COURSE STRUCTURE FOR B.TECH. Fourth year

SEMESTER VII			B.TECH. Fourth year											
Sr. No	Course Code	Course Name	Teaching Scheme					Exam Scheme						
								Theory			Practical		Total	
			L	T	P	C	Hrs/wk	MS	ES	IA	LW	LE/Viva	Marks	
1	PE-408	City Gas Distribution	3	0	0	6	3	30	60	10	--	--	100	
2	PE-402	Petrochemicals Engineering - II	3	1	0	7	4	30	60	10	--	--	100	
3	PE-403	LNG Value Chain	3	0	0	6	3	30	60	10	--	--	100	
4	PE-404	Chemical Reaction Engineering	3	1	0	7	4	30	60	10	--	--	100	
5	PE-405	Industrial Training and Viva-Voce	0	3	6	6	9	--	--	--	80	20	100	
6	PE-406	Pre Project Dissertation and Seminar	0	0	8	4	8	--	--	--	80	20	100	
7	PE -407	Transport and Marketing of Petroleum and its Products	3	1	0	7	3	30	60	10	--	--	100	
		Total	**15**	**6**	**14**	**43**	**34**						**700**	

MS = Mid Semester, ES = End Semester; IA = Internal assessment (like quiz, assignments etc)
LW = Laboratory work; LE = Laboratory Exam

PE 402 Petrochemicals Engineering-II										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	--	6	3	30	60	10	--	--	100

UNIT I: **Hours: 12**

Chemistry and technology for the production of Phenol, Maleic anhydride, Phthalic anhydride, styrene.

UNIT II: **Hours: 10**

Chemistry and technology for the production of DMT, Terephalic acid, Acrylic acid, Methyl methacrylate.

UNIT III: **Hours: 10**

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

UNIT IV: **Hours: 10**

Properties, applications and production technologies of the following engineering and thermosetting polymers: ABS plastic, nylon-6, polycarbonate, epoxy resin, unsaturated polyester resin, rubber.

Total Hours: 42

Text Books 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 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	6	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 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**	**6**	**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 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	0	0	6	3	30	60	10	--	--	100

Unit 1 **12 Hrs**

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 2 **12 Hrs**

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 3 **12 Hrs**

Unsteady state operation of reactors: Start-up of a mixed flow reactor; Semi-batch reactor; Nonisothermal 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 4 **6 Hrs**

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

TOTAL HOURS = 42

Books:

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 405 Industrial Training and Viva-Voce							
Teaching Scheme					**Examination Scheme**		
L	**T**	**P**	**C**	**Hrs/Week**	**Report writing**	**V/V**	**Total**
0	**3**	**6**	**6**	**0**	**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	6	3	3	**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**:

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.

PE 407 Transportation and Marketing of Petroleum and its Products										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	6	3	30	60	10	--	--	100

Unit-1: (**2 Hrs**)

Introduction to Transportation of petroleum and petroleum products - different means, Classification of petroleum as per "Indian Petroleum Rules – 1977" and NPRA

Unit-2: (**8 Hrs)**

Basics of pipeline construction, operation and protection. Product pipeline traffic management, Batching of different products, their receipt and accounting at storage depots. Product quality control, Metering and measurements of products.

Unit- 3: **(10 Hrs)**

Layout of petroleum product storage premises, Storage of petroleum products, Concept of storage depots, terminals and intermediate receiving & distributing depots, Packed oil storage, Distribution of products, Calibration of road tankers and tank wagons, Concept of cleaning and repair of tanks and drums

Unit- 4: **(10 Hrs)**

Operations at road and rail tank wagons/cars, loading and unloading racks., Filling methods, Precautions of Class I & II petroleum, Precautions with Class III and unclassified petroleum

Unit 5 **(6 Hrs)**

Traffic Management, Fire and safety rules (& OISD), Role of international oil companies.

Unit 6: **(6 Hrs)**

OPEC pricing mechanism. Spot marketing and other control mechanisms. Conservation of petroleum and its products.

TOTAL HOURS= **42 Hrs**

TEXT BOOK AND REFERENCES

1) Hughes, J. R. (revised by Swindles, N. S) The Storage & Handling of petroleum liquids, Charles Griffin & Co. Ltd. London
2) Mohitpur, M. (1994) Energy supply and pipeline transportation Challenges and Opportunities, ASME press.
3) Masseron, J.(1990) Petroleum Economics, Technip Publications
4) Petroleum Storage Principles: Alex Marks
5) Petroleum Production Handbook (vol-3): LC UREN
6) Oil Industry Safety Directorate (2012) Storage And Handling Of Petroleum Productsat Depots And Terminals Prepared by functioning committee (http://oisd.nic.in/PDF/OISDSTDDraft244.pdf).