7PC1 REFINERY ENGINEERING DESIGN

B.Tech. (Petrochemical) VII Semester **Max. Marks: 80**

Exam Hours: 3

Unit	Contents	Contact Hours
I	**Overview of Refinery:-**Global and Indian Refining Industry, Refinery configurations, ASTM Distillation TBP Distillation, EFV distillation. Analysis of c rude petroleum and its fractions.	**4**
	Different types of Boiling point, VABP, WABP, MABP, MeBP, CABP Computation of the curves , Calculation of ASTM temperature to TBP and EFV temperature,Average boiling points, Separation criteria in crude oil fractionation. Calculation for characterizing crude oil.	**4**
II	**Atmospheric distillation:-** Atmospheric distillation tower, types of refluxes, pump around reflux pump back reflux top tray reflux,converting crude TBP to product TBP curves, concept of overflash.	**4**
	Energy balance in a topping tower and calculations involve estimation of top, side, bottom draw tray temperatures. Calculation of side steam strippers.	**4**
III	**Vacuum distillation:-** Vacuum distillation tower, type of operations, Lube type Vacuum tower with pump back and pump around reflux heat removal.	**4**
	Lube or special vacuum distillation operation economic consideration in Vacuum Tower.	**4**
IV	**Fired Heater:-** Types of fired heaters, Horizontal Types,Vertical Types, Codes and standards Burner, Gas burner Oil burner combination burners burner.	**4**
	Preparing refractories for operation stacks emissions Basic constructional features of furnace, Different furnace types.	**4**
V	Heat exchanger in refinery, and operational problems,General considerations Choice of tube side versus shell side.	**4**
	Fluid mechanics and refinery applications,Types of heat exchangers used in refinery, Heat exchanger analysis.	**4**
	TOTAL	**40**

Text Book:

1. R.N. Watkin, Petroleum Refinery Distillation, 2/e Gulf Publishing Co, Houstan, Texas, USA, 1981.

Reference Books:

1. B.K Bhaskar Rao, Modern Petroleum Refining Processes, 3/e, Oxford n & IBH Publishing Co Pvt. Ltd., 1997.
2. Wayne C. Edmister, Applied Hydrocarbon Thermodynamics, 2/e, Gulf Publishing Co., 1988.
3. Van Winkle M., “Distillation”, McGraw Hill, 1967
4. Sinnott R. K., “Coulson and Richardson’s Chemical engineering”, Vol. 6, Third Edition, Butter Worth-Heinemann, 1999.
5. Kern D. Q., “Process Heat Transfer”, McGraw Hill, 1965.

7PC2 PROCESS MODELLING AND SIMULATION

B.Tech. (Petrochemical) VII Semester **Max. Marks: 80**
Exam Hours:3

Unit	Contents	Contact Hours
I	**The role of analysis:** Chemical engineering problems, basic concepts of analysis; the analysis process, simple example of estimating an order, source of the model equations.	4
	Conservation equations, constitutive equations, control volumes, dimensional analysis, system of units, dimensional consistency in mathematical descriptions, dimensional analysis and Constitutive relationships, final observations.	4
II	**Non-Reacting Liquid Systems:** Introduction, equation of continuity, simple mass balance, application of the model equations, component mass balances.	4
	Model behaviour: Steady state behaviour, un-steady state behaviour, density assumption, numerical integration methods of ordinary differential equation.	4
III	**Reacting Liquid Systems:** Introduction, basic model equations for a tank-type reactor, reaction rate, batch reactor, pseudo first-order reactions, reversible reactions, multiple reactions.	4
	Consecutive reactions, parallel reactions, complex reactions, constant density assumption, order and stoichiometry.	4
IV	**Treatment of experimental data:** Introduction, criteria for Best Fit, Best Slope-I, Best straight line.	4
	Fitting a quadratic, simulation examples of gravity fluid flow, heat and mass transfer.	4
V	Dynamic modelling of simple processes, sequential, simultaneous modular and equation oriented approaches.	4
	Computer programming of various iterative convergence methods such as Newton- Ralphson, false position, Muller methods.	4
	TOTAL	**40**

