysis (4th Edition).* Prentice Hall of India.

Course Name: Process Economics and Management
Course Code: A106701
Semester: 7th

Credits: 04 **L T P**
4 0 0

Course Content

Module 1: Cost Estimation 8 hrs

Factors affecting investment and production costs, Capital investments: fixed investments and working capital. Cost indices. Estimating equipment costs by scaling 6/10 factor rule, Methods for estimation capital investment. Estimation of total product cost. Different costs involved in the total product for a typical chemical process plant.

Module 2: Interest & Investment Costs 8 hrs

Types of interest (simple & compound interest), Nominal & Effective Rates of interest, Continuous interest, Present worth & discounts, perpetuities, capitalized costs, Interest & Investment costs.

Taxes & Insurance: Types of taxes and tax returns, Property taxes, excise taxes, income taxes, Types of Insurance & Legal Responsibility.

Module 3: Depreciation 8 hrs

Purpose of Depreciation as cost, Types of Depreciation, Depletion, Service life., Salvage value, Present value, Methods of Determining Depreciation , Straight- line method, Declining Balance Method, Sum of the years Digits method, Sinking Fund Method, Single Unit & Group Depreciation.

Module 4: Profitability 10 hrs

Profitability Alternative Investments & Replacement: Profitability standards, Mathematical methods of profitability evaluation: Rate of return on investment, discounted cash flow method, Net Present worth, Capitalized costs, pay out period. Determination of Acceptable investment, Alternatives when an investment must be made, Alternative analysis by method of return on incremental investment, Alternative analysis incorporating minimum return as a cost, Replacements, Balance sheets & Income statement.

Module 5: Optimum Design 8 hrs

General procedure for Determining optimum conditions, Procedure with one variable, Procedure with Two or More variables, Break even chart for production schedule and its significance for optimum analysis. Examples of optimum design in a Chemical Process Plant.

Module 6: IPR and Patent Systems 7 hrs

Intellectual property, IPRs and its types, Patent claims, legal decision making process and ownership of tangible and intellectual property. Indian patent system, current IPR laws and legislations in India for IPR

Documents required for filing patent, infringement of patents and remedies

Suggested Text/Reference Books:

1. Peters, M.S.& Timmerhaus, K.D. (2003). *Plant Design and Economics for Chemical Engineers (4th Edition)*. McGraw Hill.
2. Ulrich, G.D. (1984). *A Guide to Chemical Engineering Process Design and Economics.* John Wiley.
3. Guthrie, K.M. (1974). *Process Plant Estimation, Evaluation and Control.*California: Craftsman Book Company.
4. Douglas. (1998). *Conceptual Design of Chemical Processes.* McGraw Hill.

5. Riestra, V. (1983). *Project Evaluation in Chemical Process Industries.*McGraw Hill.

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Process Modeling and Simulation
Course Code: A106702
Semester: 7th

Credits: 04 **L T P**
4 0 0

Course Content

Module 1: Introduction **2 hrs**

Definition of mathematical model, lumped parameter models, distributed parameter models, uses of mathematical models, scope of coverage, principles of formulation.

Module 2: Fundamental laws **14 hrs**

Continuity equations, energy equations, equation of motion, equations of state, equilibrium, chemical kinetics

Module 3: Mathematical Models for Chemical Engineering Systems **16 hrs**

Series of isothermal constant holdup CSTRs, CSTRs with variable holdups, Two heated tanks, Non-isothermal CSTR, Single component vaporizer, Batch reactor, Ideal binary distillation column, Batch distillation with holdup, pH systems, Lumped parameter model of gas absorber, Model foe heat exchanger, Model for interacting & non-intracting tanks, Model for biochemical reaction.

Module 4: Simulation **16 hrs**

Meaning of simulation, Simulation examples of isothermal CSTR, non-isothermal CSTR, Batch reactor

Suggested Text/Reference Books:

1. Luyben, W.L. (1990). Process Modeling Simulation and Control for Chemical Engineers. McGraw Hill.
2. Rose, L.M. (1974). *The Application of Mathematical Modelling to Process Development and Design (1st Edition).*Applied Science Publisher Limited.
3. Bequette. (2003). *Process Dynamics- Modelling, Analysis and Simulation*. PHI.
4. Rase, H.F. (1997). *Chemical Reactor Design for Process Plants, Vol II: Case Studies and Design Data (1st Edition).*John Wiley.
5. Morton, D.M. (1986). *Process Modelling (1st Edition)*. Longman Publisher.

