Third Year Engineering

Fifth Semester

Theory						Practical		
Code	**Course Name**	**Hours/ Week L/T**	**Credits Theory**	**University Marks**	**Internal Evaluation**	**Hours/Week L/T**	**Credits Practical**	**Marks**
PCP5H001	**Optimization Engineering**	3	3	100	50			
PCP5I101	**Chemical Reaction Engineering***	3-1	4	100	50	2	1	50
PCP5I102	**Petrochemical Engineering ***	3	3	100	50	2	1	50
PCP5I103	**Petroleum Refining Engineering***	3	3	100	50	2	1	50
PCP5J001	**Petroleum Exploration and Exploitation**	3-1	4	100	50			
PCP5I201	**Advanced Lab I***					8	4	200
Total		17	17	500	250	14	7	350
Total Marks: 1100								
Total Credits: 24								
Honors PCP5D001	**Natural Gas Engineering**		4	100	50			
Minor PCP5G001	**Process Equipment Design**							

PCP5H001 OPTIMIZATION IN ENGINEERING

MODULE-I

Idea of Engineering optimization problems, Classification of optimization algorithms, Modeling of problems and principle of modeling. Linear programming: Formulation of LPP, Graphical solution, Simplex method, Big-M method, Revised simplex method, Duality theory and its application, Dual simplex method , Sensitivity analysis in linear programming.

MODULE -II

Transportation problems: Finding an initial basic feasible solution by Northwest Corner rule, Least Cost rule, Vogel's approximation method, Degeneracy, Optimality test, MODI method, Stepping stone method Assignment problems: Hungarian method for solution of Assignment problems Integer Programming: Branch and Bound algorithm for solution of integer Programming Problems Queuing models: General characteristics, Markovian queuing model, M/M/1 model, Limited queue capacity, Multiple server, Finite sources, Queue discipline.

MODULE -III

Non-linear programming: Introduction to non-linear programming. Unconstraint optimization Fibonacci and Golden Section Search method. Constrained optimization with equality constraint Lagrange multiplier, Projected gradient method Constrained optimization with inequality constraint: Kuhn-Tucker condition, Quadratic programming Introduction to Genetic Algorithm.

TEXT BOOKS

- A. Ravindran, D. T. Philips, J. Solberg, " Operations Research- Principle and Practice", Second edition, Wiley India Pvt Ltd
- Kalyanmoy Deb, " Optimization for Engineering Design", PHI Learning Pvt Ltd
- Prabhakar Pai, Operation Research, Oxford University Press

REFERENCE BOOKS:

- Stephen G. Nash, A. Sofer, " Linear and Non-linear Programming", McGraw Hill
- A.Ravindran, K.M.Ragsdell, G.V.Reklaitis," Engineering Optimization", Second edition, Wiley India Pvt. Ltd
- H.A.Taha,A.M.Natarajan, P.Balasubramanie, A.Tamilarasi, "Operations Research", Eighth Edition, Pearson Education
- F.S.Hiller, G.J.Lieberman, " Operations Research", Eighth Edition, TMH.
- P.K.Gupta, D.S.Hira, "Operations Research", S.Chand and Company Ltd.

PCP5I101 CHEMICAL REACTION ENGINEERING

Module I:

Introduction and overview of the subject, kinetics of homogeneous reactions, elementary and non-elementary reactions, concentration and temperature dependent term of a rate equation, collision theory, transition - state theory and Arrhenius theory. Interpretation of batch reactor data for both reversible and irreversible

reactions. Various methods of analysis of batch reactor data (including variable volume and variable pressure (data). Isothermal batch reactor design.

Module II:

Homogeneous flow reactors: Design equations for steady state plug flow reactor (PFR) and steady state continuous stirred tank reactor (CSTR), data analysis in flow reactors, mean residence time, space time, space velocity. Combined reactors, reactors in parallel and in series, size comparison of single reactors, recycle reactors.

Module III:

Design for parallel reactions, product distributions, contacting patterns for reactions in parallel, quantitative treatment of product distribution, selectivity, multiple reactions, and qualitative treatment of batch, PFR, and mixed reactors. Basics of non-ideal flow, RTD, age distribution of fluid, pulse experiment, relationship between F and E curves.

Text and Reference Books:

- *Chemical Reaction Engineering, 3rd ed. by O Levenspiel, Wiley.*
- *The Engineering of Chemical Reactions, Lanny D. Schmidt, Oxford University Press*
- *Elements of Chemical Reaction Engineering, 4th ed. by H S Fogler, PHI.*
- *Chemical Reactor Analysis and Design, 3rd ed. by G F Froment, K B Bischoff, and J De Wilde, Wiley.*
- *Chemical Engineering Kinetics, 3rd ed. by J M Smith, McGraw-Hill.*

PCP5I102 PETROCHEMICAL ENGINEERING

MODULE I

Heating of crude oil through exchangers.Pipestill heaters, their types and constructional features, estimation of heat duty, combustion calculation and heat transfer area in different parts in pipe still heater. Calculation of pressure drop and stack height.