Text Book:

1. Russell TWF; Introduction to Chemical Engineering Analysis - John Wiley & Sons

Reference Books:

1. Luyben W.L; Process Modelling, Simulation and Control for Chemical Engineers; TMH
2. Jana; Chemical Process Modelling and Computer Simulation; PHI Learning

7PC3 TRANSPORT PHENOMENA

B.Tech. (Petrochemical) VII Semester **Max. Marks: 80**
Hours: 3

Unit	Contents	Contact Hours
I	Similarity in momentum, heat and mass-transport - Newton's laws of viscosity.	**4**
	Fourier's laws of conduction and Fick's laws of diffusion, Flux-transport property relationships.	**4**
II	Estimation of transport properties measurement and correlations, velocity distribution in Laminar flow of falling film.	**4**
	Flow over an inclined plane, a circular tube an annulus and between two parallel plates.	**4**
III	Shell balance approach for developing equations of change for momentum, heat andmass transport.	**4**
	Shell balance approach for developing equations of change for momentum, heat and mass transport.	**4**
IV	Transport equations in turbulent flow and equations for turbulent fluxes.	**3**
	Velocity, Temperature and concentration profiles for laminar and turbulent flow conditions.	**2**
	Temperature and concentration profiles for conductive and convective transport in solids and fluids.	**3**
V	Macroscopic momentum and heat balance equations, Kinetic energy calculations.	**4**
	Constant area and variable area flow problems.	**2**
	Flow through bends, time determination for emptying of vessels.	**2**
	TOTAL	**40**

Text Book:

1. Bird R.B., Stewart W.E. and Lightfoot EW; Transport phenomena; Wiley tappon

Reference Books:

2. Brodkey RS and Hershey -Transport phenomena a unified approach; TMH
3. Geancoplis; Transport processes & separation process principles; PHI learning.

7 PC4 PIPELINE ENGINEERING

Common with Petroleum Engineering 7PE4

B.Tech. (Petrochemical) VII Semester **Max. Marks: 80**

Exam Hours: 3

Unit	Contents	Contact Hours
I	Objective and scope of pipeline as a means of fluid transportation with special reference to crude oil/gas/refined products.	**2**
	Design of Pipeline:Factors influencing oil, gas and refined products as pipeline design.	**3**
	Hydraulic surge and water hammer; specific heat of liquids; river crossing; pipe size and station spacing etc.	**3**
II	Theory and different formulae of the flow of fluids in oil/gas pipelines; basic equations for the flow of fluids through pipes; different flow equations for laminar and turbulent flow of compressible and incompressible fluids.	**4**
	Introduction to the flow of Non- newtonian fluids through pipes; multiphase flow and loop pipelines.	**4**
III	Construction of pipelines;materials; project specifications; general equipment specifications (Pipes, valves and fittings); Installation of expansion loops and thermodymetric tapping plant.	**4**
	Pigging: pigging technology, pig launcher and receiver, intelligent pigging, types of pigs.	**4**
IV	Offshore Pipeline:design and control of Sag and Over bend; description of stinger and riser.	**4**
	Articulated stinger, construction of offshore pipeline; method of underwater welding.	**4**
V	Prevention of hydrates, wax & scales. Crude conditioning and use of additives to improve flow conditions.	**3**
	Corrosion protection and control; design of cathodic protection system, pipeline automation.	**2**
	City distribution network of oil/gas. Lease and custody transfer.	**3**
	TOTAL	**40**

Text Book:

1. Piping design handbook: Macetta.John, M dekar1992

Reference Books:

1. Pipline & risers : Young Boi ,Elsevier Ocean Engineering Book series 2001Volume 3
2. Pipe Line Corrosion, Cathodic Protection: Parker M E and Peattie E G , Elsevier USA 2001

7PC5 PROCESS DYNAMICS AND CONTROL

Common with Petroleum Engineering 7PE6.2
B.Tech. (Petrochemical) VII Semester **Max. Marks: 80**
Exam Hours: 3

