PE 323   Introduction to Research Methodology

Teaching Scheme					Examination Scheme					Total Marks
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Practical**		**Total**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	**Marks**
2	0	0	2	2	30	60	10	--	--	100

Unit I : Background   **Hours: 7**

Motivation for research, building a background, role of a supervisor, time and energy management, solving a problem, writing a paper, publishing and reviewing a paper

Unit II : Quantitative Methods   **Hours: 7**

Introduction to quantitative methods, statistics and research design, implementation of various statistical technique, research literacy, data gathering technique

Unit III : Critique   **Hours: 7**

Finding a problem, solving a problem, writing a paper, publishing and reviewing of paper, scientific ethics, collaborative work, presentation skill.

Unit IV   **Hours: 7**

Bibliometrics, Recognition, awards and prizes, research funding, Intellectual Property Right, Politics in Research environment.

Total Hours: 28

Texts and References:
1. Research Methodology: A step by step guide for beginners, SAGE publication.
2. Wayne C Both and Gregory G Colomb , The craft of research.
3. Robert K Yin, The Case Study Research: Design and Methods.

PE 324 Surface Production Engineering

Teaching Scheme					Examination Scheme					Total
					Theory			Practical		Total
L	T	P	C	Hrs/Week	MS	ES	IA	LW	LE/Viva	Marks
3	1	0	4	4	30	60	10	--	--	100

Unit I   **Hours: 12**

Separation: Classification of separators, Components of separator, Types of separator, Liquid level control and relative advantages/disadvantages of different type of separators.

Unit II   **Hours: 10**

Dehydration & Desalting of Oil, De-emulsification and Desalting process. Measurement- metering of Oil, Gas, Effluent Treatment

Unit III   **Hours: 10**

Storage of Oil and Gas: Storage tank for Oil, storage of LPG, Underground storage.

Unit IV   **Hours: 10**

Transportation & Metering: Gathering, Collector and Trunk pipeline system, Pipeline design (Friction Factor and flow type, Steady state liquid / Gas / Multiphase flow, Economic pipe diameter, Allowable pressure drop and velocity). Flow improver (Pour point depression and Drag reducer, heat treatment) and pigging in pipe lines.

Total Hours: 42

Texts and References:

1. Arnold Ken and Stewart Maurice, Surface Production Operations Vol-I and II.
2. Chillangarian G V, Surface Operations in Petroleum Production.
3. Huges J R and Swindles, Storage and Handling of Petroleum Liquids.
4. Alex Marks, Petroleum Storage Principles.

PE 325 Well Test Analysis and EOR

Teaching Scheme					Examination Scheme					
					Theory			Practical		Total
L	T	P	C	Hrs/Week	MS	ES	IA	LW	LE/Viva	Marks
3	1	0	4	4	30	60	10	--	--	100

Unit I : Well Test Analysis   **Hours: 12**

Principles of fluid flow for steady state, semi steady state & non steady state conditions. Diffusivity equation derivation & Constant Terminal Rate Solution, Drill Stem Testing: Equipment, DST Chart observation, analysis & interpretation

Unit II   **Hours: 10**

Pressure Transient Tests: Pressure Build-up / Draw-down tests, RLT (Reservoir Limit Test) etc. for both oil and gas. Advanced Pressure Transient Analysis, Gas Well tests: Flow after flow, isochronal, modified isochronal tests. Other tests: Interference and pulse tests, Pressure Fall Off test in Injection wells. Multi rate tests, pulse test, Average reservoir pressure. PBU / PDD in Horizontal wells, Type Curves & their uses

Unit III : EOR and Water Injection   **Hours: 10**

Introduction to EOR, Reservoir Engineering aspects of enhanced recovery methods, Water Flooding concepts – well spacing for fluid injection. Buckley Leverett Principle for immiscible flooding & Mobility Ratio Concepts.

Unit IV : Other EOR Techniques   **Hours: 10**
Polymer Flooding, Surfactant flooding, Caustic flooding, ASP – Principles and applications. Miscible Flooding: Principles and applications of CO_2 flooding, Dry & Enriched gas flooding. Inert Gas Flooding, WAG flooding, Thermal processes in EOR.

Total Hours: 42

Texts and References:

1. John Lee, Well Test Analysis.
2. R.C. Earlougher, Modern Well Test Analysis.
3. **Mathews and Russel, Well Testing**

PE 326 Petroleum Engineering Laboratory

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

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.