MODULE II

Flash distillation , Dew point and Bubble point calculations, temperature and concentration profile in a distillation column, Multicomponent distillation , Calculation of number of stages in distillation , Key component concept, Comparison between multicomponent distillation and petroleum distillation.

MODULE III

Distillation curves and their interconversion at atmospheric ,subatmospheric and superatmospheric pressure, Collection and data for distillation column design and operation etc. Atmospheric distillation , principles and mode of excess heat removal , Flash zone calculation and estimation of side draw tray temperatures, Design aspects, Post treatment of straight run products

MODULE IV

Vaccum distillation column internals and operational aspects for lubes,asphalt, cracking feedstock, Pressure distillation and gas fractionation units, Difference between various types distillation regaining products of pressure distillation.

REFERENCE BOOKS:

- *B.K.BhaskarRao ,Modern Petroleum Refining Processes , Oxford & IBH (2006).*
- *W.L. Nelson ,Petroleum Refinery Engineering, McGraw –Hill ,1964.*
- *3 M. Vanwinkle, Distillation, McGraw –Hill ,1961.*

PCP5I103 PETROLEUM REFINING ENGINEERING

MODULE I

Occurrence of Petroleum, formation of Petroleum by Physical and Biological Methods. Origin and Reserves and Deposits of World, Estimation of Reserves Exploration and Production of Petroleum. Composition of Petroleum. Global and Indian Refining Scenario. Overview of Refinery Products, Refinery Configuration and Development.Paraffinic, Mixed and Naphthenic Based Crude Oil, Characterization Factor, Viscosity Index and Correlation Index. Distillation Characteristics, Thermal Properties of Petroleum Fractions and Important Product Properties. Testing of Petroleum Crude.

MODULE II

Dehydration and Desalting of Crudes - Settling and Electric Desalting, Heating of Crude – Pipe Still Heaters, Distillation of Petroleum - Arrangement of Towers, Atmospheric Distillation Unit and Vacuum Distillation Unit. Topping operations and Blending of Gasoline. Treatment Techniques: Physical and Chemical Impurities, Destruction of Sulphur Compounds and Catalytic Desulphurization, Dehydration of Gases and Sweetening Operations for Gases.

MODULE III

Gasoline Treatment- Copper Chloride Process, Unisol Process, Merox Sweetening, Sulphuric Acid Treatment and Catalytic Desulphurization. Treatment of Kerosene. Treatment of Lubes- Sulphuric Acid Treatment, Clay Treatment and Solvent Treatment. Wax Purification, Dewaxing with Solvents.

MODULE IV

Need and significance, types and functions of Secondary Processing. Cracking, Thermal Cracking and Visbreaking. Different Feed Stocks, Products Yields, Qualities and Recent Development. Catalytic Cracking, Commercial Catalyst, Feedstock and Catalytic Cracking Conditions, Types and Processes- Fixed Bed Cracker, Fluid Catalytic Cracking (FCC), Flexi Cracking. Theory, Reaction Conditions and Catalyst for Catalytic Reforming, Platforming, Houdri Forming, Rhein Forming, Power Forming, Selecto Forming. Ultra Forming and Rex Forming.Naphtha Cracking, Feedstock Selection and Effect of Steam.

MODULE V

Feed Stocks and Reactions for Alkylation Process- Cascade Sulphuric Acid Alkylation, Hydrofluoric Acid Alkylation. Isomerization Process- Isomerization with Platinum Catalyst and Aluminium Chloride Process.

Methods of Petroleum Coke Production – Koppers, Thermal Cracking, Delayed Coking, Fluid Coking and Contact Coking. Hydro Cracking- principles, reactions in Hydro Cracking, Catalyst, Hydro Cracking Reaction Conditions, Iso Max Processes and Hydro Desulphurization Processes.

TEXT BOOKS

- Jones, D.S.J. and Pujadó, P.R., Handbook of petroleum processing, Springer, The Netherlands, 2006
- Nelson, W. L "Petroleum Refinery Engineering", McGraw Hill Publishing Company Limited, 1985.
- Watkins, R. N "Petroleum Refinery Distillations", 2nd Edition, Gulf Publishing Company, Texas, 1981.

REFERENCES

- Parkash, S., Refining processes handbook, Gulf Professional Publishing, 2003
- Hobson, G. D "Modern Petroleum Refining Technology", 4th Edition, Institute of Petroleum, U. K. 1973.

