B.TECH-PETROLEUM ENGG. (UPSTREAM) COURSE STRUCTURE

(In line with Oklahoma University)

Third Year, V Semester

PE-Geostatistics										
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-1 **Hours: 10**

Introduction of geostatistics, Geostatistical Prediction, Geostatistics versus Simple Interpolation, Limitations, Probability Theory Review, Univariate analysis, Bivariate analysis and multivariate analysis, Gaussian Distribution, Central Limit Theorem.

Unit-2 **Hours:10**

Spatial Analysis, Conventional Analysis (Nongeostatistical), Spatial Continuity Analysis (Geostatistical), Experimental Variogram, h-Scatterplot, Variogram versus Univariate Statistics, Higher Dimensions & Statistical Anisotropy, Pure Nugget Variogram, Standard Deviation, Irregular Data: Variogram Search Envelope, Exploring Anisotropy, Spatial Continuity Analysis.

Unit-3 **Hours:10**

Variogram Modeling, Basic Permissible Models, Positive Definiteness, Basic Variogram Functions, 1D Variogram Model, Statistical Isotropy Higher Dimensional Model, Statistical Anisotropy, Nested Model, Nongeostatistical (Deterministic) Estimation.

Unit-4 **Hours:09**

Estimation Criteria, Geostatistical (Probabilistic) Estimation, random Function Models, Ordinary Kriging, Cokriging & Collocated Cokriging, Kriging with moving neighborhood. Auto Regressive (AR), Moving Average (MA), Auto Regressive Moving Average (ARMA).

Total Hours:39

Texts and References:

1. Geostatistics for environmental and geotechnical applications: a technology transferred, M. V. Cromer, in Rouhani et al. (1996)
2. Geostatistics and Petroleum Geology, Michael Edward Hohn, Kluwer academic publishers, 2013
3. Practical Geostatistics, Modeling and special analysis, Simon W. Houlding
4. Geostatistical Reservoir Modeling, Michael J. Pyrcz, Clayton V. Deutsch, Oxford University Press, 2014

Courses highlighted with RED will be offered at SPT – PDPU Campus to the students not opting for credit exchange in that particular semester.

Courses highlighted with BLUE will be offered at Oklahoma Campus to the students opting for credit exchange in that particular semester.

Courses highlighted with BLACK are completely replicated with Oklahoma University.

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

B.TECH-PETROLEUM ENGG. (UPSTREAM) COURSE STRUCTURE

(In line with Oklahoma University)

Third Year, V Semester

MATH-Intro. to Ordinary Differential Equations (MATH-3113)										
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
			3	3						

Duplicates two hours of 3413. First order ordinary differential equations, linear differential equations with constant coefficients, two-by-two linear systems, Laplace transformations, phase planes and stability.

Courses highlighted with RED will be offered at SPT – PDPU Campus to the students not opting for credit exchange in that particular semester.

Courses highlighted with BLUE will be offered at Oklahoma Campus to the students opting for credit exchange in that particular semester.

Courses highlighted with BLACK are completely replicated with Oklahoma University.

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

B.TECH-PETROLEUM ENGG. (UPSTREAM) COURSE STRUCTURE

(In line with Oklahoma University)

Third Year, V Semester

PE-Petroleum Reservoir Fluids

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**

Compression/Expansion of Ideal and Non ideal gases, First Law, Second Law and Third Law of Thermodynamics, Compression cycles, Horse power calculations – single, double and multistage with and without clearance.

Unit II **Hours: 10**

Thermodynamics of Gases and Liquid Hydrocarbons: Free Energy, Gibbs Energy, Fugacity and Fugacity Coefficients of gaseous mixtures, Equation of State, Activation Energy, Joule Thompson's Effect, Arrhenius Equation, Vapour liquid equilibria, equilibrium constant, partial molar properties, chemical potential, Raoult's law and Henry's law, ideal and non ideal solutions, Activity and activity coefficients, Gibb's Duhem equation, Gibb's adsorption equation.

