Faculty of Engineering

Syllabus
SE (Petroleum, Petrochemical and Polymer Engineering) 2015 course
(With effect from Academic Year 2016 - 17)

Savitribai Phule Pune University
Structure for SE (Petroleum, Petrochemical and Polymer Engineering)-2015 Course

Subject Code	Subject	Teaching scheme			Examination Heads					Total Marks	Credits
		Lect.	Practical	Tut. / Draw.	Online	Theory End Sem.	TW	PR	OR		
Term-I											
212381	Engineering Chemistry-I	4	2	-	50	50	-	50	-	150	4+1
212382	Engineering Materials and Solid Mechanics	4	2	-	50	50	50	-	-	150	4+1
212383	Momentum Transfer	4	2	-	50	50	-	-	50	150	4+1
212384	Particle Technology	4	2	-	50	50	-	-	50	150	4+1
212385	Elements of Social Sciences	3	-	-	50	50	-	-	-	100	3
212386	Machine Drawing and Workshop Practices	-	-	2	-	-	50	-	-	50	2
	Audit Course-1: Computational Skills	-	-	-	-	-	-	-	-	**Grade**	
	Total	**19**	**08**	**02**	**250**	**250**	**100**	**50**	**100**	**750**	**25**
Term-II											
207007	Engineering Mathematics-III	4	-	1	50	50	25	-	-	125	5
212388	Engineering Chemistry-II	4	2	-	50	50	-	50	-	150	4+1
212389	Heat Transfer	4	2	-	50	50	-	-	50	150	4+1
212390	Process Calculations	3	2	-	50	50	25	-	-	125	3+1
212391	Chemical Engineering Thermodynamics	3	2	-	50	50	50	-	-	150	3+1
212392	Technical Communication	-	2	-	-	-	-	-	25	25	1
212393	Electrical and Electronics Engineering	-	2	-	-	-	25	-	-	25	1
	Audit Course-2: Awareness related to Petroleum/ Petrochemical/ Polymer Industry	-	-	-	-	-	-	-	-	**Grade**	
	Total	**18**	**12**	**-**	**250**	**250**	**125**	**50**	**75**	**750**	**25**

Note: For non -audit courses, students are given certificates based on the assignments submitted by them.

Abbreviations: TW: Term Work, OR: Oral, PP: Passed (Only for non-credit courses), NP: Not Passed (Only for non-credit courses)

Savitribai Phule Pune University
SE (Petroleum, Petrochemical and Polymer Engineering)-2015 Course
212381: Engineering Chemistry-I
Credits: 4+1

Teaching Scheme
Theory: 4 hrs. /W
Practical: 2 Hrs. /W

Examination Scheme
Online 50 marks
End Semester 50 marks
Practical 50 marks

Prerequisites Knowledge of fundamental chemistry up to XII standard and first year engineering chemistry.

Course Objectives

- To study fundamentals of organic, inorganic and physical chemistry
- To learn synthesis techniques and their relevance to Petroleum and Petrochemical and Polymer Industry.

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Course Outcomes

On completion of the course, the students will be able to

- Correlate effect of structure with the reactivity.
- Understand step by step electronic changes involved in reaction.
- Understand basics of atomic structure and bonding and shapes of compounds.
- Analyze performance of an electrochemical cell including fuel cell.
- Understand basics of surface tension phenomenon and relate them to field application such as EOR.
- Demonstrate knowledge of synthesis of commercially important polymers.

Course Contents

Unit I: Structural Effects and Reactivity (L 08)

Bond cleavage. Reagents. Reaction intermediates formation and stability. Leaving groups. Basic structural electronic effects – Inductive, resonance, hyperconjugation, steric, tautomerism. Types of reactions. Structure of benzene and concept of aromaticity (Huckel's rule)

Unit II: Reaction Mechanism: (L 08)

Reactions Involving Carbonium ion Intermediates: Nucleophilic substitution, Electrophilic substitution in benzene and mono substituted benzene with orientation effect. Electrophilic addition to C = C. Elimination: E1 and E2 reactions, Saytzeff and Hofmann elimination. Rearrangement: Beckman, Pinacol. Reactions Involving Carbanion Intermediates: Grignard

reaction, Wurtz reaction, Aldol and Claisen ester condensation. Rearrangement: Favorskii. Reactions Involving Free Radical Intermediate: Addition and Substitution, Kolbe synthesis.

Unit III: Atomic Structure and Bonding: (L 08)

Atomic structure, Electronic theory of valency – electrovalency, covalency coordination valency, hydrogen bonding. Electronic configuration, energy levels, orbitals, quantum numbers. Chemical bonding – Covalent bond, VBT, Hybridization, Hybridizational shapes of molecules with examples (upto C. N. 6), Molecular orbital theory, LCAO. M.O. diagrams for diatomic molecules like H2, CO, O2, and N2.

Unit IV Electrochemistry and Fuel Cells: (L 08)

Electrochemical cell, conventions and standard states, cell diagram, Nernst equation, cell emf and Gibbs energy, reaction entropies, electrochemical series, standard electrode potentials, classification of electrochemical cells, Energy storage , batteries- primary (Zn-MnO2 type), secondary (Lead acid, sodium sulfur, Fuel cells: features of fuel cell, classification and construction, anodic and cathodic reactions in fuel cells, limitations on power available from fuel cells.

Unit V: Cohesion, Adhesion, and Surface Tension: (L 08)

Cohesive and adhesive forces. Surface tension. Formation of bubbles and droplets. Pressure inside a spherical bubble. Capillary action. Parachor. Interfacial tension. Emulsifying surfactants .Emulsion stability. Enhanced Oil Recovery using Surfactant-Polymer flooding and foaming.

Unit VI Chemistry of Polymerization: (L 08)

Introduction, comparative study of free radical, ionic, step growth polymerization mechanism. Polymerization techniques: bulk, solution, suspension and emulsion. Average molecular weights (Mn, Mw, Mv and Mz) of polymers. Brief overview of chemical synthesis of various types of monomers viz olefins, vinyl chloride, styrene, diamine, diacids, diols, and phenols.

Text Books:

1. Morrison R. T. and Boyd R.N., 2011, Organic Chemistry, Prentice Hall of India Private Ltd.
2. Atkins P.W. ,2001, Physical Chemistry; Oxford
3. Sykes Peter, 2003, A Guide Book to Mechanism in Organic Chemistry, Pearson.
4. Glasstone Samuel, 1981, Textbook of Physical chemistry; McMillan and Co. Ltd.
5. Gowarikar, V.R, N Viswanathan and Jaydev Sridhar, 2005, Polymer Science, New Age International.

Guidelines for Instructor's Manual

The Instructor’s manual should include Aim, theory, procedure, fig, observations, calculations and results for every experiment.

Guidelines for Student's Lab Journal

- Students should perform and write the experiment in journal and get checked by the practical in-charge on the same day
- Students should perform experiment individually/or in pair and record the same observations in their journal.
- Presentation in journal should be legible.

Guidelines for Lab Assessment

Based on the practicals performed by the students the practical examination will be conducted by S.P.P.U at the end of the semester.

Guidelines for conducting laboratory course

- The theory of the respective practical should be explained by the practical in-charge.
- The practical should be demonstrated to the students.
- Laboratory experiments should be conducted under the guidance of practical in-charge.
- Practical in-charge should monitor the results and assess the journal regularly.

Suggested List of Laboratory Assignments/experiments

Sr. No. Group A

1 Volumetric estimation of amide from the given solution of amide.
2 Purification of organic compounds by using techniques such as distillation, sublimation.
3 Preparation of benzoic acid from benzamide**.**

Group B

1. Purification and drying of vinyl monomer.
2. To determine the surface tension of liquid by tensiometer.
3. To determine the surface tension of liquid by drop number method, at room temperature (by stalagmometer).

Group C

1. To determine purity of monomer.
2. Determination of molecular weight by end group analysis
3. Determination of transport number of cation by moving boundary method / Hittorf's method.
4. Electroplating of copper on copper plate.