PCP5J001 PETROLEUM EXPLORATION AND EXPLOITATION

MODULE I

Origin of oil – Important factors that control petroleum occurrence – Migration and accumulation – Source and reservoir rocks – Oil bearing rocks – Continental environment – Transitional environment – Marine environment.

MODULE II

Geological exploration methods – Geophysical exploration methods – Geochemical methods prognostication – Classification of drilling locations – Economic analysis – Well programme – Geotechnical order.

MODULE III

Various traps – Anticline – Fracturing – Well logging – Geological control – Gas logging – Drilling control important formation evaluation using wireline logging data.

MOULE IV

Drilling Fluids: Function, composition, and classification – Packer fluid – Casing packs – Solids removal – Completion methods – Various stimulation methods, Seismic technology – Sniffer survey – Drilling technology – Off-share rigs – Primary and secondary enhanced oil recovery techniques and methods – Major well complication and Remedies.

TEXT BOOKS

- Bhagwan Sahay "Petroleum Exploration and Exploitation Practices" Allied Publishers Ltd., Chennai, 1994.
- Richard Dawe, "Modern Petroleum Technology", Vol.I, Upstream, 6th Edition, John and Wiley Sons Ltd, 2000.

REFERENCES

- Howard B. Bradley, "Petroleum Engineering Handbook", Society of Petroleum Engineers, 1987.
- Norman J. Hyne., "Nontechnical Guide to Petroleum Geology, Exploration, Drilling and Production", 2nd Edition, Pennwell Books, 2001.
- Shay B., "Wellsite Geological Techniques for Petroleum Exploration" Allied Publishers Ltd., 1991.

PCP5D001 NATURAL GAS ENGINEERING (HONORS)

MODULE I

Origin of natural gas; types of natural gas reserves; Physical Properties and composition; classification, combustion characteristics; Gas reservoir deliverability; well bore and choke performance; Well deliverability.

MODULE II

Field operations, gas hydrates, inlet receiving, compression and cooling – compressor types and power calculations; removal of acid gas and dehydration by absorption, adsorption, cryogenic fractionation, membrane separation;

MODULE III

Hydrocarbon recovery – the process and components, nitrogen rejection for gas upgrading and enhanced oil recovery; Removal of trace components like helium, mercury etc.,

MODULE IV

Liquids processing – condensate and NGL, sulphur recovery; Transportation – pipe line and gathering system design, volumetric measurement; storage; Liquefied Natural Gas – gas treating, liquefaction cycles, storage and transportation; Sweetening and processing for Compressed Natural Gas; Capital costs.

TEXT BOOK

1. Kidnay, A. J., Parrish, W., "Fundamentals of Natural Gas Processing", CRC Press, 2006.

REFERENCE

1. Boyun, G., Ali, G., "Natural Gas Engineering Handbook" Gulf Publishing Company, 2005.

PCP5G001 PROCESS EQUIPMENT DESIGN (MINOR)

MODULE I

Fired heaters, Heat Exchangers, Condensers, Evaporators, Reboilers, Cooling Tower, Dryers, Absorption column, Distillation Column, Multicomponent Distillation Column, Extraction Column

MODULE II

Packed bed Reactors, FCC units, Pressure Vessel, Storage Vessel Design of Plant Layout, Pipe Lines and Pipe Layouts, Design Schematics and Presentation, Materials of Construction and Selection of process equipments

MODULE III

Choice of separation of heterogeneous and homogeneous mixtures - Attainable region Separation systems in process flowsheets: multicomponent distillation for ideal and non-ideal systems, distillation column sequences, Heat exchange networks synthesis and utilities: Energy targets, Integration in distillation columns

TEXT BOOKS

1. Smith, R., Chemical Process Design, McGraw Hill, New York, 1995.
2. Douglas, J., Conceptual Design of Chemical Processes, McGraw Hill, 1989.

REFERENCES

- Rudd, D.F. and Watson, C.C., Strategy of Process Engineering, John Wiley, 1969.
- Sinnot, R.K., An Introduction to Chemical Engineering Design, Pergamon Press, Oxford, 1989.
- Seider, W.D. and J.D. Seader, Product and Process Design Principles: Synthesis, Analysis and Evaluation, 2nd ed., John Wiley, 2004.
- Baranan, C.R., "Rules of Thumb for Chemical Engineers", Gulf Publishing Co, Texas, 1996.
- R. K. Sinnott, "Coulson & Richardson's Chemical Engineering", Vol. 6, Butterworth Heinermann, Oxford, 1996.
- Dawande, S. D., "Process Design of Equiments", 4th Edition, Central Techno Publications, Nagpure, 2005.
- Green D. W., "Perry's Chemical Engineer's Handbook", 7th Edition McGraw Hill, 1997.