Unit	Contents	Contact Hours
I	**First–order Systems:**Introduction, Linear Open-Loop Systems, Transfer Function, Transient response (step response, impulse response, and sinusoidal response)	3
	Examples of first – order systems, response of first order systems in series.Non-interacting systems and interacting systems.	2
	Second-order systems: Transfer function, step response, impulse response, k sinusoidal response, transportation lag.	3
II	**Linear closed-loop Systems:** Control System: components of a control system block diagram.	4
	Negative feedback and positive feedback, servo problem and regulator problem.	4
III	**Closed-Loop Transfer functions:** Overall transfer function for single-loop systems, overall transfer function for set-point change and load change, multi-loop control systems.	4
	Transient Response of simple control systems: P and PI control for set-point change and for load change.	4
IV	**Controller and final control element:** Mechanism of control valve and controller, transfer functions of control valve and controllers (P, PI, PD, and PID).	4
	Examples of a chemical reactor control system.	4
V	**Stability:** Concept of Stability, Stability criteria, Routh test for stability, Root Locus.	4
	Frequency Response: Introduction to Frequency Response, Bode Diagrams for First and second order systems, Bode stability Criteria, Ziegler-Nichols and Cohen-coon Tuning rules.	4
	TOTAL	40

Text Book:

1. Process Systems Analysis and control, Coughanowr, D.R., McGraw –Hill, 1991.

Reference Books:

1. Process Systems Analysis and control, Coughanowr, D.R., McGraw –Hill, 1991.
2. Chemical Process Control, Stephanopoulos, G., PHI,
3. Process Modelling, Simulation and Control for Chemical Engineers, Luyben, W.L,McGraw Hill,
4. Process Control Principles and Application, Surekha Bhanot, Oxford Higher Education/Oxford University Press, 2008
5. Process Control, Peter Harriott, Tata McGraw-Hill Publishing Company, 1964

7PC6.1 OIL AND GAS FIELD DEVELOPMENT

Common with Petroleum Engineering 7PE5
B.Tech. (Petrochemical) VII Semester **Max. Marks: 80**
Exam Hours: 3

Unit	Contents	Contact Hours
I	Types of reserves – Proved, proved subeconomic and inferred reserves.	**3**
	Classification of reserves – Proved: Categories A, B, C1; Proved subeconomic – Category Z; and inferred: Category C2.	**3**
	SPE/WPC definitions and classification of reserves – proved, unproved, probable and possible reserves.	**2**
II	Classification of simulations based on type of reservoir – gas reservoir simulations, black oil reservoir simulations and compositional reservoir simulations.	**4**
	Input data for black oil simulation – General data of the reservoir, rock and fluid data, grid data, production / injection and well data. History matching – Verification of input initial data, pressure matching and saturation matching.	**4**
III	Field Development: Criteria for field development – Basic geological data for development planning. Data collection from initial wells.	**2**
	Discovery well – Delineation of the field limits – Volumetric estimation of in place reserves, Planning development wells based on the reservoir parameters and economic criteria – Well spacing - Final development plan.	**3**
	Rate of production – Oil recovery factor – Water injection – Pressure maintenance – Abandoning the field – Abandonment pressure.	**3**
IV	Bottom Hole Studies: Collection of reservoir samples, performance of routine reservoir tests like productivity index, build-up test, draw down test, interference test, back pressure test, and isochronal test.	**2**
	Calculation of reservoir parameters like, K, Kh, Skin, flow efficiency, P.I. etc. and other PVT parameters.	**3**
	Significance of pressure and temperature data in hydrocarbon exploration and exploitation.	**3**
V	Identification and Treatment of Sick Wells – Definition of a sick well, criteria for identification of sick well.	**4**
	Sickness due to leakage – Detection of leakage, temperature survey, temperature anomaly, Radioactive isotope (tracer) survey, Activated oxygen log, isolation by packers. Reperforation and activation.	**4**
	TOTAL	**40**