Savitribai Phule Pune University
SE (Petroleum, Petrochemical and Polymer Engineering)-2015 Course
212382: Engineering Materials and Solid Mechanics
Credits: 4+1

Teaching Scheme
Theory: 4 Hrs. /Week
Practical: 2 Hrs. /Week

Examination Scheme
Online: 50 marks
End Sem: 50 marks
Term Work: 50 marks

Prerequisites

Students undertaking this course should be conversant with

- Basic mathematical calculations.
- Basics of Engineering Mechanics.
- Basic chemistry of materials.

Course Objectives

- To understand properties and applications of different types of engineering materials.
- To study basic concepts of strength of material-stress, strain, modulus of elasticity.
- To study strength of material subjected to different types of loading

Course Outcomes

On completion of the course, the students will be able to

- Select best suitable material for required service.
- Calculate strength of material and deformation produced in members subjected to simple stresses.
- Calculate stresses induced and deformation produced in members subjected to bending, torsion and their combinations.

Course Contents

Unit I Mechanical Behavior of Metals and alloys: (L 08)

Introduction and classification of engineering materials, ferrous and non-ferrous metals and alloys, properties and applications of metals, mechanical testing of materials (destructive testing-compression test, torsion test, hardness test, impact test, fatigue, creep test).

Unit II Non-Metallic Materials (L08)

Types of non-metallic materials, properties and applications of nonmetallic materials such as polymers, plastics, rubbers, ceramics, cements, abrasives, adhesives, and insulating materials, composite materials (metal matrix, ceramic matrix, fiber reinforced plastic).

Unit III Simple Stresses and Strains (Strength of Materials) (L08)

Basic concepts of elasticity, stress, strain, stress-strain curve for ductile materials, Hook's law and modulus of elasticity, types of simple stress, strain, and modulus of elasticity, stress and strain produced in axially loaded members of uniform cross-section, and composite/compound sections, simple shear stress, strain, lateral strain and Poisson's ratio, biaxial and volumetric stress system, relation between elastic constants E, G, K, and μ, thermal stresses.

Unit IV Principal Planes and Stresses, Torsion in Shafts (L08)

Members subjected to pure or simple shear, Principle of complementary shear, stresses on oblique sections in the member subjected to uniaxial/biaxial/triaxial stress system along with complementary shear stress, concept of principal planes and stresses, calculation of principal stresses (using analytical and Mohr's circle method), theories of failure.

Concept of torsion in shafts of circular section, torsion formula, calculation of torsional shear stress and angle of twist in shaft subjected to torsion.

Unit V Stresses in Beams (L08)

Types of beams, types of loads, shear force and bending moment acting on the loaded beam, shear force and bending moment diagrams for beams (subjected to concentrated and uniformly distributed loads only), calculation of bending stress in beam section using flexure formula, calculation of shear stress in beam section.

Unit VI Materials Environment Interactions and Selection of Materials (L08)

Liquid- solid reaction- Direct Dissolution Mechanisms, Kinetics of Corrosion Reactions, Corrosion Prevention

Gas -solid reactions- Formation of gaseous reaction products, Protective and non-protective solid oxides, oxidation prevention

Solid- solid interactions- Wear mechanisms, designing to minimize friction and wear.

Radiation Damage and its prevention. Guidelines for selection of materials

Books

1. Khurmi, R.S "Strength of Materials", Chand (S) &Co. Ltd. (2005)
2. Timoshenko Stephen; "Strength of Materials Part I; Elementary theory and problems; 3/e", CBS Publishers & Distributors; (1986).
3. Beer F. P. and Johnston E. R.; Mechanics of Materials; McGraw-Hill; (1981).
4. Smith, " Science of Engineering Materials", Prentice-Hall
5. Callister W. D., " Materials Science and Engineering", John Wiley

The Instructor's manual should include Aim, theory, procedure, fig, observations, calculations and results for every experiment.

Guidelines for Student's Lab Journal

- Students should perform and write the experiment in journal with proper calculations and get checked by the practical in-charge on the same day
- Students should perform experiment individually/or in pair and record the same observations in their journal.
- Presentation in journal should be legible.

Guidelines for Lab /TW Assessment

Based on the practicals performed by the students, his regularity, consistency and performance during the practical should be taken in to consideration for giving Termwork marks

Guidelines for conducting laboratory course

Student should carry out minimum 08 experiments out of the list given below and submit the journal. (Practicals should be performed as per the Indian Standard Code of practice).

Suggested List of Laboratory Assignments/experiments

1. Tension test on mild steel, aluminum and polymeric materials
2. Izod and Charpy impact test on mild steel, copper, brass and aluminum, cast-iron.
3. Bending test on cast-iron and timber.
4. Shear Test: Single Shear and Double Shear Test on mild steel and aluminum.
5. Different types of Hardness tests on metals i.e. Rockwell Hardness Test, Brinell Hardness Test, Shore Scleroscope Test etc.
6. Torsion test on mild steel and cast-iron.
7. Fatigue test on metals.
8. Impact test on polymeric materials.
9. Compression test on concrete and cement mortar cube.
10. Measurement of shear force and bending moment in beams.

Savitribai Phule Pune University
SE (Petroleum, Petrochemical and Polymer Engineering) 2015 Course
212383: Momentum Transfer
Credits: 4+1

Teaching Scheme
Theory: 4 Hrs. /Week
Practical: 2 Hrs. /Week

Examination Scheme
Online: 50 marks
End-Sem: 50 marks
Oral: 50 marks

Prerequisites

Courses in Engineering Mathematics, Engineering Mechanics, Physics.

Course Objective

To understand basic concepts of fluid flow and its applications in upstream and downstream process industry.

Course Outcomes

On completion of the course, the students will be able to

1) Develop an ability to write governing equations for a given flow systems based on fundamental principles
2) Develop an ability to perform pressure drop calculations and line sizing for single phase and Multiphase flows
3) Develop an understanding about the operational aspects, performance evaluation of the Fluid flow Machinery

Course Contents

Unit I Fluid Properties and Fluid Statics (L08)

Introduction, density, specific gravity, surface tension and capillarity effect, viscosity. Newtonian fluid and Non-Newtonian fluid classification, Type of flows. Basic equation of fluid statics; pressure depth relationship, pressure forces on surfaces, pressure measurements

Unit II Fluid Kinematics and Dimensional Analysis (L08)

Basic method of flow description, acceleration field, material derivative, fluid flow visualization fundamentals, continuity equation, deformation of fluid elements

Dimensional Analysis: Dimensional homogeneity, Methods of non-dimensionalization of equations, dimensionless numbers in momentum transfer

Unit III Bernoulli's Equation and Momentum Equation (L08)

The energy balance for a steady, incompressible flow, Bernoulli equation, Forms of Bernoulli equation, Bernoulli for gases, Applications for Bernoulli equation, Forces Acting on Control Volume, Navier Stokes equation, Applications of Momentum Equation.

Unit IV Single Phase Flow (L08)

Flow of incompressible fluid in circular pipe; Hagen-Poiseuille equation, friction factor-Fanning and Darcy equation, Moody diagram; major and minor losses; pipe fittings and equivalent diameter. Turbulent flow in a pipe, Boundary Layer theory and its significance

Unit V Multiphase Flows (L08)

Flow resistance of immersed bodies, concept of drag and lift; variation of drag coefficient with Reynolds number. Flow through porous media, packed bed and fluidized bed, Darcy's Law, Kozeny-Carman Equation, Ergun Equation, Gas-Liquid Flow Regimes, Lockhart Martinelli equation for gas –liquid multiphase flow systems

Unit VI Fluid Moving Machines (L08)

Classification fluid flow Machinery as Fans, Blowers, Pumps and Compressors and their types and applications. Centrifugal Pumps: Operating Characteristics, Performance curves, NPSH, Affinity Laws, Series and parallel arrangements, Operating guidelines. Compressors: Characteristics, concept of surging and choking

Books

1. Yunus A Cengel , John M. Cimbala ; Fluid Mechanics: fundamentals and Applications; McGraw-Hill, 3rd Edition (2014)
2. Coulson And Richardson's, Chemical Engineering, Volume 1, Elsevier India, sixth edition (1999)
3. Noel de Nevers; Fluid Mechanics for Chemical Engineers, Third Edition; McGraw Hill, 2005.
4. McCabe, W. L, J. Smith, and P. Harriot, Unit Operations of Chemical Engineering, McGraw-Hill International Edition (Seventh edition) (2004).
5. Ron Darby, Chemical Engineering fluid Mechanics, Marcel Dekker Inc., NY (1996).