B.Tech (Petrochem and Petroleum Refinery Engineering) detail Syllabus for 6th Semester

Sixth Semester								
Theory						Practical		
Code	Course Name	Hours/ Week L/T	Credits Theory	University Marks	Internal Evaluation	Hours/Week L/T	Credits Practical	Marks
PCE6I101	Process Instrumentation	3-0	3	100	50	2	1	50
PCE6I202	Drilling Engineering	3-1	3	100	50			
PCE6J101/ PCE6J102/ PCE6J103	Well Logging/Process Plant Safety/Energy Management in Petrochemical Industries	3-0	4	100	50	2	1	50
PCE6J202/ PCE6J203/ PCE6J204	Reservoir characterization and modeling/Well Completions, Testing and Servicing/ Fundamentals of liquefied natural gas	3-1	4	100	50			
PCG6C001	Green Technologies	3-1	4	100	50			
PCE6H101	Industrial Lecture #					3	1	50
PCE6E101	Business Communication and skills for interview # #	2-0	1		50	4	2	100
Total		19	19	500	300	13	5	300
Total Marks:								
Total Credits: 24								
PCE6D101	Honours:- Advance Chemical Reaction Engineering	4	4	100	50			
PCE6G101	Minor :- Advanced Process Control							

PCE6I101 PROCESS INSTRUMENTATION

MODULE I

Elements of measuring systems and their functions. Signal transmission. Transmitters electronic pneumatic etc.

MODULE II

Temperature Measurement : Temperature scales Mecury in glass thermometer, Bimetallic thermometer, pressure spring thermometer, Thermoelectric temperature measurements, thermocouples, thermal well and potentiometers, Resistance thermometer and pyrometers.

MODULE III

Level measurements of open and pressure vessels measurement of interface level

MODULE IV

Density measurements by displacement meter, hydrometer and densitometer. Orifice, Venturi, Pitot, and Rota-meters flow measurement of open channels. Instrumentation to flow plan symbols and chemical sensors

REFERENCE BOOKS:

- D. P. Eclaman, Industrial Instrumentation, Wiley Estern, 1989.
- J. P. Bentley, Principles of Measurement Systems, 2nd ed. Longman London, 1988.
- J. W. Dally, W. F. Riley and K. G. McConnell, Instrumentation , Engineering Measurements, John Wiley and Sons, Singapore, 1984.
- C. S. Rangan, G. R. Sarma and V. S. V. Mani, Instrumentation Devices and systems, Tata McGraw Hill, New Delhi, 1983
- B. C. Nakra and K. K. Chaudhary, Instrumentation Measurement and Analysis, Tat McGraw Hill, New Delhi, 1985.

PCE6I202 DRILLING ENGINEERING

MODULE I

Rock Strengths and Stresses, Hydrostatic Pressure Forced by a Fluid. Rock Properties, Primary Migration, Reservoir Rock, Seal Rock and Secondary Migration. Reservoir Drives, Problems Related Fluids in the Reservoir.

MODULE II

Well Proposal, Gathering Data, Designing the Well, Drilling the Well and Testing the Well. Planning of Well, Hole and Casing Sizes and Drilling the Well. Selecting a suitable Drilling Rig, Classification of Drilling Rig, Rig Systems and Equipments.

MODULE III

Roller Cone Bits, Fixed Cutter Bits and Cone Bits. Optimizing Drilling Parameters- Grading the Dull Bit and Bit Selection. Functions of Drilling Fluid, Basic Mud Classification Designing the Drilling Fluid.

MODULE IV

Controlling the Well Path of a Deviated Well, Horizontal Wells and Multi Lateral Well. Importance of Casing in a Well, Designing the Casing String, Role of the Cement Outside the Casing, Mud Removal, Cement Design, Running and Cement Casing and other Cement Jobs. Evaluation Techniques, Physical Sampling at Surface and Downhole, Electrical Logging and

Production testing.

MODULE V

Personnel involved in Drilling Operation, Decision Making at the Well site and in the Office, Estimating the Well Cost. Safety Meetings, New Comers on the Rig, Training and Certification, Permit to Work Systems, Safety Alerts, Safety Equipments, Minimizing Spills and Environmental Impact Studies.

REFERENCES

- Devereux, S., “Drilling Technology”, PennWell Publishing Company, 1999.
- Azar, J.J. and G. Rabello Samuel, “Drilling Engineering”, PennWell Corporation, 1937.
- Devereux, S., “Practical Well Planning and Drilling”, PennWell Corporation, 1998.

PCE6J101

WELL LOGGING

MODULE I

Aims and objectives of well logging. Reservoir formations. Borehole conditions. Fundamental concepts in borehole geophysics physical properties of reservoir rocks. Formation parameters and their relationships: formation factor, porosity, permeability, resistivity, water and hydrocarbon saturations, and movable oil. Archie's and Humbles equations.

