

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

PE Heat and Mass Transfer										
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
<b>Unit I: Heat Transfer</b>										<b>Hours: 12</b>
Conduction: Steady-state and transient flow through various geometries, Convection: LMTD and NTU, overall heat transfer coefficient. Application of dimensional analysis to convection. Heat transfer rate and Heat transfer coefficient calculations. Double pipe parallel and counter-flow heat exchangers, natural and forced convection through tubes and outside tubes, Shell and tube heat exchanger, and finned tube heat exchanger. Boiling of liquids and condensation of vapors										
<b>Unit II : Radiation</b>										<b>Hours: 10</b>
Radiation from black and real surfaces, radiation transfer between black and grey surfaces, view factor, radiation shield, and multi-sided enclosures., Thermal insulation, Economic and critical thickness of lagging.										
<b>Unit III : Mass Transfer</b>										<b>Hours: 10</b>
Diffusion in gases: Fick's law, determination and estimation of diffusion coefficient; diffusion through stagnant gas and equimolecular counter-diffusion. Diffusion in liquids: Mass transfer across phase boundaries, two-film theory and mass transfer coefficient.										
<b>Unit IV</b>										<b>Hours: 10</b>
Gas Absorption, adsorption, and Distillation (flash and differential): Basic principles, laws, and calculations. Equilibrium, co-current and counter-current operations. Ideal stage concept and calculation of number of ideal stages. Efficiency. Packed bed and tray columns										
										<b>Total Hours: 42</b>
<b>Texts and References:</b>										
<ol style="list-style-type: none"> <li>1. Coulson and Richardson's Chemical Engineering Vol-1, 6th Ed, Elsevier (Butterworth and Heinemann).</li> <li>2. Warren L. McCabe, Julian C. Smith, Unit Operations of Chemical Engineering, McGraw Hill.</li> <li>3. Donald Q. Kern, Process heat transfer, Tata-McGraw-Hill.</li> <li>4. Badger and Banchero, Introduction to Chemical Engineering, McGraw-Hill.</li> </ol>										

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, V Semester**

PE-Petroleum Refining Engineering										
Teaching Scheme					Exam Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	--	--	3	3	30	60	10	--	--	<b>100</b>
<p><b>Unit I</b> <span style="float: right;"><b>Hours: 10</b></span>  Origin–Exploration and production of petroleum–Types of crudes, crude composition–Characteristics and classification–Crude oil properties. IS 1448: Standard –Testing of Petroleum crude–Products: Specifications and their Significance.</p> <p><b>Unit II</b> <span style="float: right;"><b>Hours: 10</b></span>  Pre-treatment of crude for Refining–Dehydration and desalting–Atmospheric distillation, Vacuum distillation of residue products–Treatment techniques for vacuum distillates with different processes like solvent extraction–Deasphalting, dewaxing, hydro fining, catalytic dewaxing and clay contact process–Production of lubricating oils. Hydro cracking, principles, process requirements, product yields and qualities and resid-cracking –Hydro treating –Sulphur removal, hydro finishing.</p> <p><b>Unit III</b> <span style="float: right;"><b>Hours: 10</b></span>  Thermal cracking – Processes, operating parameters, feed stock selection and product yields, Advantages –Types and functions of secondary processing – Visbreaking – Processes, operating parameters and advantages –Coking –Operating parameters and advantages. Fluid catalytic cracking –processes, operating parameters, feed stock selection and product yields –Advantages.</p> <p><b>Unit IV</b> <span style="float: right;"><b>Hours: 09</b></span>  Reforming –Principles, processes, operating parameters – Isomerisation –Processes, operating parameters, and advantages –Alkylation –Processes, operating parameters, advantages –Polymerization – Processes, operating parameters, and advantages. Asphalt manufacture, Air blowing technology, Bitumen Types and their properties, Acid gas removal and sulphur removal techniques.</p> <p style="text-align: right;"><b>Total Hours: 39</b></p>										
<p><b>Texts and References:</b></p> <ol style="list-style-type: none"> <li>1. Dr. B.K. Bhaskara Rao, Modern Petroleum Refining Processes (5<sup>th</sup> Edition)</li> <li>2. Dr. B.K. Bhaskara Rao, A Text Book on Petrochemicals.</li> <li>3. Marshall Sitting, Dryden’s Outlines of Chemical Technology.</li> </ol>										