Guidelines for Instructor's Manual

The Instructor's manual should include Aim, theory, procedure, fig, observations, calculations and results for every experiment.

Guidelines for Student's Lab Journal

Laboratory journal should be completed on regular basis. Index, illustrations should be properly written. Assignments given over and above the practical topics should also be attached in the journal.

Presentation in the journal should be neat.

Guidelines for Lab /TW Assessment

Assignment or practical work write-up should be submitted in the next laboratory session. Assessment should be carried out with grades.

Guidelines for conduct of laboratory course

- Arrangements for the practical should be done prior General laboratory safety instructions should be told to the students.
- Specific chemicals, machinery, hardware handling instructions should be given in the instructions
- Aim and objectives of the practical should be explained.
- After completion of experiment, review the attainment of aim and objectives of the experiment.

Suggested List of Laboratory Assignments/Experiments

Perform any eight experiments from the list given below. Journal based on the same completed in all respects with index signed and grades given for each experiment should be submitted and presented during the oral examination.

1. Viscosity measurement of Newtonian and Non-Newtonian Fluids
2. Reynolds experiment for Laminar, transitional and turbulent flow identification
3. Verification of Bernoulli's Equation
4. Determination of Coefficient of Discharge for Orifice and Venturi.
5. Estimation of frictional Pressure drop in Circular pipes of various MOC and Pressure Drop across Pipe fittings
6. Verification of Darcy's Law, Demonstration of flow through Packed bed and Fluidized bed
7. Demonstration of Gas-Liquid Multiphase flow regimes in horizontal and vertical flow through pipe
8. Study Construction, Working of Centrifugal, Reciprocating, Gear and Plunger Pumps
9. Study of Centrifugal Pumps: Pump curves, NPSH, Cavitation, Selection and Performance
10. Study of Compressors performance curves, concept of surging
11. Demonstration of utility of Process Simulation Software for fluid flow operations

Savitribai Phule Pune University
SE (Petroleum, Petrochemical and Polymer Engineering)-2015 Course
212384: Particle Technology
Credits: 4+1

Teaching Scheme
Theory: 4 Hrs. /Week
Practical: 2 Hrs. /Week

Examination Scheme
Online: 50 marks
End-Sem: 50 marks
Oral: 50 marks

Prerequisites

First year courses in engineering.

Course Objectives

- To gain basic understanding of properties and behavior of systems containing particulate solids.
- To get acquainted with the major equipment used for solid handling in Petroleum Industry.

Course Outcomes

On completion of the course, the students will be able to

- Demonstrate basic knowledge in particles characterization.
- Apply principles of settling and sedimentation for particle-fluid separation.
- Demonstrate basic understanding of fluid flow through porous medium.
- Classify and make choice from the equipment used for solid handling
- Characterize regimes of fluidization.

Course Contents

Unit I Particle Characterization and Solid Flow (L08)

Single Particles, Measurement of particle size, Screening, Particle size distribution, Mean particle size, Efficiency of separation and grade efficiency.

Particulate Solids in Bulk

General Characterizations, Agglomeration. Resistance to shear and tensile forces, Angles of repose and of friction, Flow of solids in hoppers, Flow of solids through orifices, Measurement and control of solids flow rate, Overview of solid conveyers**.**

Unit II Size Reduction and Enlargements (L08)

Mechanism of size reduction, Energy for size reduction, Methods of operating crushers, Nature of the material to be crushed, Type of Crushing equipment, Coarse crushers, Intermediate crushers, Fine crushers, Specialized applications.

Brief outline of particle size enlargement.

Unit III Settling and Sedimentation in Particle- Fluid Separation (L08)

Theory of motion of particles through fluids, motion under gravitational and centrifugal fields, Terminal settling velocity of particles in a fluid (Stoke's law and Newton's law region and K-criteria for settling), Free settling and hindered settling.

Gravity settling, Centrifugal separation (cyclone separator) and sedimentation: Principles of sedimentation, Kynch theory of sedimentation, Flocculation, Thickener design using Badger Benchero method.

Unit IV Agitation and Mixing (L08)

Agitation and mixing of fluids and solids, Types of mixers, Standard design of mixing vessel, Types of agitators: axial flow impellers and radial flow impellers, Power number and Reynolds number for mixing, Power consumption of agitated vessels, Suspension of solids, The degree of mixing, The rate of mixing.

Unit V Liquid Filtration, Filtration Equipment and Centrifugal Separation (L08)

Filtration Theory, Relation between thickness of cake and volume of filtrate, Flow of liquid through the cloth, Flow of filtrate through the cloth and cake combined. Compressible filter cakes, Filtration Practice, The filter medium, Blocking filtration, Effect of particle sedimentation on filtration, Delayed cake filtration, Preliminary treatment of slurries before filtration, Washing of the filter cake.

Filtration Equipment: Filter selection, Bed filters, Bag filters, The filter press, Pressure leaf filters, Vacuum filters, The tube press.

Basic concepts of centrifugal separator methods.

Unit VI Fluidization (L08)

Fundamentals of fluidization, Types of fluidization, Particulate, bubbling and turbulent fluidization, Minimum fluidizing velocity, Minimum fluidizing velocity in terms of terminal falling velocity, The centrifugal fluidized bed, The spouted bed, Applications of the fluidized solids technique.

Types of conveyors and its applications, Pneumatic conveying.

Books:

1. Richardson J. F. & J. H. Harker; Coulson and Richardson's Chemical Engineering, Vol.2 Particle Technology & Separation Processes; 5/e, Butterworth – Heinemann (2002).
2. McCabe W. L., J. C. Smith & P. Harriot; Unit Operations of Chemical Engineering; 5/e, McGraw-Hill Inc. (1993).
3. Badger W. L. & J. T. Banchero; Introduction to Chemical Engineering; Tata McGraw – Hill Edition (1997).
4. Geankoplis C.J.; Transport Processes and Separation Process Principles, Fourth edition, Eastern Economy Edition (2003).

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The Instructor's manual should include Aim, theory, procedure, fig, observations, calculations and results for every experiment.

Guidelines for Student's Lab Journal

- Students should perform and write the experiment in journal and get checked by the practical in-charge on the same day
- Students should perform experiment individually/or in pair and record the same observations in their journal.
- Presentation in journal should be legible**.**

Guidelines for Lab Assessment

Based on the practicals performed by the students the practical examination will be conducted by S.P.P.U at the end of the semester.

Assignment or practical work write-up should be submitted in the next laboratory session. Assessment should be carried out with grades.

Guidelines for conduct of laboratory course

- Arrangements for the practical should be done prior General laboratory safety instructions should be told to the students.
- Specific chemicals, machinery, hardware handling instructions should be given in the instructions
- Aim and objectives of the practical should be explained.
- After completion of experiment, review the attainment of aim and objectives of the experiment.

Suggested List of Laboratory Assignments/Experiments

Perform minimum three experiments from each group given below. Journal based on the same completed in all respects with index signed and grades given for each experiment should be submitted and presented during the oral examination

Group A

1. To determine particle size distribution for a given sample using standard sieve series.
2. To determine critical speed of ball mill & average particle size of the product obtained in ball mill.
3. To determine settling velocity of solid particles in stagnant fluid (Stoke's Regime).
4. To determine energy consumption for jaw crusher.
5. To determine efficiency of cyclone separator.