MODULE II

Principles, instrumentation, operational procedures and applications of different geophysical logs: S.P., electrical, induction, nuclear, sonic, caliper, temperature, dip and direction. Natural gamma ray spectrometry log, nuclear magnetic log, litho density log, neutron activation technique, thermal neutron decay time log, chlorine and oxygen logs.

MODULE III

Recording, transmission and processing of log data. Formation evaluation for hydrocarbons. Qualitative and quantitative interpretations of well log data. Overlays and cross-plots. Determination of reservoir parameters – porosity, resistivity, permeability, water and hydrocarbon saturation, movable oil. Lithology determination by neutron, density and sonic cross-plots, dual mineral method, triporosity method, litho porosity cross-plot (M-N plot), clean sand and shaly sand interpretations.

MODULE IV

Sub-surface correlation and mapping from log data. Delineation of fractures from logs. Production logging. Well logging for metallic and non-metallic minerals: radioactive and nonradioactive evaporates, coal, sulphur. Borehole geophysics for groundwater exploration. Effective pay thickness of an aquifer. Saline water-fresh water interface from log data. Determination of groundwater flow direction by logs.

MODULE V

Theoretical computations of normal and lateral log responses. Identification and delineation of sub-surface formations from well log data. Calculation of reservoir parameters: formation factor, porosity, permeability, resistivity, water and hydrocarbon saturations, and movable oil. Subsurface correlation of formations and interpretation of field data.

TEXT BOOKS:

- Standard Handbook of pertroleum and Natural Gas Engineering. 2nd Edition. William C Lyons, Gary C Plisga. Gulf Professional Publishing.
- D.P Helander 'Fundamentals Of Formation Evaluation'
- Dewan.J.T 'Essentials of Modern Open-Hole Log Interpretation' Pen Well Books, 1983,

ISBN 0878142339.

REFERENCE:

1. Serra.O ‘Fundamentals of Well log Interpretation’ Volume1. Elsevier Science Publisher, New York, 1984,ISBN 04441327.

PCE6J102

PROCESS PLANT SAFETY

MODULE I:

Hazard Assessment and Statistics, Fire and explosion Hazards, Prevention of Fire and Explosion.

MODULE II:

Toxicological Studies , Industrial Hygiene Toxicological Studies , Industrial Hygiene

MODULE III:

Radiation Hazards ,Hazard Identification, Risk Assessment

MODULE IV:

Case studies

Reference Books

1. F.P. Lees ,Loss Prevention in the Process Industries , Vol. 1,2,and 3 ,Second Edition, Butterworth (1996).

2. Danial A Crowl and Joseph F. Louvar ,Chemical Process Safety : Fundamentals with Applications, Prentice Hall (1990).

3. Sanjay Banerjee , Industrial Hazards and plant Safety , Taylor &Fransis (2003).

PCE6J103

ENERGY MANAGEMENT IN PETROCHEMICAL INDUSTRIES

MODULE I:

General energy problems, energy use patterns and scope for conservation, Energy management principles, needs of organization and goal setting, energy audit in plant
metering, review of conservation technologies.

MODULE II:

Energy management principles, needs of organization and goal setting, energy audit in plant
metering, review of conservation technologies. Properties of Hydrogen with respect to its utilization as a renewable form of energy

MODULE III:

Energy conservation economics, basic discounting life cycle, costing and other methods, factors
affecting economics

MODULE IV:

Energy pricing and incentives for conservation of energy, energy conservation of available work
in the plants, identification of irreversible processes ,Primary energy sources, optimum use of prime movers, energy efficient house keeping, energy recovery in thermal systems, energy storage, thermal insulation

Reference Books

1. D.A.Reay , Industrial Energy Conservation,Pergamon press,1980
2. T.L. Boyen, Thermal Energy Recovery, Wiley , 1980

B Elective-III: Process Design of Heat Exchangers

PCE6J202

RESERVOIR CHARACTERIZATION AND MODELING

MODULE I

Overview of reservoir characterization and modeling problems. Reservoir mapping. 3D modeling. Univariate, bivariate and multivariate statistics for geological data analysis. Pattern recognition techniques. Petrophysical predictions from well logs. Introduction to petroleum geostatitsics. Variograms. Kringin. Uncertanity quantification.

MODULE II

Stochastic reservoir modeling. Sequential simulation. Gaussian simulation.Indicator simulation. Integrating seismic attributes, well tests and production data. Constraining reservoir models with various sources of information. Reservoir up girding and upscaling.