Text Book:

1. Cole, F.W. 1961, Reservoir Engineering Manual, 2nd Edn.Gulf Eng Co, Huston, Texas.

Reference Books:

1. Advance Reservoir Engineering by T. Ahmed, P. D. McKinney, Elsevier.
2. Craft, B.C. and Hawkins, F.W. 1959. Petroleum Applied Reservoir Engineering practice Hall, New Jersey
3. Oil and Gas Pipeline Fundamentals:- Kennedy
4. Oil and Gas Field Development – Sant Kumar

7PC6.2 MULTIPHASE FLOW

B.Tech. (Petrochemical) VII Semester **Max. Marks: 80**
Common with Petroleum Engineering 5PE6.1 **Exam Hours: 3**

Unit	Contents	Contact Hours
I	**MULTIPHASE FLOW:**Scope and significance of multiphase flows, Dimensionless numbers in multiphase flows; Flow Pattern and Flow Regimes.	4
	Fluid-Solid System, Fluid-Fluid Systems, Solid-Fluid-Fluid systems.	4
II	**FLOW CLASSIFICATION:**Two-phase Co-current flow of Gas-Liquid, Gas-Solid and Liquid-Liquid, Upward and Downward Flow in Vertical pipes.	4
	Suspensions of Solid and their transport in Horizontal Pipes. Drag Reduction Phenomena, Laminar, Turbulent and Creeping Flow Regimes.	4
III	**MIXING POWER CORRELATIONS -** Theories of Intensity and Scale of Turbulence.	2
	Calculation of Circulation Velocities and Power Consumption in Agitated Vessels for Newtonian and Non-Newtonian Fluids.	3
	Blending and Mixing of Phases. Power requires for aeration to suspend to an Immiscible Liquid or Solids in Slurry Reactors, Prediction of optimum speed of Impeller Rotor and Design Criteria for Scale up.	3
IV	**QUANTIFICATION OF FLOW SYSTEM -** Prediction of Holdup, Pressure Drop and bubble size in pipe flow, Lockhart –Martinelli Parameters, Bubble Column and its Design aspects; Flow through Packed Bed and FluidizedBed, Minimum Carryover Velocity.	4
	Holdup Ratios, Pressure Drop and Transport Velocities and their prediction. Solid-Fluid Conveying and Settling.	4
V	**FLOW IN THREE - PHASE SYSTEMS -** Gas, solid and Liquid Composites Slurries in Horizontal Pipes, Flow through Porous Media of Composite Mixtures, Prediction of Holdup,	4
	Pressure Drop and throughput velocities in three – phase system. Design of Multiphase Contactors involving Solids, Liquids and Gases.	4
	TOTAL	40

Text Book:

1. Govier, G. W. and Aziz. K., "The Flow of Complex Mixture in Pipes", Van Nostrand Reinhold, New York, 1972.

Reference Books:

1. Wallis, G.B., "One Dimensional Two Phase Flow", McGraw Hill Book Co., New York, 1969.
2. Brodkey, R. S., "The Phenomena of Fluid Motions", Addision – Weseley, New York, 1967.
3. Hestroni, G., (Ed.) "Hand book of Multiphase systems", Hemisphere Publishing, Washington, 1982