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

PE-Hydrocarbon based Fertilizer Industries									
Teaching Scheme					Examination Scheme				
L	T	P	C	Hrs/Week	Theory			Practical	
					MS	ES	IA	LW	LE/Viva
3	0	0	3	3	30	60	10	--	--
<b>Unit I</b>					<b>Hours: 10</b>				
Introduction to Fertilizer Industry, Definition, Types, Consumption, uses, Role of Hydrocarbon in Fertilizer industry, Natural gas demand, Petrochemicals requirement. Reaction of natural gas in making fertilizer, Different types of process and hydrocarbon involved in making fertilizer, Air reforming Process, Partial Oxidation process, Total Recycle CO2 Stripping Urea process.									
<b>Unit II</b>					<b>Hours: 10</b>				
Different Unit involved in fertilizer process, Fluidised catalytic cracking unit, Cyclone , Catalyst transfer line, Slide valves( FCCU), Process furnaces, Heaters, Boilers, Crude stills etc., Incinerators, Air / vacuum heaters. Hoods feed lines, Coal gasifiers, Ammonia units secondary reformers, Fractionators towers & columns, Sulphur recovery units. Raw Material & Feed Stock, (Naphtha, Fuel Oil, Natural Gas, Coal), Nitrogen, Ammonia, Urea, Phosphorous acid, Potassium, Common product.									
<b>Unit III</b>					<b>Hours: 09</b>				
Key Fertilizer Product and process involved in making including multi nutrient fertilizer, Anhydrous ammonia, Aqua ammonia, Urea, Urea ammonium nitrate solutions, Ammonium nitrate, Ammonium sulphate, Calcium nitrate, Ammoniated phosphates, Potassium chloride, Potassium sulphate., Mono potassium phosphate, Potassium magnesium sulphate, Potassium nitrate.									
<b>Unit IV</b>					<b>Hours: 10</b>				
Challenges faced by fertilizer Industry, Different types of challenges faced by fertilizer industry likes natural gas demand , natural gas pricing , environmental impact, New fertilizer practices, Technological and R&D issues relating to Fertilizer Industry, India in fertilizer sector, Kind of fertilizer used in India, future prospect and demand of fertilizer in India, Natural Gas Supply for Fertilizer industry									
					<b>Total Hours: 39</b>				
<b>Texts and References :</b>									
<ol style="list-style-type: none"> <li>1. Katja, India's Fertilizer Industry: Productivity and Energy Efficiency</li> <li>2. Schumacher and Jayant Sathaye Hand book of fertilizer manufacturing process.</li> <li>3. Report of the working group on fertilizer industry for the twelfth plan (2012-13 to 2016-2017)</li> <li>4. Industry notes in key fertilizer product resources</li> </ol>									

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

PE-Fluid Mechanics										
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
<p><b>Unit I</b> <span style="float: right;"><b>Hours: 10</b></span></p> <p>Introduction – Types Methods of analysis and description – fluid as a continuum – velocity and stress field – Newtonian and Non-Newtonian fluid – Classification of fluid motion.</p> <p><b>Unit II</b> <span style="float: right;"><b>Hours: 09</b></span></p> <p>Fluid statics – basic equation – equilibrium of fluid element – pressure variation in a static fluid – application to manometer – differential analysis of fluid motion – continuity, Euler’s and Bernoulli equation.</p> <p><b>Unit III</b> <span style="float: right;"><b>Hours: 10</b></span></p> <p>The principle of dimensional homogeneity – dimensional analysis, the Pi-theorem – non dimensional action of the basic equations – similitude – relationship between dimensional analysis and similitude – use of dimensional analysis for scale up studies. Types of Flow meters and its co-efficient.</p> <p><b>Unit IV</b> <span style="float: right;"><b>Hours: 10</b></span></p> <p>Reynolds number regimes, internal flow – flow through pipes – pressure drop under laminar and turbulent flow conditions – major and minor losses; line sizing; External flows – boundary layer concepts, boundary layer thickness under laminar and turbulent flow conditions – flow over a sphere – friction and pressure drag – flow through fixed bed and fluidized beds.</p> <p style="text-align: right;"><b>Total Hours: 39</b></p>										
<p><b>Texts and References:</b></p> <ol style="list-style-type: none"> <li>Noel de Nevers, “Fluid Mechanics for Chemical Engineers “, Second Edition, McGraw-Hill, (1991).</li> <li>Munson, B.R., Yound, D.F., Okiishi, T.H. “Fundamentals of Fluid Mechanics”, 5<sup>th</sup> Edition”. John Wiley, 2006.</li> <li>White, F.M., “Fluid Mechanics”, IV Edition, McGraw-Hill Inc., 1999.McCabe W.L, Smith, J C and Harriot. P “Unit Operations in Chemical Engineering”. McGraw Hill, 5<sup>th</sup> Edition, 2001.</li> <li>Dr. R.K. Bansal., “A Text book of Fluid Mechanics and Fluid Machinery”, 9<sup>th</sup> Edition. Lakshmi Publication.</li> </ol>										