MODULE III

Reservoir simulation – Investigation of petroleum reservoir characteristics and behavior, including: pore volume, fluid distribution and movement, and recovery. The result of simulation studies include optimized field development and management plans which maximize the value and/or reserves of producing properties. Finite difference approximations to the diffusivity equation and the application of those approximations for reservoir simulations. Practical use of reservoir simulation.

MODULE IV

Pressure transient interpretation. Seismic reservoir charactreisation. Log management, correlation and petrophysical analysis. Geology correlator probe – AVO Reservoir Characterization. Software used in reservoir characterization and modeling.

TEXT BOOKS:

1. Petroleum Exploration Hand Book by Moody, G.B.

2. Wellsite Geological Techniques for petroleum Exploration by Shay's et al.

REFERENCE:

1. Standard Hand Book of Petroleum & Natural Gas Engineering" – 2nd Edition 2005-William C.Lyons & Gary J.Plisga-Gulf professional publishing comp (Elsevier).

PCE6J203

WELL COMPLETIONS, TESTING & SERVICING

MODULE I:

Well completion: Types of wells- Completion functions- Types of completion.

Mechanical aspects of well testing- Cased hole logging equipment and application and perforation methods and perforation equipment.

MODULE II:

Packers: Function- Application- Proper selection- Packer setting – Packer loads - water / gas shut off, horizon separation etc. Completion equipment (SSD, SSSV, mandrels, locks etc.)- Data acquisition in wells- Fiber optics- Permanent gauges- Memory gauges- Intelligent completion equipment.

MODULE III:

Tubing string design (dimension, materials and connections etc.) based on pressure, temperature, operating conditions- Media- Safety requirements. Drill Stem Testing: General Procedure and considerations- Test tool components and arrangement-Analysis of Test data.

MODULE IV:

HPHT and horizontal well completions- Work over equipment wire line- Scrubbing unit- Coil tubing completion and work over design and execution.

Reference Books:

1. Well Completion and Servicing, D. Perrin, Micheal Caron, Georges Gaillot, Editions Technip, 1999.

2. Primer of Well Service, Workover and Completion, Petroleum Extension Service (PETEX), University of Texas at Austin, 1997.

3. Well Testing, John Lee, Society of Petroleum Engineers, 1982.

4. Well Completion Design, Jonathan Bellarby, Elsevier, 2009.

5. Petroleum Engineering: Principles and Practice, J.S Archer & C.G. Wall, Graham & Trotman, Inc., 1986.

6. Advanced Well Completion Engineering, Wan Renpu, Gulf Professional Publishing, 2011.

PCE6J204

FUNDAMENTALS OF LIQUEFIED NATURAL GAS

MODULE I:

Introduction: Overview of LNG industry: History of LNG industry – Base load LNG – Developing an LNG Project – World and Indian Scenario – Properties of LNG.

MODULE II:

Liquefaction Technologies:Propane precooled mixed refrigerant process – Description of Air products C3MR LNG process – Liquefaction – LNG flash and storage. Cascade process: Description of Conoco Phillips Optimized Cascade (CPOC) process –Liquefaction – LNG flash and storage. Other Liquefaction Processes: Description of Linde MFC LNG process- Precooling and Liquefied Petroleum Gas (LPG) recovery – Liquefaction and Subcooling- Trends in LNG train capacity – Strategy for grassroots plant- Offshore LNG production.

MODULE III:

Supporting Functional Units in LNG Plants: Gas pretreatment: Slug catcher – NGL stabilization column – Acid gas removal unit – Molecular sieve dehydrating unit – Mercury and sulfur removal unit – NGL recovery – Nitrogen rejection – Helium recovery.

MODULE IV:

Receiving Terminals: Receiving terminals in India – Main components and description of marine facilities – Storage capacity – Process descriptions.

Integration with adjacent facilities – Gas inter changeability – Nitrogen injection – Extraction of C_2^+ components.

Reference Books:

1. LNG: Basics of Liquefied Natural Gas, 1stEdition, Stanley Huang, Hwa Chiu and Doug Elliot, PETEX, 2007. (https://ceonline.austin.utexas.edu/petexonline/file.php/1/ebook_demos/lng/HTML/index.html.)

2. Marine Transportation of LNG (Liquefied) and Related Products, Richard G. Wooler, Gornell Marine Press, 1975.

3. Marine Transportation of Liquefied Natural Gas, Robert P Curt, Timothy D. Delaney, National Maritime Research Centre, 1973.

4. Natural Gas by Sea: The Development of a New Technology, Roger Rooks, Wither by, 1993.

5. Natural Gas: Production, Processing and Transport, AlexandreRojey, Editions OPHRYS, 1997.
6. LNG: A Nontechnical Guide, Michael D'Tusiani, Gordon Shearer PennWell Books, 2007.
7. Natural Gas Transportation, Storage and Use, Mark Fennell Amazon Digital Services, Inc., 2011.
8. Liquefied Natural Gas, Walter Lowenstein Lom, Wiley 1974.
9. Liquefied Natural Gas, C. H. Gatton, Noyes, 1967.
10. Liquefied Gas Handling Principles on Ships and in Terminals, 3rd Edition, McGuire and White, Witherby Publishers, 2000.