7PC6.3 MODERN SEPARATION TECHNIQUES

B.Tech. (Petrochemical) VII Semester **Max. Marks: 80**

Exam Hours: 3

Unit	Contents	Contact Hours
I	**BASICS OF SEPARATION PROCESS:**Review of Conventional Processes, Recent advances in Separation Techniques based on size,surface properties, ionic properties and other special characteristics of substances.	4
	Processconcept, Theory and Equipment used in cross flow Filtration, cross flow Electro Filtration, Surface based solid – liquid separations involving a second liquid.	4
II	**MEMBRANE SEPARATIONS:**Types and choice of Membranes, Plate and Frame, tubular, spiral wound and hollow fiberMembrane Reactors and their relative merits, commercial.	4
	Pilot Plant and Laboratory Membrane permeators involving Dialysis, Reverse Osmosis, Nanofiltration, Ultra filtration and Micro filtration, Ceramic- Hybrid process and Biological Membranes.	4
III	**SEPARATION BY ADSORPTION:**Types and choice of Adsorbents, Adsorption Techniques, Dehumidification Techniques, Affinity.	4
	Chromatography and Immuno Chromatography, Recent Trends in Adsorption.	4
IV	**INORGANIC SEPARATIONS:**Controlling factors, Applications, Types of Equipment employed for Electrophoresis.	4
	Dielectrophoresis, Ion Exchange Chromatography and Eletrodialysis, EDR, Bipolar Membranes.	4
V	**OTHER TECHNIQUES:** Separation involving Lyophilisation, Pervaporation and Permeation Techniques for solids,liquids and gases, zone melting.	4
	Adductive Crystallization, other Separation Processes, Supercritical fluid Extraction, Oil spill Management, Industrial Effluent Treatment by Modern Techniques.	4
	TOTAL	40

Text Book:

1. King, C. J., “Separation Processes”, Tata McGraw Hill, 1982.

Reference Books:

1. Roussel, R. W., “Handbook of Separation Process Technology”, John Wiley, New York, 1987
2. Nakagawal, O. V., “Membrane Science and Technology”’ Marcel Dekkar, 1992

Laboratory

7PC7 PROCESS DYNAMICS AND CONTROL

List of Experiment

1. To determine the time constant of a given thermometer and thermocouple
2. To study the open loop,three mode PID and two mode PD control
3. To study the working principal and clibration procedure of capacitance type level transmitter.
4. To obtain the step response of a single tank liquid level system to a step change in input flow and compare it with the theoretical response.
5. To study the inherent characteristics of control valve.
6. To study the theoretical time constant and damping coefficient of the manometer.
7. To study the interacting and non-interacting mode of system.
8. To study the behaviour of a PID controller.

7PC8 PIPE LINE DESIGN

Study of the following:

1. Introduction to Piping and Interaction & Interface for Piping Engineers.
2. Piping Elements and Thickness Calculation.
3. Basics of Piping Drawings.
4. Equipment & Piping Plans.
5. Piping Considerations for Pumps, Compressors, Blower and Static Equipment.
6. Pipe Racks & Sleeper Selections & Location.
7. Colour Coding of Pipelines.
8. Surface Preparation &Painting In Piping.
9. Codes & Standard.
10. Valves & Specification.

7PC9 PROJECT –I

7PCE10 INDUSTRIAL TRAINING

Objective of Industrial Training

The objective of undertaking industrial training is to provide work experience so that student's engineering knowledge is enhanced and employment prospects are improved. The student should take this course as a window to the real World and should try to learn as much as possible from real life experiences by involving and interacting with industry staff. Industrial training also provides an opportunity to students to select an engineering problem and possibly an industry guide for their Major Project in final semester.

7PC11 DECA

8PC1 NATURAL GAS ENGINEERING

Common with Petroleum Engineering 8PE1
B.Tech. (Petrochemical) VIII Semester **Max. Marks: 80**
Exam Hours: 3

