

PE 404 Chemical Reaction Engineering

Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	30	60	10	--	--	100

Unit I

Hours: 12

Rate equations of elementary and non-elementary reactions. Analysis of batch reactor data: Reversible and irreversible single reactions; Homogeneous catalytic reactions; Chain reactions; Series, parallel and series – parallel reactions; Enzymatic reactions.

Unit II

Hours: 12

Behaviour of ideal flow reactors; Design of mixed flow reactors; Plug flow reactors and their combinations for single and multiple reactions (series, parallel and series – parallel); Recycle reactors; Yield and selectivity in multiple reactions. Non-isothermal operation of reactors: Optimum temperature progression; Adiabatic and nonadiabatic batch, mixed flow and plug flow reactors; Exothermic reactions in mixed flow reactors; Multiple reactions: Yield and selectivity.

Unit III

Hours: 12

Unsteady state operation of reactors: Start-up of a mixed flow reactor; Semi-batch reactor; Non isothermal batch, mixed flow and plug flow reactors. Reaction with separation; Reactive distillation. Non-ideal flow; Residence time distribution; Dispersion and tank in series models; Multi-parameter models; Mixing of fluids; Degree of segregation; Laminar flow reactor; Conversion in segregated flow; Early and late mixing; Mixing of two fluids - Product distribution in multiple reactions.

Unit IV

Hours: 6

Catalyst characterization: Surface area and pore size distribution; Introduction to other characterization techniques (XRD, electron microscopy, electron spectroscopy, thermal analysis, Desorption spectroscopy.)

Total Hours: 42

Texts and References:

1. Levenspiel. O, "Chemical Reaction Engineering", John Wiley & Sons.
2. Smith. J.M., "Chemical Engineering Kinetics", McGraw-Hill book Co.
3. Fogler, H.C., "Elements of Chemical Reaction Engineering", Prentice-Hall, Inc.

PE 408 City Gas Distribution

Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	30	60	10	--	--	100

Unit I : Introduction

Hours: 10

Natural Gas: Fuel for Future (Properties of Natural Gas); Energy Resources for CGD; Update on Gas Discoveries; Demand-Supply Gap; History of CGD in India; Pre and Post PNGRB Era; LNG and CGD business
Gas Retailing Business: Introducing Gas Retailing; Terminology used in CGD; Various components of CGD Network; CGD Business Segments; CGD Projects – Status in India; CGD Companies in India; Role of CNG and PNG in Gas Distribution; CGD Economics

Unit II

Hours: 12

Regulatory Framework and Standards for City Gas Distribution: Petroleum and Natural Gas Regulatory Board (PNGRB) era; Purpose, role and functions of PNGRB; Challenges faced by PNGRB; Technical Standards including T4S.

Gas Value Chain: Gas Transmission and Distribution System; City Gate Station (CGS); Gas Filtration and Pressure reduction skids; Odorizing unit; Common pressure reduction station (CPRS)/District Regulation Station (DRS); Metering system; Pipeline for CGD network; Steel and PE Pipelines; **CNG infrastructure:** Mother Station, Online Station, Daughter Station, Daughter Booster Station; SCADA System

Unit III: Operation and Maintenance

Hours: 10

Annual O&M Plan; Steel Pipeline O&M (Cathodic Protection); Maintenance planning.

QHSE : CNG Safety; Emergency Response Plan; Disaster Management Plan; Quality assurance concepts; Inspection and Surveillance; Risk Assessment in CGD Business.

Unit IV : Business Scenario

Hours: 10

CGD Business Scenario – India and Abroad; Profile of Major Players; Gas Pricing in CGD; Customer Service Issues in CGD Business; Innovations in CGD; Accelerators and Retarders of CGD business; Case Studies – India and Abroad

Total Hours: 42

Texts and References:

1. City Gas in India(BS Negi)
2. Natural Gas (AK Jain)
3. City Gas Distribution in India: Demystifying the Opportunity, Growth and Investment Potential (Infra line Energy)

PE 402 Petrochemical Engineering-II

Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	30	60	10	--	--	100

Unit I

Hours: 8

Properties, applications and production technologies of the following commodity polymers –Polyethylene, LLDPE, HDPE, polypropylene, polystyrene, PVC.

Unit II

Hours: 12

C3, C4 and higher hydrocarbons C3 derivatives: Propane, propylene, Isopropyl alcohol, Acetone, Propylene oxide, Propylene glycol, Acrylonitrile, Acrylic acid C4 derivatives: Butane, Butylene, Butylene oxide-glycol, Acetic acid from butane Higher Hydrocarbon derivatives: Separation of paraffins (Wax cracking)

Unit III

Hours: 12

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

Unit IV

Hours: 10

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

Total Hours: 42

Texts and References:

1. Waddams, A.L., 'Chemicals from Petroleum', 4th edition, Gulf Publishing Company, London, 1980.
2. Lewis F. Hatch & S Matar, From Hydrocarbon to Petrochemicals
3. B.K. Bhaskara Rao, A Text on Petrochemicals, 2/e, Khanna Publishers, Delhi, 1998.
4. Mall, I.D., "Petrochemical Process Technology", Macmillan India Limited, Delhi, 2007.
5. F.A. Lowenheim and M. K. Moran; Industrial Chemicals, John Wiley & Son Inc., USA