Unit III **Hours: 10**

Phase rule of single, two, three, multi component and multi phase systems, phase behaviour in different conditions, Thermodynamic aspects of phase equilibria. Calculation of phase equilibria. Ternary and pseudo ternary phase diagrams. Single phase flow & multiphase flow through vertical, incline and horizontal conduits. Pressure traverse curves and their applications. Venturi flow, nozzle flow, pipe internal flow, annular flow and nozzle flow thermodynamics of multiphase & multicomponent system

Unit IV **Hours: 09**

Calculation of compressibility factor and experimental analysis (compositional analysis, constant composition expansion, flash and differential liberation for oil and gas condensate) of reservoir fluids using PVT cell , Water Properties- Water from petroleum reservoirs, water production, water analysis at atmosphere pressure.

Total Hours: 39

Texts and References:

1. Thermodynamics of Hydrocarbon Reservoirs, Abbas Firoozabadi, McGraw-Hill.
2. PVT and Phase behavior of Petroleum Reservoir Fluids, Ali Danesh, Elsevier, 1998.
3. Properties of Petroleum Rocks and Fluids, Abhijeet Dandekar.

Courses highlighted with RED will be offered at SPT – PDPU Campus to the students not opting for credit exchange in that particular semester.

Courses highlighted with BLUE will be offered at Oklahoma Campus to the students opting for credit exchange in that particular semester.

Courses highlighted with BLACK are completely replicated with Oklahoma University.

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

B.TECH-PETROLEUM ENGG. (UPSTREAM) COURSE STRUCTURE

(In line with Oklahoma University)

Third Year, V Semester

PE- Petroleum Reservoir Fluids (PE-3123)										
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3			3	3						**100**

Properties of petroleum behavior of gases, phase behavior of liquids, qualitative and quantitative phase behavior of hydrocarbon systems, reservoir fluid characteristics. Application of these concepts to the prediction of gas and gas-condensate reservoir behavior

Courses highlighted with RED will be offered at SPT – PDPU Campus to the students not opting for credit exchange in that particular semester.

Courses highlighted with BLUE will be offered at Oklahoma Campus to the students opting for credit exchange in that particular semester.

Courses highlighted with BLACK are completely replicated with Oklahoma University.

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

B.TECH-PETROLEUM ENGG. (UPSTREAM) 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	
					MS	ES	IA	LW	LE/Viva
3	0	0	3	3	25	50	25	--	--

Unit I **Hours: 10**

Introduction – Types Methods of analysis and description – fluid as a continuum – velocity and stress field – Newtonian and Non-Newtonian fluid – Classification of fluid motion.

Unit II **Hours: 10**

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.

Unit III **Hours: 10**

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.

Unit IV **Hours: 09**

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.

Total Hours: 39

Texts and References:

1. Noel de Nevers, "Fluid Mechanics for Chemical Engineers ", Second Edition, McGraw-Hill, (1991).
2. Munson, B.R., Yound, D.F., Okiishi, T.H. "Fundamentals of Fluid Mechanics", 5th Edition". John Wiley, 2006.
3. 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, 5th Edition, 2001.
4. Dr. R.K. Bansal., "A Text book of Fluid Mechanics and Fluid Machinery", 9th Edition. Lakshmi Publication.

Courses highlighted with RED will be offered at SPT – PDPU Campus to the students not opting for credit exchange in that particular semester.

Courses highlighted with BLUE will be offered at Oklahoma Campus to the students opting for credit exchange in that particular semester.

Courses highlighted with BLACK are completely replicated with Oklahoma University.

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

B.TECH-PETROLEUM ENGG. (UPSTREAM) COURSE STRUCTURE

(In line with Oklahoma University)

Third Year, V Semester

PE Fluid Mechanics (PE-3223)										
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	--	--	3	3	--	--	--	--	--	**100**

Coverage of the fundamental of fluid statics and dynamics. Formulation of the equations of fluid flow such as Navier Stokes, Euler, Bernoulli, etc. and their application. Examples of ideal and viscous fluid flow in open and closed conduits.

Courses highlighted with RED will be offered at SPT – PDPU Campus to the students not opting for credit exchange in that particular semester.

Courses highlighted with BLUE will be offered at Oklahoma Campus to the students opting for credit exchange in that particular semester.