Unit	Contents	Contact Hours
I	**Properties and Measurement of Natural Gas:**Introduction to Natural Gas, origin of natural gas, other sources of gaseous fluids.	3
	Phase behaviour fundamentals, qualitative and quantitative phase behaviour, vapour liquid equilibrium.	2
	Equation of state, critical pressure and temperature determination. Gas compressibility, viscosity and thermal conductivity, formation volume factor.	3
II	**Gas Reservoir Performance and Gas flow measurement:** Fundamentals of gas flow in conduits, fundamentals of fluid flow in porous media, inflow performance curves, outflow performance.	4
	Gas flow measurement: Fundamentals, Methods of measurements, Orifice meters equation, turbine meters.	4
III	**Flow of Gas in Production Tubing:** Introduction, gas flow fundamentals, vertical and inclined single phase flow of gas.	4
	Calculating flow and static bottom hole pressure, gas flow through restrictions. Temperatures profiling in flowing gas systems.	4
IV	**Natural gas Processing:** Gas liquid separations, dehydration processes, absorption and adsorption by gas permeation.	4
	Desulfurization processes, solid bed sweetening process, physical and chemical absorption processes, Acid gas removal. Integrating natural gas processing.	4
V	**Gas Compression:** Introduction, types of compressors, Selection, Thermodynamics of compressors,	2
	Design fundamentals for reciprocating, centrifugal and rotary compressors (single and multistage).	3
	Gas Gathering and Transport Gas gathering system, steady state flow in simple pipeline system, steady state and non-steady state flow in pipelines, solution for transient flow. Installation, operation and trouble shooting of natural gas pipelines.	3
	TOTAL	40

Text Book:

1.Kumar Sanjay, "Gas Production Engineering", Gulf Publishing Company, TX, USA, 1987.

Reference Books:

1. Ikoku, Chi, "Natural Gas Production Engineering", John Wiley and Sons, 1984.
2. Beggs, D, H, Gas Production Operations. Edition Technip. 1984
3. "Gas Processes Suppliers Handbook", USA, 1980.
4. Lee, J, Wattenbarger, R. A., "Gas Reservoir Engineering", Society of Petroleum Engineers, TX, USA, 1996

8PC2 PLANT DESIGN AND ECONOMICS

B.Tech. (Petrochemical) VIII Semester **Max. Marks: 80**

Exam Hours: 3

Unit	Contents	Contact Hours
I	Introduction, Process Design development, General design considerations, Cost and asset accounting,	**4**
	Cash flow for industrial operations, factors effecting investment and production cost, capital investments, estimation of capital investments, cost indices, cost factors in capital investment.	**4**
II	Organizations for presenting capital investments, estimates by compartmentalization, estimation of total product of cost direction, production costs, fixed charges, plant overhead costs, financing.	**4**
	Interest and investment cost, type interest, nominal and effective interest rates, continuous interest, present worth and discount annuities, cost due interest on investment, source of capital.	**4**
III	Taxes and insurances, type of taxes: federal income taxes,	**4**
	Insurance-types of insurance, self-insurance.	**4**
IV	Depreciation: types of depreciation, services life, salvage value, present value,	**4**
	Methods for determining depreciation, single unit and group depreciation.	**4**
V	Profitability: alternative investments and replacements, profitability standards, discounted cash flow	**4**
	Capitalized cost, pay out period, alternative investments, analysis with small investments, increments and replacements.	**4**
	TOTAL	**40**

Text Book:

1. Max S. Peters, Klaus D. Timmerhaus and Ronal E. West, Plant Design and Economics for Chemical Engineers, 5th ed. (2002), McGraw-Hill, New York

Reference Books:

1. Schwever , H.D., “Process Engineering Economics”, McGraw- Hill.
2. Chilton, “Chemical Engineering Cost Estimation”, McGraw-Hill.
3. Bauman, H.C., “Fundamentals of Cost Engineering in the Chemical Industry”, Reinhold Book Corporation, New York.
4. Jelen, F.C., “Cost and Optimization Engineering”, Mc Graw-Hill, New York.