Course Name: Oil and Gas Transportation System
Course Code: A106703
Semester: 7th

Credits: 04 **L T P**
4 0 0

Course Content

Module 1: **8 hrs**
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.

Module 2: **10 hrs**
Pipe line transport of oil and gas: Route selection, pipe line construction process and equipment: trenching, aligning, connecting pipes, corrosion protection, lowering & back filling.

Module 3: **8 hrs**
Flow of oil and gas through pipelines, Pressure drop calculation, types, sizing and location of pumps and compressor, Instrumentation and control

Module 4: **10 hrs**
Flow measurement and control arrangement. Corrosion in pipelines: Types, chemical and electro-chemical process; coating, cathodic protection principle and design.

Module 5: **12 hrs**
Pipe line branching: Gas distribution control. Offshore pipe line: Sag and over bend; stinger and riser, under-water welding.

Suggested Text/Reference Books:
1. Liu, H. (2005). *Pipeline Engineering.* Lewis Publishers.
2. Antaki, G.A. (2003).*Piping and Pipeline Engineering: Design, Integrity and Repair (1st Edition).* CRC Press.

Course Name: Natural Gas Engineering
Course Code: A106704
Semester: **7th**

Credits: 04 **L T P**
4 0 0

Course Content

Module 1: Introduction **2 hrs**

Composition, properties, fields & reserves in India and energy scenario; major NG producing industries of India and their contribution to Indian economy; techniques of utilization

Module 2: Gas Processing: **16 hrs**

Conventional and advanced separation techniques; free liquid removal; low temperature separation; dehydration processes: chemical and refrigeration system. Natural gas sweetening: amine process; sulphur recovery; LPG, LNG & CNG systems. Specifications of NG for transportation in pipelines, NG Utilization**:** uses, underground storage, conservation & concept of peak shaving etc. CBM, NG hydrates & in-situ coal gasification, conversion of gas to liquid (GTL); NGL: process, system, storage, transportation and utilization.

Module 3: Transportation of NG: **14 hrs**

Compression calculations; gas stations & transmission; city gas distribution system; gas flow measurement: orifice meter, turbine meter, principles and performance; compressor sizing.

Module 4: Marketing, retailing and gas trading: **16 hrs**

Underground storage, System and production performance, CBM, NG hydrates & in-situ coal gasification, conversion of gas to liquid (GTL).

Suggested Text/Reference Books:

1. Bradley, H.B. (1987).*Petroleum Production Handbook.* SPE Publication.
2. Skimmer, D.R. (1982).*Introduction to Petroleum Production, Volume-1, 2 & 3.* Gulf Publishing.
3.Katz, D.L. & Lee, R.L. (1990).*Natural Gas Engineering-Production and Storage.* McGraw-Hill.
4.Kumar, S. (1987).*Gas production Engineering*. Gulf Publishing.

Course Name: Membrane Separation Processes
Course Code: A106705
Semester: **7th**

Credits: 04 **L T P**

4 0 0

Course Content

Module 1: Separation Processes
Industrial chemical processes, Mechanism of separation, separation power, selection of feasible separation processes.

Module 2: Membrane Separations
Membrane Materials, Membrane Modules, Transport in Membranes – Porous Membranes, Bulk Flow, Liquid Diffusion in Pores, Gas Diffusion, Nonporous Membranes, Solution-Diffusion for Liquid Mixtures, Solution-Diffusion for Gas Mixtures, Module Flow Patterns, Cascades, External Mass-Transfer Resistances, Concentration Polarization and Fouling. Dialysis and Electrodialysis, Reverse Osmosis, Gas Permeation, Pervaporation, Ultrafiltration, Microfiltration.

