FACULTY OF ENGINEERING

Syllabus for the

M.E (Petroleum Engineering)

(W.e.f 2008-2009)

THE SYLLABUS IS PREPARED BY:

BOS- Petroleum and Petrochemical Engineering
University of Pune

PEER REVIEW BY:

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Note: - This syllabus is subject to change without prior notice by the concerned BOS

UNIVERSITY OF PUNE
STRUCTURE OF M.E. (PETROLEUM ENGINEERING)
REVISED TWO-YEAR COURSE (2008)

SEMESTER I

Code	Subject	Teaching Scheme		Examination Scheme					Credits
		L	Pr.	P	TW	Or	Pr	Total	
512101	Numerical Methods and simulation in Petroleum Engineering	3	-	100	-	-	-	100	3
512102	Petroleum Reservoir Management	3	-	100	-	-	-	100	3
512103	Horizontal, Multilateral and Intelligent wells	3	-	100	-	-	-	100	3
512104	Elective I	3	-	100	-	-	-	100	3
512105	Elective II	3	-	100	-	-	-	100	3
512106	Lab Practice I	-	6	-	50	-		50	3
512107	Seminar I	-	4	-	50	-	-	50	2
Total of First Term		15	10	500	100	-	-	600	20

512104 Elective I

a) Advanced Geological Methods in Petroleum Exploration and Development
b) Reservoir Petrophysics
c) Oil and Gas Field Development
d) Petroleum Business Strategies and Risk Analysi**s**

512105 Elective II

a) Modern Completion Technology
b) Well Design and Engineering
c) Well Testing and Analysis
d) Well Control

SEMISTER II

Code	Subject	Teaching Scheme		Examination Scheme					Credits
		L	Pr	P	TW	Or	Pr	Total	
512108	GIS and Computer Applications in Petroleum Industry	3	-	100	-	-	-	100	3
512109	Environmental Management Technology and Safety Measures	3	-	100	-	-	-	100	3
512110	Advanced Natural Gas Engineering	3	-	100	-	-	-	100	3
512111	Elective III	3	-	100	-	-	-	100	3
512112	Elective IV (Open)	3	-	100	-	-	-	100	3
512113	Lab Practice II	-	6	-	50	-		50	3
512114	Seminar II	-	4	-	50	-	-	50	2
Total of Second Term		15	10	500	100	-	**-**	600	20

512111 Elective III

a) Artificial Lift Techniques
b) Advanced Stimulation Techniques
c) Piping Design and Engineering
d) Advanced Offshore Technology

512112 Elective IV (Open)

a) Technology of Coal Bed Methane
b) Unconventional Hydrocarbon Resources and Development Strategies
c) Open elective, can be taken from any branch of elective

SEMISTER III

Code	Subject	Teaching Scheme		Examination Scheme					Credits
		L	Pr	P	TW	Oral	Pr	Total	
512115	Seminar III	-	4	-	50	-	-	50	2
512116	Project Stage I	-	18	-	50	-		50	6
Total of Third Term		-	22	-	50	-	-	50	08

SEMISTER IV

Code	Subject	Teaching Scheme		Examination Scheme					Credits
		L	Pr	Project	TW	Oral	Pr	Total	
512116	Project Stage II	-	18	150*	-	50		250	12
Total of Fourth Term		-	18	200	-	50	-	250	12

Note- The Contact Hours for the calculation of load of teacher
Seminar- 1 Hr / week / student, Project - 2 Hr / week / student

* The Term Work of Project stage II of semester IV should be assessed jointly by the pair of internal and external examiners along with the oral examination of the same.

512101 Numerical Methods and Simulation in Petroleum Engineering

Teaching Scheme:	Examination Scheme:
Lectures: 4 Hours/Week	Paper: 100 Marks Duration: 3 Hours.

Overview of Reservoir Geology and Engineering:

Numerical Reservoir Simulation: Introduction and overview:

Reservoir fluid and rock properties. Formulation of basic equations for single-phase flow. Discrete flow equations for single phase flow: finite difference approximation. General reservoir flow equations. Reduction to the black oil model. Discretisation of the black oil equations. Truncation errors and stability. Transmissibilities, upstream weighing, implicit and explicit treatment of transmissibilities. Numerical dispersion and gridorientation effects. The IMPES method. Model and grid selection. Model initialization. Representation and Treatment of wells in simulators. Pseudo-functions. Compositional reservoir simulator equations. Fractured reservoir models. Thermal models. History matching. Planning and executing a reservoir simulation study.