PC6G001 **GREEN TECHNOLOGIES** **3-1-0**

MODULE I:-

Global Warming and its effect:- Introduction and physical definition of global warming, the New Carbon Problem: Accumulation, Long Half-Life, Heating Potential, Carbon Emission Factors, Carbon Absorption in Nature, The Global Emission Situation and its effect in India, The Kyoto and Other Protocols and its view in India, Effect of climate change and its impact.

Planning for the Future to reduce global warming:- Steps taken to Control Carbon Emissions universally, Use of Promotional and Punitive Mechanisms for Reducing Carbon in Atmosphere, The General Approach in Planning for the Future, Developing Countrywide Adaptive Measures for Safety of Local People, Developing Mitigative Measures for Global Reduction of Carbon, India's National Action Plan on Climate Change (NAPCC) till date, National Mission for a Green India, The MRV Debate.

MODULE II:-

Opportunities in Control of Carbon Emissions and Accumulation:- Essential Steps for Control of Carbon Emissions and Accumulation, Procedure to develop own Priorities and Business Opportunities in India for control of carbon emissions and accumulation, Needs a Mix of Green and Traditional Power Sources in India, A Logical Approach for Carbon Reduction, Need in India —More Forests, Less Deforestation and payment rates procedure for controlling carbon emissions and its Promotional Mechanisms at India.

Green Technologies for Energy Production :- Various Technologies Available for Energy Production, Cost Comparison of a Few Typical Systems for Power Generation, Sources of Energy Production Already in Use, Alternative Methods Ready for Use, Green Technologies Needing some Prior R&D Work.

MODULE III:-

Green Technologies for Personal and Citywide Application :- Measures to be taken for Green city, Carbon Emission Reduction at Personal Level, Carbon Emission Reduction at Local Authority and Citywide Level, Carbon Emissions from Imports.

Green Technologies for Specific Applications:- Promotion of 'Green' Buildings, Guidelines, The Energy Conservation Building Code (ECBC), Green Hotels and Hospitals, Green Technologies for Transport, Green Roads, Ports and Harbors, Industries, Carbon, Carbon Emissions from a Few Selected Industries in India, The Changing Scenario in Cities, Need for Wider Application to Town Planning and Area Re-Development Projects ,'Green' Infrastructure for Municipal Services, Bringing up Indian Villages, Green Services for Crematoria, Spreading Message to all Stakeholders.

MODULE IV:-

Some High-tech Measures for Reducing Carbon Emissions :- Use of Solar Power with Satellite-Based Systems ,Use of Carbon Capture and Storage (Sequestration) ,Microorganisms, A Quick SWOT Analysis.

Recommended Plan of Action :- India's National Action Plan Take Us to a Low-Carbon Path, The Missions Help Develop Awareness, Few case studies on Projects undertaken by Various Countries, Adaptive Measures Essential for Indian People to Cope with Climate Change

Text Book:

1. Green Technologies, Soli J. Arceivala, Mc Graw Hill Education

Reference Book :

1. Green Technologies and Environmental Sustainability edited by Ritu Singh, Sanjeev Kumar
2. http://cpcbenvis.nic.in/greentechnology.html#

PCE6E101
BUSINESS COMMUNICATION AND SKILL FOR INTERVIEW

Course Objectives

- To develop communication competence in prospective engineers.
- To enable them to convey thoughts and ideas with clarity and focus.
- To develop report writing skills.
- To equip them to face interview & Group Discussion.
- To inculcate critical thinking process.
- To prepare them on problem solving skills.
- To provide symbolic, verbal, and graphical interpretations of statements in a problem description.
- To understand team dynamics & effectiveness.
- To create an awareness on Engineering Ethics and Human Values.
- To install Moral and Social Values, Loyalty and also to learn to appreciate the rights of others.
- To learn leadership qualities and practice them.

MODULE I

Communication Skill: Introduction to Communication, The Process of Communication, Barriers to Communication, Listening Skills, Writing Skills, Technical Writing, Letter Writing, Job Application, Report Writing, Non-verbal Communication and Body Language, Interview Skills, Group Discussion, Presentation Skills, Technology-based Communication.

MODULE II

Critical Thinking & Problem Solving: Creativity, Lateral thinking, Critical thinking, Multiple Intelligence, Problem Solving, Six thinking hats, Mind Mapping & Analytical Thinking.