Module 3: Adsorption, Ion Exchange, and Chromatography
Sorbents: Adsorbents, Ion Exchangers, Sorbents for Chromatography
Equilibrium Considerations: Pure Gas Adsorption, Liquid Adsorption, Ion Exchange Equilibria, Equilibria in Chromatography
Kinetic and Transport Considerations: External Transport, Internal Transport, Mass Transfer in Ion Exchange and Chromatography
Sorption Systems: Adsorption, Ion Exchange, Chromatography, Slurry Adsorption (Contact Filtration), Fixed-Bed Adsorption (Percolation), Thermal-Swing Adsorption, Pressure-Swing Adsorption, Continuous, Countercurrent Adsorption Systems, Simulated-Moving-Bed Systems, Ion-Exchange Cycle, Chromatographic Separations

Suggested Text/Reference Books:
1. Seader, J.D.& Henley, E.J. (2006). *Separation Processes Principles.*John Wiley.
2. Rousseau, R.W. (1987).*Handbook of Separation Process Technology*. Wiley-Interscience.
3. Strathmann, H. (2004). *Ion-Exchange Membrane Separation Processes*. Elsevier Science.

Course Name: Optimization Techniques
Course Code: A106705
Semester: 7th

Credits: 04 **L T P**
4 0 0

Course Content

Module 1: Introduction: **(5 hrs)**
Engineering application of optimization, Design variables, constraints, objective function, variable bounds, statement and formulation of an optimization problem, Examples of chemical engineering Optimization problems, Classification of optimization problems, different optimization algorithms.
Optimal Point: Local optimal point, global optimal point and inflection point.

Module 2: Single variable Optimization Techniques: (12 hrs)
1. Optimality criterion.
2. Bracketing method (Bounding phase method).
3. Region elimination methods (Internal halving method, Fibonacci search method, Golden section search method).
4. Point estimation method (Successive quadratic estimation methods).
5. Gradient-based methods (Newton-Raphson method, Bisection method, Secant, Cubic search method.)
6. Root finding using optimization techniques.

Module 3: Multivariable Optimization Techniques: (12 hrs)
1. Optimality criterion – Hessian Matrix and its use in optimization
2. Unidirectional search method.
3. Direct search method (Evolutionary method, Hooke-Jeeves Pattern Search method, Powell's conjugate direction method)
4. Gradient-based methods (Steepest descent method, Newton's method, Marquardt's methods)

Module 4: Constrained Optimization Algorithms: (12 hrs)
1. Kuhn - Tucker conditions
2. Transformation method (penalty function method)
3. Direct search for constrained minimization (variable elimination method, complex search method.)

Module 5: Linear Programming: (7 hrs)
Linear programming problems, Degeneracy, Simplex method of linear programming, dual phase simplex method.

Suggested Text/Reference Books:
1. Deb, K. (2005). *Optimization for Engineering,Design Algorithms and Examples.* Prentice Hall of India.

2. Edgar, T.I., Himmelblau, D.M., & Lasdon L.S. (2001).*Optimization of Chemical Processes.*McGraw Hill.
3. Rao, S.S. (2009). *Engineering Optimization Theory and Practice (4th Edition).* John Wiley.
4. Ray, W.H. and Szekely, J. (1973).*Process Optimization with Applications to Metallurgy & Chemical Engineering.* Wiley Interscience.
5. Beveridge, S.G. and Schechter R.S. (1973).*Optimization: Theory & Practice.* McGraw Hill.
6. Grewal, B.S. (1991).*Numerical Methods in Engineering and Science.* Khanna Publishers.

