B.TECH-PETROLEUM (DOWNSTREAM) DETAIL COURSE STRUCTURE

(In line with Oklahoma University)

Third Year, VI Semester

PE-Polymer Science and Technology										
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:10**

Chemistry of high polymers & Characterization: Monomers, functionality, degree of polymerizations, classification of polymers, glass transition, melting transition, criteria for rubberiness, polymerization methods: addition and condensation; their kinetics, metallocene polymers and other newer techniques of polymerization, copolymerization, monomer reactivity ratios and its significance, kinetics, different copolymers, random, alternating, azeotropic copolymerization, block and graft copolymers, techniques for copolymerization-bulk, solution, suspension, emulsion. Solubility and swelling, concept of average molecular weight, determination of number average, weight average, viscosity average and Z-average molecular weights, polymer crystallinity, analysis of polymers using IR, XRD, thermal (DSC, DMTA, TGA), microscopic (optical and electronic) techniques.

Unit II **Hours: 10**

Polymer Synthesis, properties, blends and composites: Commodity and general purpose thermoplastics: PE, PP, PS, PVC, Polyesters, Acrylic, PU polymers. Engineering Plastics: Nylon, PC, PBT, PSU, PPO, ABS, Fluoropolymers Thermosetting polymers: PF, MF, UF, Epoxy, Unsaturated polyester, Alkyds. Natural and synthetic rubbers: Recovery of NR hydrocarbon from latex, SBR, Nitrile, CR, CSM, EPDM, IIR, BR, Silicone, TPE. Difference between blends and composites, their significance, choice of polymers for blending, blend miscibility-miscible and immiscible blends, thermodynamics, phase morphology, polymer alloys, polymer eutectics, plastic-plastic, rubber-plastic and rubber-rubber blends, FRP, particulate, long and short fibre reinforced composites.

Unit III : Polymer Technology & Rheology **Hours: 10**

Polymer compounding-need and significance, different compounding ingredients for rubber and plastics, cross linking and vulcanization, vulcanization kinetics. Flow of Newtonian and non-Newtonian fluids, different flow equations, dependence of shear modulus on temperature, molecular/segmental deformations at different zones and transitions. Measurements of rheological parameters by capillary rotating, parallel plate, cone-plate rheometer. Visco elasticity-creep and stress relaxations, mechanical models, control of rheological characteristics through compounding, rubber curing in parallel plate viscometer, ODR and MDR.

Unit IV : Polymer processing and testing **Hours: 09**

Compression moulding, transfer moulding, injection moulding, blow moulding, reaction injection moulding, extrusion, pultrusion, calendaring, rotational moulding, thermoforming, rubber processing in two-roll mill, internal mixer. Mechanical-static and dynamic tensile, flexural, compressive, abrasion, endurance, fatigue, hardness, tear, resilience, impact, toughness. Conductivity-thermal and electrical, dielectric constant, dissipation factor, power factor, electric resistance, surface resistivity, volume resistivity, swelling, ageing resistance, environmental stress cracking resistance.

Total Hours : 39

Courses marked with GREEN are core Downstream Courses (Students are bifurcated in Upstream and Downstream after second year)

Note +: At SPT – PDPU Campus, the laboratory component will be of two hours but the allotted credit will be 1.

B.TECH-PETROLEUM (DOWNSTREAM) DETAIL COURSE STRUCTURE

(In line with Oklahoma University)

Third Year, VI Semester

Texts and References:

1. Freid, J (2013) Polymer science and Technology, Prentice Hall
2. Billmeyer, F. W. (1994) Textbook of Polymer Science
3. Maiti, S (2003) Analysis and Characterization of polymer, polymer science

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B.TECH-PETROLEUM (DOWNSTREAM) DETAIL COURSE STRUCTURE
(In line with Oklahoma University)
Third Year, VI Semester

PE-Natural Gas Processing										
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**		**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**LA**	**LW**	**LE/Viva**	
3	0	0	3	3	25	50	25	--	--	**100**

Unit I : Introduction **Hours: 09**

Composition, properties, fields & reserves in India and energy scenario; major NG producing industries of India and their contribution to Indian economy; techniques of utilization

Unit II : Gas Processing **Hours: 10**

Conventional and advanced separation techniques; sulphur recovery; LPG, LNG & CNG systems; specifications of NG for transportation in pipelines, NG Utilization: uses, underground storage, conservation & concept of peak shaving etc.