Group B

1. To determine coefficient of permeability of the given medium and verify Darcy's law.
2. To determine filter medium resistance and cake resistance by using vacuum leaf filter.
3. To determine area of batch thickener by conducting batch sedimentation test.

4. To determine power consumption in agitated vessel.
5. To determine filter medium resistance and cake resistance by using plate & frame filter press.

Group C

1. To determine minimum fluidization velocity.
2. To determine angles of repose and of friction for a given particulate mass.
3. To validate the equation (for example Brown's equation) for flow of solids through an orifice.
4. To determine mixing index of a mixture in sigma mixer.
5. To work out material balance calculations over a continuous screening equipment using electronic spreadsheet.

Savitribai Phule Pune University
SE (Petroleum, Petrochemical and Polymer Engineering)-2015 Course
212385: Elements of Social Sciences
Credits: 3

Teaching Scheme
Theory: 3 Hrs. /Week

Examination Scheme
Online: 50 marks
End-Sem: 50 marks

Prerequisites

- Knowledge of Social studies at school level.
- Knowledge of societal problems.
- Introductory knowledge of macroeconomics.

Course Objectives

- To get introduced to the concepts of macroeconomics.
- To get acquainted with the contemporary economic perspectives in India.
- To understand the nature of social structure and social change.
- To enhance the perception of human values.

Course Outcomes

On completion of the course, the students will be able to

- Demonstrate understanding of the basic language of economics and sociology
- Demonstrate understanding of relationship between technology and society
- Demonstrate understanding of the significance of "Unity in Diversity"
- Demonstrate understanding of the constructive role of religion in individual and social life.

Course Contents

Unit I Basic Problems of Economic Organization (08)

What is Economics? The Scientific Approach, Pitfalls in Economic Reasoning, The Law of Scarcity, The Uses of Economics.

Basic Problems of Economic Organization

a. The key problems of economic organization. What, how, and for whom? Inputs and Outputs, Market, Command and Mixed Economies.
b. Society's Technological Possibilities. The Production Possibility Frontier, Efficiency, Opportunity cost, The Law of diminishing returns.
c. Features of a modern economy, Specialization, and division of labor, Money; Factors of production (land, labour, capital). Capital and private property.

Unit II Markets and Government in a Modern Economy (L08)

a. How markets solve the basic economic problems

The market mechanism, who governs the market? Prices as signals, market equilibrium, perfect and imperfect competition, Adam Smith's "Invisible Hand Doctrine".

b. The economic role of government.

The three functions of government, Efficiency, Equity, and Stability, Macroeconomic Growth.

Basic Elements of Supply and Demand

Analysis of supply and demand, the demand schedule, Supply schedule. Influences affecting supply and demand curves, Equilibrium of supply and demand, Effect on equilibrium of a shift in supply or demand. Rationing by prices.

Unit III Indian Economy (L08)

A historical perspective on the economic policies implemented in India during the post-independence period to achieve the goals of planned economic development. Monitory and fiscal policies, industrial policy, foreign trade and exchange rate policies, price and wage policies.

Overview of economic reforms introduced after year 1990.

Unit IV Basic Sociology and Indian Context (L08)

Basic Sociology

Civilization, Culture and Society, Cultural diversity and cultural change, Socialization, Individual freedom, Crime and punishment in modern society, Gender and Sexuality, Origins of Sex differences, Gender Socialization, Gender Relations, Feminism, Marriage and family in modern society, Features of modern urbanism, Globalization: its impact on third world in economic, Social and cultural areas, Human rights,

Indian Sociology:

Cultural diversity in India, Bases of secular polity, Problem of communalism, Casteism in India, Social reform and reformers, Census in India, Changing demographic picture. Population advantages and need for control.

Unit V Technology and Society (L08)

Technology and social change, Ecological crisis, Concept of sustainable development, Science and technology policy in India, Nature and impact of IT revolution. Make in India, Skill India (Scope).

Unit VI Religion and Philosophy (L08)

Nature of religion, Functions of religion, Problem of religious fundamentalism, World Religions, Harmonious coexistence of different religious faiths, Vivekananda's views on religion and union of science and religion, Distinctive features of Indian philosophy.

Books:

1. Broom Leonard, Selznic Philip and Dorothy Broom Darroch; Sociology; Harper and Row; (1981).
2. Haralambos Michael; Sociology themes and Perspectives; Oxford University Press; (1980).
3. Samuelson Paul A. and Nordhaus William D.; Economics; McGraw Hill International; (1992).
4. Dutt Ruddar & Sundaram K. P. M.; Indian Economy; S. Chand and Company Ltd., (2009).
5. Radhakrishnan S. and Moore C. A. (Eds); A Source Book in Indian Philosophy; Princeton Univ. Press; (1967).
6. Chatterjee S. and Datta D.; Introduction to Indian Philosophy; University of Calcutta 6th Edition; (1960).

Savitribai Phule Pune University
SE (Petroleum, Petrochemical and Polymer Engineering)-2015 Course
212386: Machine Drawing and Workshop Practices
Credits: 2

Teaching Scheme
Tut./ Drawing: 2 Hrs. /Week

Examination Scheme
Term Work: 50 marks

Prerequisites

Engineering Graphics I and II, Manufacturing Practices.

Course Objectives

To introduce the students basic concepts in engineering drawing and hands on during workshop practices

Course Outcomes

After completion of this course the students should be able to demonstrate

- Understanding of principles of machine drawing and its importance in machine shop operations.
- Understanding of basics of detailed and assembly drawing for various equipment, machine
- Understanding of elements of machine components.
- Familiarity with the software for computer aided drawing of machine equipment and components.
- Familiarity with the workshop tools, fundamental machine shop operations and to learn machining processes on different types of engineering materials.

Course Contents

List of practicals:

Group I: Drawing

1. One drawing sheet of symbols and basic conventions of machine elements, materials and processes as per Indian and International Standards.
2. One drawing sheet of screw threads, screwed fastenings, cotter pin joints, pipe joints, knuckle joint, riveted and welded joints etc. (minimum two views of each component)
3. One drawing sheet on detail parts and their assembly of valves, couplings, clutches, brakes, pulleys, engine parts etc.
4. One drawing sheet based on AutoCAD with all three views for at least two machine elements/components mentioned above.

Group II: Workshop

1. Study of different types of machine tools like lathe, drilling, jig boring, shaper, milling and grinding.
2. One job on lathe with taper turning, thread cutting and drilling.
3. One job on lathe + milling machine – keyway cutting + grinding etc.
4. One job of welding and related processes.
5. One job of pattern making and foundry – one job of non- ferrous material.

Books:

1. S. K. Hajra Choudhary, A. K. Hajra Choudhary; Elements of Workshop Technology; Vol. I: Manufacturing Processes, Vol. II: Machine Tools; Media Promoters and Publisheres Pvt. Ltd.
2. N. D. Bhatt, V. M. Panchal; Machine Drawing; Charotor Publishing House, Anand, India.
3. Narayana K. L, P. Kannaiah, K. and Venkata Reddy; Machine Drawing; New Age International Limited.
4. Goutam Pohit, and Goutam Ghosh; Machine Drawing with AutoCAD, PEARSON Education.

Guidelines for Instructor's Manual

The Instructor’s manual should include Aim, theory, procedure, fig, observations, calculations and results for every experiment.

Guidelines for Student's Lab Journal

The students should drawing during practical in the drawing hall and complete the same during same practical and obtain the sign of the faculty. Neatness in drawing should be maintained.

The students should prepare the job on their own during workshop practices.

Guidelines for Lab Assessment

Termwork should be based on continuous monitoring of students during sessions.

Savitribai Phule Pune University
SE (Petroleum, Petrochemical and Polymer Engineering) - 2015 Course
Audit Course-1: Computational Skills

Teaching Scheme
Assignments

Examination Scheme
Certification

Objectives

- To cover some basic tasks associated with use of spreadsheets in engineering practice.