PE 413 Asset Management & Economics										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	30	60	10	--	--	100
UNIT I Hours: 5										
Definition of Petroleum Asset; Exploration Asset and Production Asset; Steps for the development of project										
UNIT II : Asset Economics Hours: 7										
Economic feasibility of project using order of magnitude cost estimates, Asset cost estimation, and Product cost Estimation.										
<i>Cash Flows:</i> Time value of money, investment, costs, sales, profits, taxes, depreciation.										
<i>Profitability Analysis:</i> Rate of return, payback period, Comparing investment alternatives and replacements, and application of compound interest calculations.										
UNIT III : Asset Management Hours: 10										
Stages of a Project, Project Planning and Scheduling, Schematic Representation of Project Management, Pitfalls in Project Planning, Milestones and Milestone Planning, Project Organogram, Work Breakdown Structure (WBS), Hierarchical Plan, Project Network, Activity Floats, Programme Evaluation & Review Technique (PERT), Critical Path Method (CPM), Project Control, Decision Making, Project Reporting, Project Meetings, Project Failure and Success; Asset Resourcing; Asset Closure and Documentation; Joint Venture Organizations, Main Contributing Factors For Successful Projects, Management of Projects, Organization Management Functions, Project Management Team, Desirable Characteristics, Competencies of Project Manager, Duties of A Project Manager, Project Team										
UNIT IV : Project Execution Hours: 7										
Project organization: Project structures, Cost monitoring, Time scheduling/monitoring of dates, P&IDs, Measurement and Control engineering, Layout and building design, Documentation, Erection, Commissioning										
Total Hours: 28										
Texts and References:										
1. Ramaraju Thirumalai, ' <i>Project Management in Emerging Environment of Globalization</i> ', Himalaya Publishing House.										
2. Richard D Seba, ' <i>Economics of Worldwide Petroleum Production</i> ', Pennwell Publication										
3. Plant Design and Economics for Chemical Engineers, Max S. Peters, Klaus D. Timmerhaus, McGraw-Hill, Inc.										

PE 403 LNG Value Chain

Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	30	60	10	--	--	100

Unit I

Hours: 12

Introduction to LNG, Properties of Natural Gas; Global Gas Production and gas Trading; Constituents of International Gas Trading- Pipelines ; LNG; CNG ;Pre-treatment of Natural Gas; LNG Value Chain.

Unit II

Hours: 10

Gas Producing Acreage, proven reserves, minimum Reserves for LNG plant; Gas Treatment- Suitable for LNG preparation; LNG Liquefaction Principle; Liquefaction of Oxygen; Liquefaction of Air; Liquefaction Process (APCI, BHP, Black and Wealth, Cascade); LNG Storage: Single, Double and Full Containment Tank, Membrane Tank.

Unit III

Hours: 10

Marine facilities; LNG Transportation/ shipping; LNG Carriers – Moss and Membrane Type; LNG; Regasification terminal; Regasification Concept; Vaporizers for regasification – Open Rack, Ambient Air, Submerged, Intermediate Fluid, Shell and Tube; Regas Send Out Facilities; LNG by tanker Concept.

Unit IV

Hours: 10

LNG –Indian Scenario (History, Present status, upcoming terminal, possibility of composite plant (Combined Liquefaction and gasification Plant); LNG Safety – Health Hazards & Safety Hazards linked to LNG, Possible release; Accidents linked to LNG, Case Study on Past Accidents; LNG Pricing – Linear and S-Curve method; LNG Contracts, Risks associated with LNG contracts; M&As in LNG Business Economics of LNG plants- Sizing(Train size, Plant size, shipping Capacity); Utilization of Cold energy of LNG

Total Hours: 42

Texts and References:

1. Negi BS, LNG an Indian Scenario, Published by Technology Publication Dehradun
2. Negi BS, LNG an Emerging Global Trade, Published by Technology Publication Dehradun.

PE 417 Industrial Training and Viva-Voce							
Teaching Scheme					Examination Scheme		
L	T	P	C	Hrs/Week	Report writing	V/V	Total
0	3	6	6	9	80	20	100
Aim: To get exposure on day- to-day activities of various segments of hydrocarbon industries.							

PE 406 Pre-project Dissertation & Seminar							
Teaching Scheme					Examination Scheme		
L	T	P	C	Hrs/Week	Report writing	V/V	Total
0	0	8	4	8	80	20	100
Aim: To address specific industry and research related problems.							
Unit 1: Problem Identification							
Unit 2: Literature survey and Methodology							
Unit 3: Framing of Experimentation set up and Preliminary data collection							
Unit 4: Future Deliverables & Expected Outcome							
Text Books & Recommended Software:							
<ol style="list-style-type: none"> 1. Kothari, C. R. (2008) Research Methodology: Methods and techniques, 2. Murray, R (2002) How to write a thesis, McGrawal Hill Publication 3. Recent ENDNOTE Software for referencing 4. JABREF for Referencing. 							