

B.TECH-PETROLEUM (DOWNSTREAM) DETAIL COURSE STRUCTURE*(In line with Oklahoma University)***Fourth Year, VII Semester**

PE-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	25	50	25	--	--	100
<p>Unit I Hours: 12</p> <p>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.</p>										
<p>Unit II Hours: 12</p> <p>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.</p>										
<p>Unit III Hours: 12</p> <p>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.</p>										
<p>Unit IV Hours: 6</p> <p>Catalyst characterization: Surface area and pore size distribution; Introduction to other characterization techniques (XRD, electron microscopy, electron spectroscopy, thermal analysis, Desorption spectroscopy.)</p> <p style="text-align: right;">Total Hours: 42</p>										
<p>Texts and References:</p> <ol style="list-style-type: none"> Levenspiel. O, "Chemical Reaction Engineering", John Wiley & Sons. Smith. J.M., "Chemical Engineering Kinetics", McGraw-Hill book Co. Fogler, H.C., "Elements of Chemical Reaction Engineering", Prentice-Hall, Inc. 										

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B.TECH-PETROLEUM (DOWNSTREAM) DETAIL COURSE STRUCTURE***(In line with Oklahoma University)*****Fourth Year, VII Semester**

PE-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	25	50	25	--	--	100
<p>Unit I : Introduction Hours: 10</p> <p>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</p> <p>Unit II Hours: 10</p> <p>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; <i>CNG infrastructure:</i> Mother Station, Online Station, Daughter Station, Daughter Booster Station; SCADA System</p> <p>Unit III: Operation and Maintenance Hours: 10</p> <p>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.</p> <p>Unit IV : Business Scenario Hours: 09</p> <p>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</p> <p style="text-align: right;">Total Hours: 39</p>										

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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)

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PE-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	25	50	25	--	--	100
Unit I					Hours: 9					
Properties, applications and production technologies of the following commodity polymers – Polyethylene, LLDPE, HDPE, polypropylene, polystyrene, PVC.										
Unit II					Hours: 10					
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: 10					
Petroleum Aromatics BTX Production: Naptha reforming, Paraxylene from Naptha Benzene derivatives: Phenol, Aniline, Benzoic acid, Styrene, Maleic anhydride, Toluene derivatives: Caprolactum, DMT, Terephthalic 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: 39										
Texts and References:										
<ol style="list-style-type: none"> 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 										

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PE-LNG Value Chain										
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	25	50	25	--	--	100
<p>Unit I Hours: 6 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.</p> <p>Unit II Hours: 7 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.</p> <p>Unit III Hours: 6 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.</p> <p>Unit IV Hours: 7 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</p> <p style="text-align: right;">Total Hours: 26</p>										
<p>Texts and References:</p> <ol style="list-style-type: none"> 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. 										

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PE-Dissertation & Seminar I							
Teaching Scheme					Examination Scheme		
L	T	P	C	Hrs/Week	Report writing	V/V	Total
--	--	3	3	3	80	20	100
<p>Aim: To address specific industry and research related problems.</p> <p>Unit 1: Problem Identification</p> <p>Unit 2: Literature survey and Methodology</p> <p>Unit 3: Framing of Experimentation set up and Preliminary data collection</p> <p>Unit 4: Future Deliverables & Expected Outcome</p>							
<p>Text Books & Recommended Software:</p> <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 Publication3. Recent ENDNOTE Software for referencing4. JABREF for Referencing.							

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