Contents

Students will write following assignments and submit the same

1. Data table with columns dependent on each other through formulae/functions.
2. Formatting and conditional formatting of cells.
3. Preparation of different types of charts.
4. Regression analysis of given data.
5. Data sorting using advanced filters and data analysis.
6. Solving system of equations using Solver.
7. Recording and creating macros.
8. Linking of data across work sheets.

The students as a part of this audit course will submit assignments based on above work. Successful completion of assignments will allow students to earn basic certification.

Books:

1. Bernard V. Liengme, 2016, A Guide to Microsoft® Excel 2013 for Scientists and Engineers, Elsevier, 363 pp.

Savitribai Phule Pune University
SE (Petroleum, Petrochemical and Polymer Engineering)-2015 Course
207007: Engineering Mathematics-III
Credits: 5

Teaching Scheme
Theory: 4 Hrs. /Week
Tutorial: 1 Hr./Week

Examination Scheme
Online: 50 marks
End- Sem: 50 marks
Term Work: 25 marks

Prerequisites: - Differential and Integral Calculus, Taylor series and Infinite series, Differential equations of first order and first degree, Fourier series, Vector algebra.

Course Objectives:

After completion of the course, student will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Ordinary and partial differential equations applied to Chemical engineering problems, heat and mass transfer.
2. Integral Transforms such as Laplace transform, Fourier transform and applications to ordinary and partial differential equations arising in Vibration theory, Fluid Mechanics, Heat and Mass Transfer and Thermodynamics.
3. Vector differentiation and integration applied to problems in Fluid Mechanics.

Course Outcomes:

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

1. Solve higher order linear differential equations and apply to modeling and analyzing chemical transformation, heat and mass transfer systems.
2. Apply Laplace Transform and Fourier Transform techniques to solve differential equations involved in vibration theory, Liquid level systems and related chemical engineering applications.
3. Perform vector differentiation and integration, analyze the vector fields and apply to fluid mechanics problems.
4. Solve various partial differential equations such as wave equation, one and two dimensional heat flow equations.

Unit I: Linear Differential Equations (LDE) and Applications (09 L)

LDE of n^{th} order with constant coefficients, Method of variation of parameters, Cauchy's & Legendre's DE, Simultaneous & Symmetric simultaneous DE. Applications of LDE to chemical engineering problems and mass spring system.

Unit II: Fourier Transform (FT): (09 L)

Fourier integral theorem. Fourier Sine & Cosine integrals. Fourier Transform, Fourier Cosine Transform, Fourier Sine Transforms and their inverses. Finite FT, Application of FT to problems on one and two dimensional heat flow problems.

Unit III: Laplace Transform (LT) and Applications: (09 L)

Definition of LT, Inverse LT, Properties & theorems, LT of standard functions, LT of some special functions viz. error, First order Bessel's, Periodic, Unit Step, Unit Impulse, ramp, jump, parabolic, Si(t) and Ei(t).

Applications of LT for solving ordinary differential equations, liquid level systems, consisting of single tank and two tanks in series (interacting and non-interacting systems), second order systems (damped vibrator).

Unit IV: Vector Differential Calculus (09 L)

Physical interpretation of Vector differentiation. Radial, Transverse, Tangential & Normal components of velocity and acceleration. Vector differential operator, Gradient, Divergence & Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities.

Unit V: Vector Integral Calculus and Applications (09L)

Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem.

Applications of vectors to problems in Fluid Mechanics, Continuity equations, Stream lines, Equations of motion, Bernoulli's equations.

Unit VI: Applications of Partial Differential Equations (PDE) (09 L)

Basic concepts, modeling of Vibrating string, Wave equation, one and two dimensional Heat flow equations, method of separation of variables, use of Fourier series. Applications of PDE to problems of Chemical and allied engineering.

Text Books:

1. Advanced Engineering Mathematics, 9e, by Erwin Kreyszig (Wiley India).
2. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil (Cengage Learning).

Reference Books:

1. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).
2. Advanced Engineering Mathematics, Wylie C.R. & Barrett L.C. (McGraw-Hill, Inc.)
3. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).
4. Applied Mathematics (Volumes I and II) by P. N. Wartikar & J. N. Wartikar (Pune Vidyarthi Griha Prakashan, Pune).
5. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
6. Advanced Engineering Mathematics with MATLAB, 2e, by Thomas L. Harman, James Dabney and Norman Richert (Brooks/Cole, Thomson Learning).

Guidelines for Tutorial and Term Work:

i) Tutorial shall be engaged in four batches (batch size of 20 students maximum) per division.

ii) Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.

Savitribai Phule Pune University
SE (Petroleum, Petrochemical and Polymer Engineering)-2015 Course
212388: Engineering Chemistry-II
Credits: 4+1

Teaching Scheme
Theory: 4 Hrs. /Week
Tutorial: 2 Hrs. /Week

Examination Scheme
Online: 50 marks
End-Sem: 50 marks
Practical: 50 marks

Prerequisites

Knowledge of fundamental chemistry up to XII standard, first year engineering chemistry and Engineering Chemistry-I course second year first semester.

Course Objectives

- To study fundamentals of Organic, Analytical and Physical Chemistry.
- To learn identification and synthetic techniques and its relevance to different processes in Polymer, Petroleum and Petrochemical Industry

Course Outcomes

On completion of the course, the students will be able to

- Demonstrate knowledge of common methods of functional group inter conversions.
- Demonstrate understanding of three dimensional shapes of organic compounds.
- Analyze kinetic data and to predict performance of batch reaction using rate law.
- Demonstrate knowledge of different analytical techniques of identification and separation of chemical compounds.
- Demonstrate knowledge of characterization of air and water pollution
- Demonstrate knowledge of different routes of conversion of biomass into heat, power and fuels.

Course Contents

Unit I Functional Group Conversions (L08)

Definition of functional group, functional group interconversions and common methods for synthesis of carboxylic acids and their derivatives, nitriles, aldehydes, ketones, amines, alcohols, phenols, alkyl halides, ethers, alkanes, alkenes and alkynes.

Unit II Stereochemistry (L08)

Basic concepts of stereochemistry, conformation isomerism of ethane, propane, butane, cyclohexane, mono substituted cyclohexane; monosaccharide (glucose and fructose) disaccharides (sucrose and maltose) polysaccharides (starch and cellulose). Optical isomerism with one and two chiral centers (AA and AB type), enantiomers, threo, erythro, meso, distereo isomers. Geometrical isomerism (cis, trans and E, Z). tacticity in polymers.

Unit III Chemical Kinetics (L08)

Order, molecularity, rate law, integral rate equation, method of determination of order of reaction (first, second, third and zero order reactions), half-life, theories of reaction rates, numerical based on above.

Unit IV Analytical Chemistry (L08)

Paper, Column, T. L. C.and G.C. applications. Thermal analysis –Thermogravimetry (TGA), differential thermal analysis (DTA), and differential scanning calorimetry (DSC), principles, method, applications. Spectroscopy –A.A.S., Instrumentation and applications

Unit V Environmental Chemistry (L08)

Air pollution: Introduction, primary pollutants, basic reactions involved in their formation, sources, sinks and control, acid rain, control of gaseous pollutants from industry, mobile sources and particulate emission. Effects of atmospheric pollution. Water pollution: Introduction, sources and causes, types of pollutants, waste water treatment, domestic water treatment, dissolved substances and dissolved gases, D.O., BOD and COD, water pollution control, Effects of water pollution.