Teamwork: Groups, Teams, Group Vs Teams, Team formation process, Stages of Group, Group Dynamics, Managing Team Performance & Team Conflicts.

MODULE III

Ethics, Moral & Professional Values: Human Values, Civic Rights, Engineering Ethics, Engineering as Social Experimentation, Environmental Ethics, Global Issues, Code of Ethics like ASME, ASCE, IEEE.

MODULE IV

Leadership Skills: Leadership, Levels of Leadership, Making of a leader, Types of leadership, Transactions Vs Transformational Leadership, VUCA Leaders, DART Leadership, Leadership Grid & leadership Formulation.

Expected outcome:

The students will be able to

- Communicate effectively.
- Make effective presentations.
- Write different types of reports.
- Face interview & group discussion.
- Critically think on a particular problem.
- Solve problems.
- Work in Group & Teams
- Handle Engineering Ethics and Human Values.
- Become an effective leader.

References:

1. Barun K. Mitra; (2011), “Personality Development & Soft Skills”, First Edition; Oxford Publishers.
2. Kalyana; (2015) “Soft Skill for Managers”; First Edition; Wiley Publishing Ltd.
3. Larry James (2016); “The First Book of Life Skills”; First Edition; Embassy Books.
4. Shalini Verma (2014); “Development of Life Skills and Professional Practice”; First Edition; Sultan Chand (G/L) & Company
5. John C. Maxwell (2014); “The 5 Levels of Leadership”, Centre Street, A division of Hachette Book Group Inc.

PCE6D101

ADVANCED CHEMICAL REACTION ENGINEERING (Major)

Module I:

Homogeneous reactor design and analysis-I: Ideal reactors. Review of isothermal design for batch, semi-batch,and flow reactors.Multiple reactions and reaction networks: Yieldselectivity concepts, Wei-Prater analysis forfirst order networks, reaction networks of general order. Reactor energy balance and its applications to reactordesign and analysis.

Module II:

Homogeneous reactor design and analysis-II: Non-ideal reactors. Review of the basicconcepts of residence time distributions, single parameter models for real reactor behavior, macromixing andmicromixing, segregated flow model and Zweitering's analysis of maximum mixedness, IEM and other models formicromixing.

Module III:

Heterogeneous reactors-I: Gas-solid systems. Review of kinetics of gas-solid catalytic reactionswith and without diffusion limitations. Reactor design for fixed and fluidized bed reactors. Selected case studies,Non-catalytic gas-solid reactions: review of kinetics; reactor design case studies.

Module IV:

Heterogeneous reactors-II:Gas-liquid systems. Basic theories of mass transfer with chemical reaction model systems and model reactors,Reactor design for mechanically agitated and bubble column reactors. Selected case studies.

Reference Books:

1. Chemical Reactor Analysis and Design, 3rd ed. by G F Froment, K B Bischoff, and J De Wilde, Wiley.

2. Elements of Chemical Reaction Engineering, 4th ed. by H S Fogler, PHI.

3. Chemical Reaction Engineering, 3rd ed. by O Levenspiel, Wiley.

4. Chemical Reactor Analysis and Design Fundamentals by JBRawlings and J G E kerdt,Nob Hill Publishing.

5. Chemical and Catalytic Reaction Engineering by J JCarberry, Dover Publications.

6. Heterogeneous Reactions, Vol. I and II by L K Doraiswamy and MMSharma, John Wiley& Sons.

PCE6G101

ADVANCED PROCESS CONTROL (MINOR)

MODULE I:

A brief review on preliminary concepts of process control. Modeling of a few complicated systems. Understandingof first and second order systems and PID controllers. State space and transfer function matrix models. Stabilitycriterion of transfer function matrix models.

MODULE II:

Development of empirical model from process data. Identifyingdiscrete time models from experimental data. Design of Feedforward and Ratio control. Study of CascadeControl system.

MODULE III:

Digital Sampling, Filtering, and Control: Sampling period, Analog and digital filters, Z-transform. Use of SIMULINK, Design of digital controller. Multiloop Control. Calculation of extent of interaction and pairingof controlled and manipulated variable, Implementation of real time optimization in computer control. Study ofModel Predictive Control (MPC), Concepts of Statistical process control.

REFERENCE BOOKS:

- *Process Dynamics and Control, 3rd ed. by D E Seborg, T F Edgar, D A Mellichamp, and F J Doyle, John Willey& Sons.*
- *Process Dynamics, Modeling, and Control by BAOgunnaike and W H Ray, Oxford University Press.*
- *Process Control: Modeling, Analysis, and Simulation by BWBequette, PHI.*
- *Computer Control of Processes by MChidambaram, Narosa Publishing House.*
- *Process Systems Analysis and Control, 3rd ed. by DRCoughanowr and S E LeBlanc, McGraw-Hill.*