PE 327 Seminar							
Teaching Scheme					**Examination Scheme**		
L	**T**	**P**	**C**	**Hrs/Week**	**Report writing**	**V/V**	**Total**
0	**0**	**2**	**2**	**4**	**80**	**20**	**100**

Aim: To improve the presentation and inter-personal skill of the students

PE 331 Advanced Drilling

Teaching Scheme					Examination Scheme					
					Theory			Practical		Total
L	T	P	C	Hrs/Week	MS	ES	IA	LW	LE/Viva	Marks
2	1	0	3	3	30	60	10	--	--	100

Unit I   **Hours: 4**

Directional Drilling Technology, Objectives of Directional Drilling. Tools for deflection & orientation. Directional well profiles and well path – deflection & corrections Motor Types: PD motors and Turbo-drills; their description, power calculations and applications

Unit II   **Hours: 12**

Horizontal Well Drilling, Introduction of Horizontal well drilling: Objectives & selection, Drilling techniques and different well profiles, Special mud requirements and their characteristics. Measurements While Drilling: Objectives of MWD / LWD their tools, telemetry system and data interpretation Well Surveying: Objectives & methods. Surveying analysis & calculations for well coordinates Directional drilling problems & their remedies Auto and Verti-track systems: Rotary steerable motors and geo-steering tools.

Unit III   **Hours: 6**

Directional, Horizontal & Multilateral Well Economics: Slant Hole Drilling: Objectives & selections of rig etc., Well profiles & applications.

Unit IV   **Hours: 6**

Special Drilling Methods: Aerated / under balanced / overbalanced / HP-HT / plasma / electrical / top-drive / re-entry / extended   reach / jet / multilateral / slim-hole and coil tubing drilling methods.

Total Hours: 28

Texts and References:

1. 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.
2. Watson, D., Terry Brittenham and Preston Moore (2002) Advanced Well Control Manual., SPE Textbook Series, 2002
3. Joshi, S. D. (1991) Horizontal Well Technology, Penn Well Publishing.
4. Adam, N. J. (1980) Well control Problems and Solutions. Petroleum Publishing Company
5. Lummus, J. L. and Azar, J. J. (2007) Drilling fluids optimization, Pennwell Books
6. Lapeyrouse, N. J. (2002) Formulas and Calculation for Drilling, Gulf Professional Publishing.

MA 301T Advanced Numerical Methods

					Theory			Practical		Total
	Teaching Scheme				**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs/Week**	**MS**	**ES**	**IA**	**LW**	**LE/Viva**	**Total Marks**
3	1	0	4	4	30	60	10	--	--	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:15

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 2nd 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: 7

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: 42

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.

						Theory			Practical		Total
						Theory			**Practical**		**Total**
L	**T**	**P**	**C**	**Hrs/Week**		**MS**	**ES**	**IA**	**LW**	**LE/Viva**	**Marks**
2	1	0	3	3		30	60	10	--	--	100

PE 345 Prime movers, Pumps and Compressors

Teaching Scheme					Examination Scheme						

Unit I   **Hours: 7**
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: 7**
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: 7**

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: 7**

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: 28

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 346 PETROLEUM EQUIPMENT DESIGN

Teaching Scheme					Examination Scheme					Total
					Theory			Practical		
L	T	P	C	Hrs/Week	MS	ES	IA	LW	LE/Viva	Marks
2	1	0	3	3	30	60	10	--	--	100

Unit I   **Hours: 8**

Casing program, casing and tubing design, principles of cementing, completion added skin, well perforating, hydraulic fracturing. Drill bit design, .roller cone bits, pdc drill bits, nomenclature and IADC codes for drill bits. BHA (Bottom hole assembly). ESP(Electrical submersible pumps). SRP(Sucker rod pumping) unit design.

Unit II   **Hours: 7**

Design of Surface Facilities -Design of production and processing equipment, including deparation problems, treating, and transmission systems, Capstone design

Unit III   **Hours: 6**

Oil desalting-horizontal and spherical electrical dehydrators- Natural Gas Dehydration-Horton sphere- Natural Gas Sweetening. Crude & Condensate Stabilization-design of stabilizer- Oil and Gas Treatment. Treating Equipment.

Unit IV   **Hours: 7**

Refinery Equipment Design-atmospheric distillation column Design and construction of on/ offshore pipelines, Fields Problems in pipeline, Hydrates, scaling & wax etc and their mitigation..

Total Hours: 28

Texts and References:

1. Petroleum Exploration Hand Book by Moody, G.B.
2. Wellsite Geological Techniques for petroleum Exploration by Sahay.B et al
3. Standard Hand Book of Petroleum & Natural Gas Engineering" – 2nd Edition 2005-William
4. C.Lyons & Gary J.Plisga-Gulf professional publishing comp (Elsevier).