Course Name: Advanced Transport Phenomena
Course Code: A106707
Semester: 7th

Credits: 04 **L T P**
4 0 0

Course Content

Module 1: Introduction To Transport Phenomena: Transport Phenomena and Module Operation, Equilibrium and Rate Processes, Fundamental variables and Modules, The analogy between Heat, Mass & Momentum Transfer, Concept of Thermal Conductivity, Diffusion Coefficient & viscosity. (10 hrs)

Module 2: Momentum Transport: Viscosity & Mechanism of Momentum Transport, Newton's Law of Viscosity, Non-Newtonian Fluids, Pressure & Temperature dependence of viscosity, Velocity distributions in laminar flow: Shell momentum balance, Flow of a falling film, Flow through a circular tube, flow through an annulus, Adjacent flow of two immiscible fluids, Creeping flow around a solid sphere, The equation of Change for isothermal system, The equation of continuity, the equation of motion, the equation of mechanical energy. (10 hrs)

Module 3: Energy Transport: Thermal conductivity and mechanism of energy transport. Fourier's Law of Heat Conduction, Temperature & Pressure dependence of thermal conductivity in Gas and Liquids. Temperature distribution in solids and in Laminar Flow, shell energy balance, Heat conduction with an electrical Heat source, Heat conduction with a nuclear heat source, Heat conduction with a viscous heat source, heat conduction with a chemical heat source, Heat conduction through composite walls (addition of resistances), Heat conduction in a cooling fin. (10 hrs)

Module 4: Mass Transport And Transport Property: Diffusivity and Mechanisms of Mass transport, definition of concentration velocities, Mass fluxes, Fick's law of diffusion, temperature and pressure dependence of mass diffusivity. Concentration distribution in solids and in Laminar flow, shell mass balance, diffusion through a stagnant gas film, diffusion with homogenous chemical reaction, diffusion with heterogeneous chemical reaction, Measurement of Transport properties, viscosity measurement, Thermal conductivity measurement, diffusion coefficient measurement. Non-Newtonian phenomena: a) Rheological characteristics of materials, Time independent behaviour, Time dependent behaviour, visco-elastic behaviour. b) Rheological measurement, capillary viscometer, Rotational viscometers.

Suggested Text/Reference Books:

1) Bird, R.B; Stewart, W.E; &Lightfoot, E.N. (2007).*Transport Phenomena (2nd Edition).*John Wiley.
2) Welty, J.,Wicks, C. & Wilson, R.E. (1984).*Fundamentals of Momentum, Heat & Mass Transfer (3rd Edition).* John Wiley.

Course Name: Energy Engineering
Course Code: A106708
Semester: 7th

Credits: 04 **L T P**
4 0 0

Contents

Module 1: Introduction: 2 hrs
Energy crisis in the world and position in India

Module 2: Conventional Sources of Energy:

Solid Fuels: 10 hrs
Principal solid fuel-coal, origin, composition and classification of coal, origin, composition and classification of coals, analysis and properties of coal, characteristics and distribution of Indian coals, coal preparation, Storage of coal, coal carbonization, briquetting, gasification and liquefaction of solid fuels.

Liquid Fuels: 12 hrs
Petroleum and Related Products:
Introduction: Origin, occurrence and reserves, reserves, Production and consumption, classification and characteristics of Petroleum properties and characteristics, petroleum refining in India.
Refining Unit Processes: Cracking, thermal cracking, catalytic cracking, hydro cracking, reforming thermal and catalytic reforming, alkylation, and polymerization, Isomerisation Petroleum Products - Naphtha, motor gasoline, aviation gasoline, kerosene, diesel oil, gas oils, fuel oils, lubricants, petroleum waxes, Petroleum coke.

Gaseous Fuels: 6hrs
Types, natural gas, methane from coal mines, producer, water carburettor, water, coal, blast furnace and refinery gases, gases from biomass, LPG, gasification of coal and oil, purification of gaseous fuels.

Module 3: Combustion Process and Appliances: 6 hrs
Nature and types of combustion processes, mechanism of combustion reaction, spontaneous ignition temperature, gas and oil burners, coal burning equipments, fluidized bed combustion

Module 4: Furnaces: General classification and description of different types of furnaces with special reference to furnaces used in ceramic, petroleum and pharmaceutical industries.

Module 5: Non- Conventional Sources of Energy:
12hrs
Nuclear energy: - Nuclear reactions, fuel materials, moderators and structural materials, reactors Energy by bio-processes-bio-gas Solar Energy - Photovoltaic cells, solar collectors, wind, tidal and geothermal energy, bio fuels.