Unit III : Transportation of NG **Hours: 10**

Compression calculations; gas stations & transmission; city gas distribution system; gas flow measurement; compressor sizing

Unit IV: Marketing, Retailing and Gas Trading **Hours: 10**

CBM, NG hydrates & in-situ coal gasification, conversion of gas to liquid (GTL)

Total Hours: 39

Texts and References:

1. Bradley,H. B.(1987)Petroleum Production Handbook.SPE Publication.
2. Skimmer,D. R. (1982)Introduction to Petroleum Production Volume 1,2and 3, Gulf Publishing
3. Katz: D. L.and Lee, R. L.(1990), Natural Gas Engineering-Production and Storage, McGraw-Hill Publishing Company, New York.
4. Kumar,S (1987)Gas production Engineering., Gulf Publishing

Courses marked with GREEN are core Downstream Courses (Students are bifurcated in Upstream and Downstream after second year)

Note +: At SPT – PDPU Campus, the laboratory component will be of two hours but the allotted credit will be 1.

B.TECH-PETROLEUM (DOWNSTREAM) DETAIL COURSE STRUCTURE

(In line with Oklahoma University)

Third Year, VI Semester

PE-Design of Hydrocarbon Process Equipment										
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**

Unit I **Hours: 10**

Various code and standards for pressure vessel; design considerations and factors influencing design of unfired pressure vessels; materials of construction, type and selection, fabrication of process equipment; unfired pressure vessels with internal pressure; unfired pressure vessels with external pressure; end closures-types, considerations for selection, design under internal pressure and external pressure; testing of pressure vessels

Unit II **Hours: 8**

Non-pressure storage tanks -type and design; design of tall vertical vessels; vessels supports type – selection, Introduction to flanges and gaskets –design of non-standard flanges.

Unit III **Hours: 6**

Process design of Separators (gas-liquid) –Vertical and Horizontal, selection of separator; Distillation Column basics, selection between tray column and packed column, sieve tray performance, factors affecting operation of tray column –entrainment, flooding, weeping, and dumping; sieve tray column sizing, tray hydraulic design, and tray pressure drop calculation.

Unit IV **Hours: 18**

Classification of Heat Exchanges, concept of LMTD, components of Shell and Tube Heat Exchangers (STHE), classification of STHE, TEMA types, fluid allocation, tube geometry, baffles types, cut, spacing; tinker flow model; Thermal design of STHE –duty, diameter, heat transfer coefficient, pressure drop calculation; Introduction to pumps, pump classification and applications, Basic concepts –head, Net Positive Suction Head, cavitations.

Total Hours : 42

Texts and References:

1. Brownell and Young Process Equipment Design: John Willey
2. Bhattacharya, B. C. Process Equipment Design: CBS Publications
3. Joshi, M. V. Process equipment design, Macmillan
4. Sinnot, R.K., Chemical Engineering Design, Coulson-Richardson, Vol 6

PE-Petrochemical Engineering I	
Teaching Scheme	**Examination Scheme**

Courses marked with GREEN are core Downstream Courses (Students are bifurcated in Upstream and Downstream after second year)

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B.TECH-PETROLEUM (DOWNSTREAM) DETAIL COURSE STRUCTURE

(In line with Oklahoma University)

Third Year, VI Semester

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: 10**

Definition of Petrochemicals – petrochemical industries and products – feed stock for petrochemicals – Separation of Aromatics: Azeotropic separation of Toluene, Separation of Styrene, Extraction process, Crystallisation process – Air separation (Making Oxygen and Nitrogen).

Unit II **Hours:10**

Production of methanol via synthesis gas – production of formaldehyde from methanol – production of methylamines - production of chloromethane – trichloroethylene – percholoroethylene – Ethylene dichloride production – Vinyl chloride via ethylene dichloride pyrolysis and acetylene HCl reaction. Ethylene Oxide by air oxidation of ethylene. Butadiene via dehydrogenation of butane – butadiene from butane by oxy-dehydrogenation process – butadiene from ethanol – hydro dealkylation process.

Unit III **Hours: 10**

Synthetic fibres, rubbers, plastics, resins: method, mechanism and types of polymerization , production of poly butadiene, polyesters, nylons, acrylic fibres, etc. production of phenol formaldehyde resin, epoxy resin, production principle of ABS plastic, polycarbonates, etc. manufacturing techniques of butyl rubber, SBR, isoprene rubber, etc.

Unit IV **Hours: 09**

Application of various components of Hydrocarbon, Major industrial applications – Fertilizer, power generation, petrochemicals, sponge iron, glass industry, Ceramic Industry.