Unit VI Biomass Conversion (L08)

Biomass potential of India and world. Main conversion routes for production of heat, power, and transport fuels from biomass. Thermochemical conversion: Combustion, Gasification, Cogeneration, Pyrolysis, and Hydrothermal Liquefaction. Biochemical conversion: Biogas from Anaerobic Digestion, Bioethanol from Fermentation. Chemical conversion: Trans-esterification of vegetable oil to produce biodiesel. Concept of Bio-refinery**.**

Books

1. Morrison R.T. and Boyd R.N., 2011, Organic Chemistry, Prentice Hall of India Ltd.
2. Glasstone Samuel, 1981, Textbook of Physical chemistry.
3. Sykes Peter, 2003, A Guide Book to Mechanism in Organic Chemistry, Pearson.
4. Hoffman Robert V., 1997, Organic Chemistry – An Intermediate Text; Oxford University Press.
5. Wiebren de Jong and J. Ruud van Ommen (Eds.),2015, Biomass as a sustainable energy source for the future: fundamentals of conversion processes, John Wiley & Sons Inc
6. Balram Pani, 2007, Textbook of Environmental Chemistry, I K International Pvt Ltd.

Guidelines for Instructor's Manual

The Instructor’s manual should include Aim, theory, procedure, fig, observations, calculations and results for every experiment.

Guidelines for Student's Lab Journal

- Students should perform and write the experiment in journal and get checked by the practical in-charge on the same day

- Students should perform experiment individually/or in pair and record the same observations in their journal.
- Presentation in journal should be legible.

Guidelines for Lab Assessment

Based on the practicals performed by the students the practical examination will be conducted by S.P.P.U at the end of the semester.

Guidelines for conduct of practical course

- The theory of the respective practical should be explained by the practical in-charge.
- The practical should be demonstrated to the students.
- Laboratory experiments should be conducted under the guidance of practical in-charge.
- Practical in-charge should monitor the results and assess the journal regularly.
- Suggested List of Laboratory Assignments

Group A, Any six organic compounds from following list,

Organic qualitative analysis - Preliminary tests, type, elements, functional group and physical constants - at least one compound from each type

1. Acids – benzoic acid, salicylic acid, phthalic acid, oxalic acid, acetic acid cinnamic acid p-nitrobenzoic acid.
2. Phenols - α naphthol, β naphthol, resorcinol, o- nitrophenol, p-nitrophenol, p-cresol, phenol.
3. Bases – Aniline, p-toludine, diphenylamine
4. Neutral – Benzaldehyde, glucose, acetone, ethyl methyl ketone, benzophenone, methyl acetate, ethyl acetate, naphthalene, nitrobenzene, urea, thiourea

Group B, Any three experiments from following list,

1. To determine of rate constant of hydrolysis of methyl acetate by dilute HCl and to show that it is a first order reaction.
2. To determine the rate constant of hydrolysis of ethyl acetate by NaOH (saponification) and to show that it is a second order reaction.
3. Identification of metal ions by paper chromatography
4. Biodiesel preparation from a vegetable oil
5. Determination of oxygen dissolved in water.

Group C, Demonstration experiments (any one),

1. BOD and COD of a waste water
2. Biomass Gasification/Pyrolysis

Savitribai Phule Pune University
SE (Petroleum, Petrochemical and Polymer Engineering)-2015 Course
212389: Heat Transfer
Credits: 4+1

Teaching Scheme
Theory: 4 Hrs. /Week
Practical: 2 Hrs. /Week

Examination Scheme
Online: 50 marks
End-Sem: 50 marks
Oral: 50 marks

Prerequisites

Physics, Engineering Mathematics-I and II, Momentum Transfer

Course Objectives:

1. To study various modes of heat transfer and the laws governing them.
2. To study basic principles of condensation and boiling and understand their applications.
3. To be able to classify, select and understand the types of process design aspects for heat exchanger, evaporators and fins and predict their performance.

Course Outcomes

On completion of the course, the students will be able to

1. Apply knowledge of basic physics and mathematics involved in three modes of heat transfer and their applications.
2. Identify, formulate and solve engineering problems related to heat transfer.
3. Identify heat exchange equipment appropriate for a given task and design the same.

Course contents

Unit I Conduction (L08)

Heat transfer modes, laws; General Differential equation; Steady state problems in plane and composite systems; Thermal resistance; Insulation and critical radius; Unsteady state heat conduction; Extended surfaces as Fins.

Unit II Convection (L08)

Principles, Dimensional analysis of Heat Transfer by Natural Convection
Heat balance Equation in laminar flow; Natural convection heat transfer from plate and cylinder.

Principles, Dimensional analysis of Heat Transfer by Forced Convection
Laminar and Turbulent Boundary layers; Laminar and turbulent flow heat transfer in a circular pipe. Dimensionless groups in heat transfer.

Unit III Radiation (L08)

Basic concepts; Emission characteristics and laws of black body radiation; Radiation incident on a surface; Solid angle and radiation intensity; Heat exchange by radiation between two black surface elements; Heat exchange by radiation between two finite black surfaces; The shape factor; Radiation shields, Introduction to different solar energy transmitting systems**.**

Unit IV Heat Exchangers (L08)

Basic types of heat exchangers; Flow arrangements; Overall heat transfer coefficient and fouling factor calculations; Analysis of Heat Exchangers; Mean temperature difference; Effectiveness – NTU Method; Constructional features of shell and tube heat exchangers, TEMA standards in heat exchangers.

Unit V Phase Change Heat Transfer (L08)

Types of condensation; Drop and Film condensation on a vertical plate, vertical tube and horizontal tubes; Effect of superheated vapor and non-condensable gases; Types of boiling; Pool and Forced Convection boiling; Boiling curve; Simplified relations for boiling heat transfer with water; Critical Flux; The concept of heat pipe.

Unit VI Evaporators (L08)

Boiling point elevation, Types of evaporators; Design of Single and multiple effect evaporators, Capacity, Economy, Material balance, Energy balance.

Books

1. Sukhatme S. P., 2005, Heat Transfer, 4th Edition; University Press (India) Private Limited.
2. Holman J. P., 2002, Heat Transfer, 9th Edition; Tata McGraw-Hill.
3. Eduardo Cao, 2010, Heat Transfer in Process Engineering, McGraw-Hill.
4. Kern D. Q., 1997, Process Heat Transfer; McGraw Hill.
5. McCabe W. L., J. C. Smith and P. Herriot, 2005, Unit Operations of Chemical Engineering, 7th Edition, McGraw Hill.

Guidelines for Instructor's Manual

The Instructor’s manual should include Aim, theory, procedure, fig, observations, calculations and results for every experiment.

Guidelines for Student's Lab Journal

- Students should perform and write the experiment in journal and get checked by the practical in-charge on the same day
- Students should perform experiment individually/or in pair and record observations in their journal.
- Presentation in journal should be legible**.**

Guidelines for Lab Assessment

Based on the practical performed by the students the practical examination will be conducted by S.P.P.U at the end of the semester.

Guidelines for conducting practical course

- The theory of the respective practical should be explained by the practical in-charge.
- The student should observe the safety precautions.
- Laboratory experiments should be conducted under the guidance of practical in-charge.
- Practical in-charge should monitor the results and assess the journal regularly.

Suggested List of Laboratory Assignments

- Study of Multiple effect evaporators.
- Study of design of Heat Exchanger by using TEMA Standards.

List of Laboratory experiments

Perform minimum ten experiments from the list given below. Journal based on the same completed in all respects with index signed and grades given for each experiment should be submitted and presented during the oral examination.

1 To determine thermal conductivity of a metal bar.
2 To determine thermal conductivity of a liquid.
3 To determine critical radius of an insulating material.
4 Study of an unsteady-state heat transfer.
5 To determine efficiency of a Pin Fin.
6 To determine the emissivity of a test plate.
7 To determine heat transfer coefficient in forced convection.
8 To determine heat transfer coefficient in natural convection.
9 To determine heat transfer coefficient in Double Pipe Heat Exchanger.
10 To determine overall heat transfer coefficient (U) for Shell and Tube Heat Exchanger.
11 To determine overall heat transfer coefficient and effectiveness of a plate type heat exchanger.
12 To study heat transfer in a heat pipe.
13 To determine heat transfer coefficient for two phase heat transfer.
14 Simulation studies and design of a Shell and Tube Heat Exchanger using HTRI.