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

PE-Petroleum 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
<p><b>Unit I</b> <span style="float: right;"><b>Hours: 5</b></span>            Definition of Petroleum Asset; Exploration Asset and Production Asset; Steps for the development of project</p> <p><b>Unit II : Asset Economics</b> <span style="float: right;"><b>Hours: 6</b></span>            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.</p> <p><b>Unit III : Asset Management</b> <span style="float: right;"><b>Hours: 10</b></span>            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 &amp; 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</p> <p><b>Unit IV : Project Execution</b> <span style="float: right;"><b>Hours: 5</b></span>            Project organization: Project structures, Cost monitoring, Time scheduling/monitoring of dates, P&amp;IDs, Measurement and Control engineering, Layout and building design, Documentation, Erection, Commissioning</p> <p style="text-align: right;"><b>Total Hours: 26</b></p> <p><b>Texts and References:</b></p> <ol style="list-style-type: none"> <li>Ramaraju Thirumalai, '<i>Project Management in Emerging Environment of Globalization</i>', Himalaya Publishing House.</li> <li>Richard D Seba, '<i>Economics of Worldwide Petroleum Production</i>', Pennwell Publication</li> <li>Plant Design and Economics for Chemical Engineers, Max S. Peters, Klaus D. Timmerhaus, McGraw-Hill, Inc.</li> </ol>										

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PE-Numerical Methods for Petroleum Engineering Computing										
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	30	60	10	--	--	<b>100</b>
<p><b>Unit I : Numerical solution of Algebraic &amp; Transcendental equations</b> <span style="float: right;"><b>Hours:10</b></span>  Introduction, Descarte's Sign rule, Bisection Method, Method of false position, Secant method, Iteration method, Extended method of iteration, Newton-Raphson method, it's applications, Solution of nonlinear simultaneous equations, Newton-Raphson method for multiple roots, Horner's method, Lin-Bairstow's method or Method for Complex Root, Graeffe's root squaring method, Comparison of various methods.</p> <p><b>Unit II : Finite Differences</b> <span style="float: right;"><b>Hours:10</b></span>  Introduction, Finite differences, Operators: Forward Difference, Backward Difference, Central Difference, Shift Operator, Averaging Operator. Relation between operators, Factorial Notation, Synthetic Division, and Missing term Technique. <b>Interpolation:</b> Newton Gregory Forward Interpolation Formula, Newton Gregory Backward Interpolation Formula, Gauss's Forward and Backward Interpolation Formula, Stirling's Central Difference Formula, Lagrange's Interpolation Formula for unevenly spaced Formula, Inverse Interpolation, Divided Differences, Properties of Divided Differences, Newton's Divided Difference Formula, Relation between Divided Differences and Ordinary Differences.</p> <p><b>Unit III : Numerical Differentiation</b> <span style="float: right;"><b>Hours:10</b></span>  Introduction, Formulae for Derivatives; Numerical integration : Introduction, Newton-Cotes's Quadrature Formula, Trapezoidal rule, Simpson's one-third rule, Simpson's Three-Eighth rule, Weddle's rule, Romberg's method, Double Integration. Solution of Simultaneous Algebraic Equations: Direct methods, Iterative methods: Gauss-Jacobi's method, Gauss-Seidal method, Relaxation method. Numerical Solution of Ordinary Differential Equation: Taylor's method, Euler's method, Rung- Kutta method, Modified Euler's method, Predictor Corrector method: Adam's method &amp; Milne's method. Numerical Solution of Partial Differential Equation: Difference Quotients, Graphical representation, Classification of PDE's of 2<sup>nd</sup> order, Elliptic equations, Solutions of Laplace equation by Liebmann's iteration method, Poisson's equation, Parabolic equation(One dimension heat equation), Bender-Schmidt method Crank-Nicholson method.</p> <p><b>Unit IV : Introduction to Finite Elements Methods</b> <span style="float: right;"><b>Hours: 9</b></span>  Introduction to Finite Element Methods, Functionals, Base Functions. Methods of Approximation: The Rayleigh-Ritz Method, The Galerkin Method. The FEM for one dimensional problems and applications to two dimensional problems. Curve fitting methods</p> <p style="text-align: right;"><b>Total Hours: 39</b></p>										

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**Third Year, V Semester**

**Texts and References:**

1. Numerical Methods in Engineering and Science with Programs in C & C++ by B.S. Grewal, Khanna Publisher.
2. Introductory Methods for Numerical Analysis by S.S. Sastry, Fourth edition, Prentice Hall of India.
3. Numerical Methods for Scientific and Engineering Computation by M.K. Jain, S.R.K. Iyenger and R.K. Jain, 5<sup>th</sup> edition, New Age International .
4. An introduction to Finite Element Method By J N Reddy, Mc Graw Hill.
5. Advanced Engineering Mathematics by R.K. Jain & S.R.K. Iyenger, 3<sup>rd</sup> edition, Narosa .
6. Numerical Methods for Engineers by S C Chapra , Raymond P. Canale, Tata McGraw Hill Pub. Co. Ltd.

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