Courses highlighted with BLACK are completely replicated with Oklahoma University.

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

B.TECH-PETROLEUM ENGG. (UPSTREAM) COURSE STRUCTURE
(In line with Oklahoma University)
Third Year, V Semester

PE - Drilling and Completion I

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: Basic Drilling Practices **Hours : 10**

Well Planning, Drilling Rig: Components, Selection and Operating systems - Hoisting, Circulation and Rotary systems, Power transmission, Rig control system. Wire lines and service life evaluation. Casing Practices – Configuration, operation, properties, types and design, casing setting depth and hole sizes, liner design, casing handling practices, casing. Pore Pressure. Drill String - Components, functions and design. Drill Bits – Types, Performance and Criteria for design. Balanced/Underbalanced drilling. Fracture pressure , abnormal pressure. Mud Hydraulics and Mud weight and Pressure loss calculations in round trip circulation cycle.

Unit II: Drilling Problems and Remedies **Hours : 10**

Pipe sticking and failure, Lost circulation, Hole Deviation, Sloughing shale, Formation damage, Bore hole instability. Drill string fatigue failure. Bit failure, wire line failure etc. Fishing and coring operations. Well kick and Blow outs: Problem, symptoms and controlling measures, Hole Cleaning. General equipment and Personnel.

Unit III: Drilling Fluids **Hours : 10**

Drilling Fluids – Basics, Functions, Classification, Properties and Nature. Drilling fluids equipment related to pressure and separation. Formulations of drilling fluid, separation of drilled solids from drilling fluid, rheology models of drilling fluids. Mud systems like Pneumatic. Synthetic oil based, Inhibitive and Non-inhibitive drilling fluids. Water and Oil based drilling fluid testing procedures. Latest advances and emerging trends in drilling fluid like use of NDDF. Advanced mud Technology, Safety and Environmental Impact of Drilling fluid. Waste management, classification of drilling waste, approaches of drilling waste minimization.

Unit IV: Cementation Techniques **Hours : 09**

Cementing, Cements & cement slurry: Objectives of cementing, oil well cements, Classification of cement, Slurry design, Slurry additives, Factors influencing cement slurry design, Cementing equipments. Cementing Methods - Primary cementing, Stage cementing, Liner cementing, Plugging, Squeeze Cementing techniques in practice. Deep well cementing, Characteristics of good quality cementation. Cementing calculations.

Total Hours: 39

Courses highlighted with RED will be offered at SPT – PDPU Campus to the students not opting for credit exchange in that particular semester.

Courses highlighted with BLUE will be offered at Oklahoma Campus to the students opting for credit exchange in that particular semester.

Courses highlighted with BLACK are completely replicated with Oklahoma University.

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

B.TECH-PETROLEUM ENGG. (UPSTREAM) COURSE STRUCTURE

(In line with Oklahoma University)

Third Year, V Semester

Text and References:

1. Carl Gatlin (1960), Petroleum Engineering: Drilling and Well Completion, Prentice Hall; 1st Ed.
2. Bourgoyne , Adam T. Jr., Martin E. Chenevert, Keith K. Millheim and F.S. Young Jr., Richardson, TX (1991), Applied Drilling Engineering, Society of Petroleum Engineers.
3. Neal J.Adams (1985), Drilling Engineering: A Complete Well Planning and approach, PennWell Books
4. H Rabia (1986), Oil Well Drilling Engineering Principles and Practices, Kluwer Law International
5. Gray and Darley (1988), Composition and properties of drilling and completion fluids, Gulf Professional publishing.
6. ASME Shale Shaker Committee (2004), Drilling fluids processing handbook, Gulf Professional publishing
7. James L. Lummus (1986), Drilling fluids optimization: a practical field approach, PennWell Books

PE - Drilling and Completion I(PE -3313)

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

Drilling operations, drilling costs and economics, drilling fluids, pressure losses in circulating systems, rotary drilling bits and penetration rate, rotary drilling techniques, pore and fracture gradients.

Courses highlighted with RED will be offered at SPT – PDPU Campus to the students not opting for credit exchange in that particular semester.

Courses highlighted with BLUE will be offered at Oklahoma Campus to the students opting for credit exchange in that particular semester.