Total Hours: 39

Texts and References:

1. Maiti, S (1992) Introduction to petrochemical, Oxford & IBH Publishing Company.
2. Chaudhary, U. R. (2011) Fundamentals of petroleum and petrochemical engineering, CRC Press Mall, I. D (2007) Petrochemical processes technology, Macmillan India.
3. Rao, B. K. B (2009) Modern Petroleum refining processes 5th Ed, Oxford & IBH Publishing Company

Courses marked with GREEN are core Downstream Courses (Students are bifurcated in Upstream and Downstream after second year)

Note +: At SPT – PDPU Campus, the laboratory component will be of two hours but the allotted credit will be 1.

B.TECH-PETROLEUM (DOWNSTREAM) DETAIL COURSE STRUCTURE

(In line with Oklahoma University)

Third Year, VI Semester

Elective - Prime movers, Pumps and Compressors										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	1	0	3	3	25	50	25	--	--	**100**

Unit I **Hours: 10**

Reciprocating Engines: Two & four stroke engines, engine cycles and their comparisons. Natural Aspirated and Supercharged engines. Carburetion and Fuel Injection systems including MPFI system Supercharging & Turbo Charging, Engine cooling and lubrication. Engine testing and performance Emission and control mechanism,

Unit II **Hours: 9**

Gas Turbine Engines: Fundamentals (Bayton cycle and Regeneration cycle) Combined cycle & waste heat recovery etc. Single and multi-shaft turbines Effects of intake compressor speed and air contamination

Unit III **Hours: 10**

Pumps: Pumps classification & types Advantages & disadvantages, Basic principles – head, HP, Net Positive Suction Head (NPSH), Selection criteria, Centrifugal multiple pump and stage installations and their characteristics. Pumping stations (series & parallel installations).Types of seal systems etc. Reciprocating pumps Pulsation dampening system, Various codes & standards

Unit IV **Hours: 10**

Compressors: Types, Advantages & disadvantages, Centrifugal Compressors, Specifying a compressor, Determination of HP & No of stages, Surge control & stonewalling, Reciprocating compressors, Components, Capacity control devices, Cooling & lubricating systems, API Specs; 11P & 618, Environmental Aspects:, Air pollution

Total Hours: 39

Texts and References:

1. Boyce, M. P. (2012) Gas turbine engineering Handbook, Elsevier
2. American Petroleum Institute (1995) Positive displacement pumps-resciprocating
3. Girdhar, P (2008) Performance evaluation of pumps and compressors, Lulu. Com

Elective - Elements of Reservoir Engineering

Courses marked with GREEN are core Downstream Courses (Students are bifurcated in Upstream and Downstream after second year)

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B.TECH-PETROLEUM (DOWNSTREAM) DETAIL COURSE STRUCTURE

(In line with Oklahoma University)

Third Year, VI Semester

Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	1	0	3	3	25	50	25	--	--	**100**

Unit I **Hours: 10**

Reservoir. Origin and distribution of hydrocarbon fluids. Lithology of petroleum reservoirs. Types of reservoir rock. Reservoir image. Well characteristics and potential. Recoverable reserves.

Unit II **Hours: 9**

Porosity. Permeability - Darcy's Law, Permeability averaging – Series and Parallel, Transmissibility, Measurements of permeability heterogeneity, Porosity - Permeability relationship, Effective and relative permeability, Klinkenberg effect, carmen-kozeny Equation Two phase and three phase relative permeability curve, Drainage and imbibitions process. Wettability. Surface forces and capillary pressure. Fluid saturations. Electrical conductivity of fluid saturated rocks. Coring and core analysis.

Unit III **Hours: 10**

Types of Fluids. Fluid Properties - Density, Viscosity, Compressibility, Formation volume factors, Critical properties, Phase behavior. Equation of state. Flow regimes and equations. Applicability of Darcy's law and other physical laws.

Unit IV **Hours: 10**

Reservoir energies and drives - water drive, solution gas drive, gas cap drive, gravity drainage drive and combination drive. Recovery factor; Volumetric reserve estimation. Stochastic Method, Decline curve analysis. Material balance equation for oil and gas reservoirs.

Total Hours: 39

Texts and References:

1. Boyce, M. P. (2012) Gas turbine engineering Handbook, Elsevier
2. American Petroleum Institute (1995) Positive displacement pumps-resciprocating
3. Girdhar, P (2008) Performance evaluation of pumps and compressors, Lulu. Com

PE-Petroleum Product Testing Lab+

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B.TECH-PETROLEUM (DOWNSTREAM) DETAIL COURSE STRUCTURE

(In line with Oklahoma University)

Third Year, VI Semester

Teaching Scheme					Examination Scheme		
L	**T**	**P**	**C**	**Hrs/Week**	**Report writing**	**V/V**	**Total**
--	--	2	1	2	--	--	--

Laboratory Courses: Practical classes shall be based on theory course content of the corresponding courses.

Aim: Theory courses which are taught will be practiced in the laboratory.

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