8PC3 PROCESS PLANT UTILITIES

. **B.Tech. (Petrochemical) VIII Semester** **Max. Marks: 80**

Exam Hours: 3

Unit	Contents	Contact Hours
I	**IMPORTANT OF UTILITIES** Hard and Soft water, Requisites of Industrial Water and its uses. Methods of water Treatment such as Chemical Softening and Demineralization.	4
	Resins used for Water Softening and Reverse Osmosis. Effects of impure Boiler Feed Water.	4
II	**STEAM AND STEAM GENERATION** Properties of Steam, problems based on Steam, Types of Steam Generator such as Solid Fuel Fired Boiler.	4
	Waste Gas Fired Boiler and Fluidized Bed Boiler. Scaling and Trouble Shooting. Steam Traps and Accessories.	4
III	**REFRIGERATION** Refrigeration Cycles, Methods of Refrigeration used in Industry and Different Types of Refrigerants.	4
	Chlorofluro Carbons and Brins, Refrigerating Effects and Liquefaction Processes.	4
IV	**COMPRESSED AIR** Classification of Compressor, Reciprocating Compressor, Single Stage and Two StageCompressor, Velocity Diagram for Centrifugal Compressor,Silp Factor, Impeller Blade Shape.	4
	Properties of Air –Water Vapors and use of Humidity Chart. Equipments used for Humidification, Dehumidification and Cooling Towers.	4
V	**WASTE WATER TREATMENT:** Water treatment processes, (theory and application): aeration, solids separation, settling operations, coagulation, softening,	4
	Treatment of waste water from refineries, exploration and productions.	4
	TOTAL	40

Text Book:

1. Eckenfelder, W. W, Jr. “Industrial Water Pollution Control” McGraw-Hill: New York, 1966

Reference Books:

1. P. L. Ballaney, “Thermal Engineering”, Khanna Publisher New Delhi, 1986.
2. Perry R. H. Green D. W. “Perry's chemical Engineer's Handbook”, McGraw Hill, New York, 2007.
3. P. N. Ananthanarayan, “Basic Refrigeration & Air conditioning”, Tata McGraw Hill, New Delhi, 2007

8PC4.1 INDUSTRIAL ENGINEERING MANAGEMENT

Common with Petroleum Engineering 8PE4.1
B.Tech. (Petrochemical) VIII Semester **Max. Marks: 80**
Exam Hours: 3

Unit	Contents	Contact Hours
I	Basic functions of Management – Planning, organizing, staffing, directing and controlling.	**4**
	Introduction to Industrial Engineering techniques.\	**4**
II	Productivity: definition, measurement.	**4**
	Work study and its role in improving productivity of an organization. Types of production systems.	**4**
III	Introduction to production planning and control.	**8**
IV	Concepts of Human Resource	**4**
	Management – Selection, Training & Development.	**4**
V	Finance Management – Capital Budgeting Techniques. Pay-back period, ARR, NPV, IRR, PI; Sources of capital.	**3**
	Cost concepts and Break-even analysis.	**3**
	Project Management: Introduction, Network construction & identification of critical activities in CPM & PERT.	**2**
	TOTAL	**40**

Text Book:

1. Varshney, R.L. and Maheswari, K.L. 2006. Managerial Economics, 19th Edn., Sultan Chand & Sons., New Delhi.

Reference Books:

1. Koontz, H. and Weihrich, H. 2007. Essentials of management, 7th Edn., Tata McGraw Hill, New Delhi.
2. Prasad, L.M. 2006. Organisational behaviour, 4th Edn., Sultan Chand & Sons, New Delhi.
3. Luthans, F. 2005. Organisational behaviour, 10th Edn., Mc-Graw Hill International Edn., Singapore.
4. Keat, P.G. and Young, P.K.Y. 2004. Managerial Economic, pears education Inc.

8PC4.2OIL AND GAS PROCESSING PLANT DESIGN

Common with Petroleum Engineering 8PE4.2

B.Tech. (Petrochemical) VIII Semester **Max. Marks: 80**

Exam Hours: 3

Unit	Contents	Contact Hours
I	Oil desalting: Operation, variables, Heater treater design. Crude & Condensate Stabilization: LTX Stabilization. Oil & Gas Treatment.	**4**
	Oil desalter, emulsion treatment theory and practice, Emulsifiers & Demulsifiers, Gravity Separation, coalescence, coalescing media, electrostatic coalescers.	**4**
II	Treating Equipment: pressure vessels - Vertical, horizontal, Electrostatic. Process heat duty.	**4**
	Sensible heat of natural gas, water, heat transfer from fire-tube. Heat exchangers types, fluid placement, sizing, number of tubes.	**4**
III	Natural Gas Dehydration: (a) Glycol Process: operation, effect of variables, dew point depression, stage calculation.NTU - graphical and analytical methods, Absorber sizing.	**4**
	Lean oil absorption. (b) Solid bed process: design & operation, effect of process variables, Regeneration and cooling calculations. Hydrocarbon recovery. (c) Hydrate formation & inhibition.	**4**
IV	Natural Gas Sweetening: Acid gases, Toxicity, Pipeline specification. Solid-bed Process.	**4**
	Design, operation & effect of variables. Adsorbent selection.	**4**
V	Multistage Separation, Hengsteback's Flash calculation, stabilizer design.	**4**
	Amine and other absorptive process details.	**4**
	TOTAL	**40**