Suggested Text/Reference Books:

1. Samir Sarkar. (2003). *Fuels and Combustion (2nd Edition).*Orient Longman.
2. Gupta, O.P. (1997).*Elements of Fuels, Furnaces and Refractories.*Khanna Publications.
3. Wilson, P.J.& Wells, G.H. (1950).*Coal, Coke and Coal Chemicals.* McGraw Hill.
4. Griswold, J. Fuels. (2006). *Combustion and Furnaces.* McGraw Hill.
5. Francis, W. & Peters M.C. (1980). *Fuels and Fuel Technology: A Summarized Manual (2nd Edition).* Pergarmon Press.

Course Name: Petroleum Engineering System Design
Course Code: A106709
Semester: 7th

Credits: 04 **L T P**
4 0 0

Course Content

MODULE – 1 **8 hrs**
Choice of well profile: drill string and casing design. Rig choice for load and installed power for a
Drill well.

MODULE – 2 **10 hrs**
Design of cementing operation forthe drilling and specification of casing head and well head system

MODULE – 3 **12 hrs**
Specification of anoptimum separation process and system for a given type of oil production

MODULE – 4 **10 hrs**
Design of a sucker-rod pumping production system

MODULE – 5 **8 hrs**
Design of gas-lift production system forcontinuous and intermittent gas-lift systems

Suggested Text/Reference Books:
1. Golan, M. & Whitson, H.C. (1991).*Well Performance (2nd Edition)*. Prentice Hall.
2. Beggs, D.H. (2008).*Production Optimization Using Nodal Analysis (1st Edition)*. Oil & Gas Consultants International and Petroskills publications.

Course Name: Process Plant Design
Course Code: A106710
Semester: 7th

Credits: 02 **L T P**
0 0 4

Course Content

1. Mechanical Design of Process Equipment: Introduction, Classification of pressure vessels, pressure vessel codes and standards, Fundamental Principles and equations review
2. Design Considerations: Design Pressure, Design Temperature, Materials of construction, Weld joint efficiency, corrosion allowance, design loads.
3. Design of thin walled vessels under Internal Pressure: Cylindrical and spherical vessels
4. Design of heads and closures – design of flat head, conical head, dished heads, hemispherical and elliptical heads
5. Design of thick walled vessels under Internal Pressure
6. Design of Vessels subject to External Pressure: Cylindrical & spherical vessels, Stiffening rings, vessel heads
7. Design of vessels under combined loading: Dead Weight, wind load
8. Design of supports: Skirt support, lug support

The examination shall include a viva-voce examination based on the design report.

Suggested Text/Reference Books:

1. Brownell, L.E. & Young, E.H. (1959). Process Equipment Design. Wiley Interscience.
2. Bhattacharya, R.C. (1985).*An Introduction to Chemical Equipment Design- Mechanical Aspects (1st Edition).* CBS Publication.
3. Mahajani V.V.&Umarji S.B. (2009).*Joshi's Process Equipment Design (4th Edition).* Macmillan Indian Ltd.

Total Number of Course	53
Number of Theory Course	40
Number of Practical Course	23
Total number of noncredit courses	**0**
Total Number of Credits	**211**

Annexure-4

ACADEMIC INSTRUCTIONS

Attendance Requirements

A student shall have to attend 75% of the scheduled periods in each course in a semester; otherwise he / she shall not be allowed to appear in that course in the University examination and shall be detained in the course(s). The University may condone attendance shortage in special circumstances (as specified by the Guru Kashi University authorities). A student detained in the course(s) would be allowed to appear in the subsequent university examination(s) only on having completed the attendance in the program, when the program is offered in a regular semester(s) or otherwise as per the rules.

Assessment of a course

Each course shall be assessed out of 100 marks. The distribution of these 100 marks is given in subsequent sub sections (as applicable).

	Internal (50)						**External (50)**	**Total**
Components	**Attendance**	**Assignment**			**MST 1**	**MST2**	**ETE**	
		A1	A2	A3				
Weightage	10	10	10	10	30	30	50	
Average Weightage	10	10			30		50	100

Passing Criteria

The students have to pass both in internal and external examinations. The minimum passing marks to clear in examination is 40% of the total marks.