Courses highlighted with BLACK are completely replicated with Oklahoma University.

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

B.TECH-PETROLEUM ENGG. (UPSTREAM) 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	25	50	25	--	--	**100**

Unit I **Hours: 6**

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.

***Cash Flows*:** Time value of money, investment, costs, sales, profits, taxes, depreciation.

Profitability Analysis: Rate of return, payback period, Comparing investment alternatives and replacements, and application of compound interest calculations.

Unit III : Asset Management **Hours: 7**

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: 6**

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: 26

Texts and References:

1. Ramaraju Thirumalai, '*Project Management in Emerging Environment of Globalization*', Himalaya Publishing House.
2. Richard D Seba, 'Economics of Worldwide Petroleum Production', Pennwell Publication
3. Plant Design and Economics for Chemical Engineers, Max S. Peters, Klaus D. Timmerhaus, McGraw-Hill, Inc.

Courses highlighted with RED will be offered at SPT – PDPU Campus to the students not opting for credit exchange in that particular semester.

Courses highlighted with BLUE will be offered at Oklahoma Campus to the students opting for credit exchange in that particular semester.

Courses highlighted with BLACK are completely replicated with Oklahoma University.

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

B.TECH-PETROLEUM ENGG. (UPSTREAM) COURSE STRUCTURE

(In line with Oklahoma University)

Third Year, V Semester

PE-Petroleum Economics (PE-3712)										
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
2	--	--	2	2	--	--	--	--	--	**100**

Application of petroleum engineering principles and economics to the evaluation of oil and gas projects; evaluation principles, time value of money concepts, and investment measures; cost estimating, price and production forecasting; risk and uncertainty, project selection, and capital budgeting.

Courses highlighted with RED will be offered at SPT – PDPU Campus to the students not opting for credit exchange in that particular semester.

Courses highlighted with BLUE will be offered at Oklahoma Campus to the students opting for credit exchange in that particular semester.

Courses highlighted with BLACK are completely replicated with Oklahoma University.

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

B.TECH-PETROLEUM ENGG. (UPSTREAM) COURSE STRUCTURE

(In line with Oklahoma University)

Third Year, V Semester

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	
3	0	0	3	3	25	50	25	--	--	**100**

Unit I : Numerical solution of Algebraic & Transcendental equations **Hours:10**

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.

Unit II : Finite Differences **Hours:10**

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. **Interpolation:** 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.

Unit III : Numerical Differentiation **Hours:10**

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 & Milne's method. **Numerical Solution of Partial Differential Equation:** Difference Quotients, Graphical representation, Classification of PDE's of 2^{nd} 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.

Unit IV : Introduction to Finite Elements Methods **Hours: 9**

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.

Total Hours: 39

Courses highlighted with RED will be offered at SPT – PDPU Campus to the students not opting for credit exchange in that particular semester.

Courses highlighted with BLUE will be offered at Oklahoma Campus to the students opting for credit exchange in that particular semester.

Courses highlighted with BLACK are completely replicated with Oklahoma University.

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

B.TECH-PETROLEUM ENGG. (UPSTREAM) COURSE STRUCTURE

(In line with Oklahoma University)

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, 5th 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, 3rd edition, Narosa .
6. Numerical Methods for Engineers by S C Chapra , Raymond P. Canale, Tata McGraw Hill Pub. Co. Ltd.

PE-Numerical Methods for Petroleum Engineering Computing (PE-3723)										
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	--	--	3	3	--	--	--	--	--	**100**

Course uses specific software applications tailored toward petroleum engineering majors. Basic methods for obtaining numerical solutions with a digital computer. Included are methods for the solutions of algebraic and transcendental equations, simultaneous linear equations, ordinary and partial differential equations, and curve fitting techniques. The methods are compared with respect to computational efficiency and accuracy.

Courses highlighted with RED will be offered at SPT – PDPU Campus to the students not opting for credit exchange in that particular semester.

Courses highlighted with BLUE will be offered at Oklahoma Campus to the students opting for credit exchange in that particular semester.

Courses highlighted with BLACK are completely replicated with Oklahoma University.

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