Savitribai Phule Pune University
SE (Petroleum, Petrochemical and Polymer Engineering)-2015 Course
212390: Process Calculations
Credits: 3+1

Teaching Scheme
Theory: 3 Hrs. /Week
Practical: 2 Hrs. /Week

Examination Scheme
Online: 50 marks
End Sem: 50 marks
Term Work: 25 marks

Prerequisites

Basics Mathematics, Applied Sciences, Momentum Transfer

Course Objective

To understand and apply fundamentals of mass and energy balance to processes.

Course Outcomes

On completion of the course, learner will be able to

- Perform material and energy balances for a given unit operation or process
- Carry out degrees of freedom analysis
- Calculate utility requirements of a process
- Use modern software tools to solve material and energy balance problems

Course contents

Unit I Units and Conversions (L06)

Units, Conversions: Units and Dimensions, Conversion of units. Basic process variables: Mass. Volume. Flow rate, Chemical composition: Volume, Mass and mole fractions. Wet basis and dry basis, Average molecular weight, specific gravity, API gravity, Behavior of gases: Ideal and Van der Waal Gases. Specific volume of gas mixtures.

Unit II Material Balance on Non-reacting Systems (L06)

Overall and Component balances. Steady state and unsteady state Processes. Degrees of Freedom analysis for given process unit. Material balance on non-reacting systems. Calculations for Absorber- Stripper, Extraction- Distillation.

Unit III Material Balance on Reacting Systems (L06)

Introduction to Stoichiometry, molar table for converter, Balances on reacting systems. Limiting and excess reactants. Fractional conversion. Extent of reaction. Multiple reactions. Yield and selectivity. Mass balances in combustion operation.

Unit IV Energy Balance on Non-reactive Systems (L06)

Energy balance for open systems, enthalpy calculations, heat capacities of solid, liquid and gases, sensible and latent heats, enthalpy change for gaseous and liquid streams, energy balance for phase change processes such as condensation and boiling, heat of mixing.

Unit V Energy Balance on Reactive Systems (L06)

Heat effects accompanying chemical reactions, Hess's law, Standard heat of reaction, combustion and formation, Effect of temperature on standard heat of reaction, Adiabatic reaction temperature, Heat load and utility calculations for non-adiabatic operations, Energy balances in combustion operation.

Unit VI Recycle, Bypass, Purge Calculations (L06)

Material and Energy balances on Recycle, Bypass and Purge operations for non-reactive and reactive systems containing multiple units.

Books

1. Bhat B. I. and Vora; Stoichiometry; 2/e, Tata McGraw Hill; (2000).
2. Himmelblau D. M.; Basic Principles and Calculations in Chemical Engineering; 6/e, Prentice-Hall, India, (1996).
3. Narayanan K.V.and.Lakshmikutty B; Stoichiometry and Process Calculations; 1/e, Prentice-Hall, India, (2006).
4. Felder R. M. and R. W. Rousseau; Elementary Principles of Chemical Processes; 3/e, John Wiley and Sons; (2000).
5. Hougen O. A., K. M. Waston & R. A. Ragatz; Chemical Process Principles Part-I, Material and Energy Balances; Asia Publishing House, Mumbai; (1995).

Guidelines for Instructor's Manual

The Instructor's manual should include Aim, theory, procedure, fig, observations, calculations and results for every experiment.

Guidelines for Student's Lab Journal

Laboratory journal should be completed on regular basis. Index, illustrations should be properly written. Assignments given over and above the practical topics should also be attached in the journal.

Presentation in the journal should be neat.

Guidelines for Lab /TW Assessment

Assignment or practical work write-up should be submitted in the next laboratory session. Assessment should be carried out with grades.

Guidelines for conducting the practical course

Arrangements for the practical should be done prior General laboratory safety instructions should be told to the students.

Specific chemicals, machinery, hardware handling instructions should be given in the instructions

Aim and objectives of the practical should be explained.

After completion of experiment, review the attainment of aim and objectives of the experiment.

Suggested List of Laboratory Assignments

First 6 Assignments shall include manual calculations, spread sheets and a process simulation in any process design software such as ASPEN-HYSYS etc., on any ONE of the following exercises

1. Specific volume of a hydrocarbon gas mixture
2. Molar table for a converter
3. Single phase stream heating / cooling duty calculation
4. Heating duty for a phase change equipment
5. Non-adiabatic reactor calculations
6. Adiabatic reaction temperature calculations
7. Recycle purge calculations with and without reaction
8. Steam and other utility calculations
9. Simple process plant based mass and energy balance

Savitribai Phule Pune University
SE (Petroleum, Petrochemical and Polymer Engineering)-2015 Course
212391: Chemical Engineering Thermodynamics
Credits: 3+1

Teaching Scheme
Theory: 3 Hrs. /Week
Practical: 2 Hrs. /Week

Examination Scheme
Online: 50 marks
End-Sem:50 marks
Term Work: 50 marks

Prerequisites

Knowledge of Elements of Mechanical Engineering, Momentum Transfer, Engineering Mathematics, Physics and Chemistry

Course Objectives

- To be able to calculate heat and work effects associated with a process.
- To learn to predict and correlate important thermodynamic properties.
- To learn the basics of solution thermodynamics

Course Outcomes

On completion of the course, the students will be able to

1. Apply the laws of thermodynamics
2. Apply appropriate equation of state for representing the PVT behavior of fluids.
3. Calculate the various thermodynamic properties of the fluids in the absence of experimental data.
4. Demonstrate the knowledge of various thermodynamic cycles
5. Distinguish between ideal and non-ideal solutions

Course Contents

Unit I First Law (L06)

The scope of thermodynamics, fundamental and derived quantities, first law of thermodynamics: Formulation of 1st law of thermodynamics, state and path functions, thermodynamic systems, steady state flow system, phase rule, reversible process, heat capacity.

Unit II Volumetric Properties of Pure Fluids (L06)

The P-V-T behavior of pure substance, the viral equation, the ideal gas, the constant volume, constant pressure, adiabatic, polytrophic processes, real gas, applications of Viral equation, critical properties, Van der Waal equation, Benedict- Webb – Rubin equation, Redlich – Kwong equation.

Unit III the Second Law (L06)

Limitations of First Law, Statements of second law, analysis of Carnot cycle, ideal and actual engine efficiencies, Concept of entropy and derivation from second law, mathematical statement of 2nd law, statement of 3rd law.

Unit IV Thermodynamic Cycles (L06)

Various thermodynamic cycles, power cycles with external combustion or heat pump cycles, power cycles with internal combustion, Refrigeration cycle (p-v, t-s, h-s, and h-x diagrams) for Vapor Compression and Absorption refrigeration systems, Evaluation of COP, liquefaction**.**

Unit V Thermodynamic Properties of Fluids (L06)

Fundamental property relations for closed systems, Maxwell relationships, residual properties, residual properties by equations of state, two-phase systems, Clausius- Clapeyron equation, thermodynamic diagrams, Concept of Availability.

Unit VI Solution Thermodynamics (L06)

Fundamental Property Relation, The Chemical Potential and Phase Equilibria, Partial Molar Properties, Ideal-Gas Mixtures, Fugacity and Fugacity Coefficient: Pure Species and Species in Solution, The Ideal Solution, and Excess Properties.

Books:

1. Smith, J. M. and Van Ness H. C.., 'Introduction to Chemical Engineering Thermodynamics', McGraw-Hill, 1996.
2. Narayanan, K.V., 'A Textbook on Chemical Engineering Thermodynamics', Prentice Hall of India Ltd, 2013
3. Rao, Y.V.C., 'An Introduction to Thermodynamics', University Press (India) Pvt. Ltd., 2004
4. Vidal Jean, 'Thermodynamics: Applications in Chemical Engineering and Petroleum Industry', Editions Technip, 2003.

Guidelines for Instructor's Manual

The Instructor's manual should include Aim, theory, procedure, fig, observations, calculations and results for every experiment.

Guidelines for Student's Lab Journal

Laboratory journal should be completed on regular basis. Index, illustrations should be properly written. Assignments given over and above the practical topics should also be attached in the journal. Presentation in the journal should be neat.