Text Book:

1.Gas Production Engineering – S. Kumar-Gulf publishing Co., 1987.

Reference Books:

1. Production operations, T. O. Allen and A. P. Roberts, SPE – Vol - I 4-th edition.

8PC4.3OPTIMIZATION OF CHEMICAL PROCESSES

B.Tech. (Petrochemical) VIII Semester **Max. Marks: 80**

Exam Hours: 3

Unit	Contents	Contact Hours
I	**INTRODUCTION AND CLASSIFICATION** Basic concept of optimization, Mathematical formulation of optimization problems; applications of optimization in chemical engineering.	3
	Classification of Optimization Problems - single variable problems, Multivariable problems without constraints, Multivariable problems with constraints, Maximization and minimization problems.	5
II	**SINGLE VARIABLE OPTIMIZATION** Necessary and sufficient conditions for optimum;, interpolation method - quadratic	4
	Region elimination methods -internal halving, Fibonacci	4
III	**MULTIVARIABLE OPTIMIZATION** Optimization of Functions One Dimensional Search: Analytical Methods: classification, stationary points, direct substitution, constrained variation, penalty function, Lagrangian Multiplier, Kuhn-Tucker theorem.	5
	Numerical methods general principles of numerical search, direction of search, final stage in search, direct search, pattern search.	3
IV	**OTHER OPTIMIZATION METHODS** Introduction to geometric, dynamic and integer programming and genetic algorithms.	4
	Application of Geometric Programming: chemical engineering problems with degree of difficulty equal to zero or one with constraints.	4
V	**APPLICATIONS OF OPTIMIZATION** Optimization of staged and discrete processes.	2
	Optimal shell-tube heat exchanger design.	3
	Optimal pipe diameter.	3
	TOTAL	40

Text Book:

1. Rao, S. S., Engineering Optimization - Theory and Practice, Third Edition, John Wiley & Sons, New York, 1996.
2. Edgar, T.F., Himmelblau, D.M., "Optimisation of Chemical Processes ", McGraw-Hill Book Co., New York, 1985.

Reference Books:

1. Reklaitis, G.V., Ravindran, A., Ragsdell, K.M. "Engineering Optimizations: Methods and Applications", John Wiley & Sons, New York, 2006.
2. Optimization: Theory and Practice by MC Joshi and K M Moudgalya, Narosa Publishing. ISBN: 81-7319-424-6.

LABORATORY

8PC5 GAS TESTING

Practicals:

1. Determination of compositions of Gas with Gas Chromatography.
2. Determination of Reid Vapour Pressure.
3. Determination of Gas gravity.
4. Determination of Gas density.

8PC6 PROCESS MODELLING AND SIMULATION

1. Simulation of gravity flow tank by Euler Method
2. Simulation of gravity flow tank by Range Kutta Method
3. Simulation of three CSTR in series by Range Kutta method
4. Simulation of three CSTR in series by Euler method
5. Simulation of three CSTR in series with feedback -loop by Euler method
6. Modelling a batch reactor-verification of 1st and 2nd order rate kinetics.
7. Counter current double pipe heat exchanger modeling-data analysis by iterative methods
8. Simulation of a distillation column-binary systems, equi-molal overflow, constant relative, volatility.

8PC7 PROJECT-II

8PC8 SEMINAR

8PCE9 DECA