Guidelines for Lab /TW Assessment

Assignment or practical work write-up should be submitted in the next laboratory session. Assessment should be carried out with grades.

Guidelines for conducting the practical course

Arrangements for the practical should be done prior General laboratory safety instructions should be told to the students.

Specific chemicals, machinery, hardware handling instructions should be given in the instructions

Aim and objectives of the practical should be explained.

After completion of experiment, review the attainment of aim and objectives of the experiment.

Suggested List of Laboratory Assignments/experiments

Perform minimum six experiments from the list given below. Journal based on the same completed in all respects with index signed and grades given for each experiment should be submitted.

1. Experiment based on Heat and Work Effects
2. Energy Balance over Boiler
3. Study of Refrigeration Unit
4. Joule Thomson Coefficient Experiment
5. Study of Compressor Characteristics
6. HVAC demonstration
7. Experiment on VLE for an ideal system
8. Determination of Partial Molar Enthalpies by Adiabatic Calorimetry
9. Spread sheet computation and graphical analysis of properties (P,T,V,U,H,S) of closed system ideal gas cycles

Savitribai Phule Pune University
SE (Petroleum, Petrochemical and Polymer Engineering)-2015 Course
212392: Technical Communication
Credits: 1

Teaching Scheme
Practical: 2 Hrs. /Week

Examination Scheme
Oral: 25 marks

Objectives:

- To appreciate and understand the factors to be considered in a technical communication.
- To learn the techniques of better technical communication.
- To learn to use appropriate style in English.
- To practice skills of communication in front of varied audience**.**

Course Outcomes

At the end of this course the student will be able to

- Develop the ability to communicate effectively using suitable styles and techniques
- Present technical material orally and using audio-visual way with confidence and poise
- Perform well during GDs, Presentations, and Interviews
- Communicate technical material to a variety of audiences
- Work well in teams and understand lifelong learning concepts

Term Work

Term work and theory are considered as an integral part of the course. Term work shall consist of a journal containing regular assignments and presentations completed in the practical class and at home. As far as possible, submission should be word processed on computer using standard package by the student himself. For the purpose of assignments, extensive use of research papers published in technical journals and articles published in magazines and newspapers may be made so that there is no repetition by individuals. Oral presentation exercises and group discussions should be conducted batch wise so that there is a closer interaction.

The total number of assignments should not be less than ten, generally covering the topics mentioned below. All students should submit a journal as a part of Term work and oral examination will be based on assignment performed in the journal.

List of Assignments

1. Formal speech and manuscript submission on following topics; a. About myself b**.** Problems faced while communicating, and c. Contemporary issues
2. Writing of Résumé/Biodata/CV
3. Writing of Statement Of Purpose (SOP)

4. Writing report on any topic with executive summary.
5. Ethical issues in technical writing
6. Research paper comprehension and writing
7. Précis writing
8. Group discussions on current topics
9. Power Point Presentation
10. Games on team building
11. E-mail writing etiquettes
12. Holding a webinar/communication using podcast
13. Collaborative content creation using Wiki
14. Blog writing
15. Writing instruction manual

Books

1. Pravil S. R. Bhatia, “Professional Communication Skills”, S. Chand and Co., New Delhi, 2000
2. Sunita Mishra, C. Muralikrishna, “Communication Skills for Engineers”, Pearson Education, 2003
3. Krisna Mohan and Banerji Meera; Developing Communication Skills; Macmillan India Ltd.; (1996).
4. Rutherford A. J.; Basic Communication Skills for Technology; Pearson Education; Inc.; (2000).

Savitribai Phule Pune University
SE (Petroleum, Petrochemical and Polymer Engineering)-2015 Course
212393: Electrical and Electronics Engineering
Credits: 1

Teaching Scheme
Practical: 2 Hrs. /Week

Examination Scheme
Term Work: 50 marks

Course Outcomes

At the end of this course the student will be able to demonstrate

- Familiarity with Electrical and Electronics systems.
- Knowledge about motor characteristics.
- Knowledge about electrical and electronic starters for ac and dc motors.
- Knowledge about generation of power.

Unit I: 3-Phase Circuits (L02)

Measurement of power in 3-phase circuits using 2-wattmeter method for balanced star and delta loads;
Measurement of reactive power using one-wattmeter method.

Unit II DC Motors (L02)

Principle of working, construction, types, characteristics, starters, Methods of speed control, applications.

Unit III Induction Motors (L02)

a) 3-phase: Rotating Magnetic Field, Slip, and Torque slip, Characteristics, Starters and Applications.
b) Single phase: Types, Starting methods, Applications.

Unit IV Alternators (L03)

Principles of operation, definition of regulation and efficiency. Converters and Invertors.

Unit V Industrial Electronics Devices and Applications (L03)

SCR, Triac, Power MOSFET, IGBT, Characteristics and Simple applications like Controlled Rectifiers, Study of UPS, Light Dimmers, Fan Regulators (Only Block Diagram).

Unit VI Controllers, Transducers and Sensors (L03)

AC / DC / Stepper Motor Controllers, Transducers for Temperature, Pressure, Displacement, Level, Photo Sensors, Actuators.

Note
The term work shall consist of a record of the following experiments performed.

List of Practicals

1. Measurement of power in three-phase circuit by two wattmeter methods.
2. Measurements of reactive power in three phase circuit using one wattmeter method.
3. Brake Test on D.C. shunt motor.
4. Load test on D.C. series Motor.
5. Speed variation of D.C. shunt motor using armature voltage and field current control.
6. Load Test on three phase Induction Motor.
7. Study of single-phase induction motors.
8. Study of starters for (a) D.C.Motors (b) 3-phase Induction Motors

Books

1. Hughes Edward; Electrical Technology, 5th Edition; English Language Book Society; (1982)
2. Taylor E. O.; Utilization of Electric Energy; Orient Longman Pvt. Ltd.; (1983.)
3. Cotton H.; Electrical Technology; CBS; (1999.)
4. Liptak, Bela, Instrument Engineers Hand Book Vol-I &Vol-II, CRC Press, (2012)
5. Krishna Kant , Computer Based Industrial Control, Prentice Hall of India, (1997)

Savitribai Phule Pune University
SE (Petroleum, Petrochemical and Polymer Engineering)-2015 Course
Audit Course-2: Awareness related to Petroleum/ Petrochemical/ Polymer Industry

Teaching Scheme	**Examination Scheme**
Assignments	Certification

Objectives:

1. To understand the vertically integrated structure of Petroleum Industry.
2. To familiarize with key areas of study in upstream, midstream and downstream industry.

Student will submit six assignments based on the themes grouped as A, B and C. Every student will submit at least one assignment from each of the three groups A, B, and C. Successful completion of assignments will allow students to earn basic certification.

GROUP A

1. The international energy scene and the global economic environment
2. Worldwide distribution of oil and gas reserves
3. Conventional and the challenge of changing resources into reserves
4. Reserve estimate and development strategy of an oil or gas field
5. Review drilling operations, well architecture and equipment.
6. Challenges of designing surface facilities
7. Environmental aspects in Drilling, Production, Refining Operations and Petrochemicals
8. Natural gas: processing, storage, and specification.

GROUP B

1. Overview of Chemical, Petrochemical and Polymer Industry
2. Refinery Process Flow
3. Fuel Products : New BS/Euro Specifications
4. Capacities and locations of India's major refineries.
5. Alternative feedstocks for Energy and Petrochemicals
6. Challenges of greenhouse gas (GHG) emissions
7. Value chain in hydrocarbon sector: from bulk chemicals to polymers/fertilizers/fine chemical intermediates

GROUP C

1. Overview of polymer industry : commodity and engineering plastics
2. Recycling of Polymers/Plastics
3. Methods of Polymerization
4. New Age Polymers.
5. Properties and Applications of polymeric materials in various fields.
6. Overview of the major polymer processing operations leading to consumer end products
7. Bio-polymers