Reservoir simulation and management.

Selecting a numerical method to solve the problem.

Reference Books:

Mattax, C. C. and Dalton, R. L.: Reservoir Simulation, SPE Monograph, 1990.

Fanchi, J. R.: Applied Reservoir Simulation, Gulf Publishing Co., 1997.

Thomas, G. W.: Principles of Reservoir Simulation, IHRDC Pub. 1982.

Armin Iske, and Trygve Randen (Editors), Mathematical Methods and Modelling in Hydrocarbon Exploration and Production, Part III. Springer, 2004.

Carlson, M., “Practical Reservoir Simulation”, Pennwell, 2003.

Chapra, S. C. and Canale, R. P.: Numerical Methods for Engineers, McGraw Hill, 1998

512102 Petroleum Reservoir Management

Teaching Scheme:	Examination Scheme:
Lectures: 4 Hours/Week	Paper: 100 Marks Duration: 3 Hours.

Geology of Reservoirs. Rock and fluid properties. Reservoir System, Reservoir Heterogeneities / Anisotropies. Geostatistics in Reservoir characterization.

Reservoir Management Concepts and Processes, Fundamentals, Data acquisition, interpretation and integration.

Static and Dynamic Reservoir Modeling, Integration of exploration and development technology

Reservoir Performance Analysis and Prediction, Conservation of reservoir energy. Influence of reservoir structure on water control

Reservoir Economics: risk and uncertainties, economic evaluation and optimization

Applications of Improved Recovery Processes, new drilling, completion and production technology. Use of artificial intelligence.

Case studies from petroleum literature

Reference Books:

Armin Iske, and Trygve Randen (Editors), Mathematical Methods and Modelling in Hydrocarbon Exploration and Production, Part I and II. Springer, 2004.

Carlson, M., “Practical Reservoir Simulation”, Pennwell, 2003

Cossentino, Intergraded Petroleum Studies, Technip, 2001.

Mattax, C. C. and Dalton, R. L: Reservoir Simulation, SPE Textbook Series, 1984.

Satter, A. and Thakur, G. C.: Integrated Petroleum Reservoir Management, PennWell Pubs, 1994.

SPE Reprint Series, **48,** Reservoir Management**,** Dallas (1998).

512103 Horizontal, Multilateral and Intelligent wells

Teaching Scheme:
Scheme:
Lectures: 4 Hours/Week

Examination

Paper: 100 Marks
Duration: 3 Hours.

Review of conventional drilling techniques. Review of drill string and casing design, conventional well control techniques.

Study of directional drilling, horizontal drilling and multilateral drilling: types, objectives, technology, equipments, and methods, sidetracking techniques. Intelligent (Smart) Wells. Downhole monitoring and control. Optimization of multilateral well performance.

Comparison with vertical drilling techniques, reservoir engineering concepts and well completions.

Applications of above drilling techniques in field development. Development of tight reservoirs. Recent Trends.

MWD, LWD, drilling economics, drilling optimization methods, associated problems. Economics of complex wells.

Case Studies from Petroleum literature.

Reference Books:

Borgoyne, A. T., Chenevert, M. Milheim, K., Young, F. S.: Applied Drilling Engineering, SPE Textbook Series, 1985.

Joshi, S: Horizontal Drilling, Penn Well Books, 1991.

Rabia, H. Oil Well Drilling Engineering, Principles and Practice, Graham and Trotman, 1993.

Short, J. A.: Introduction to Directional and Horizontal Drilling, Penn Well Books, 1993.

Advanced Exploitation Technology Manual, MAURER ENGINEERING INC, 2000

Supplemental papers from the literature

512104 **Elective I**

a. Advanced Geological Methods in Petroleum Exploration and Development

Teaching Scheme:
Scheme:
Lectures: 4 Hours/Week

Examination

Paper: 100 Marks
Duration: 3 Hours.

Overview of Petroleum Geosystem. Petroleum traps.

Petrography of reservoir rocks, application of core data, structural and stratigraphic applications of log and dipmeter data, reservoir geology models for development planning particularly water flooding and Enhanced Oil Recovery (EOR) operations.

Geological considerations in reservoir heterogeneity and reservoir characterization, application of seismic techniques to reservoir delineation, shale geology, subsurface pressure systems, origin, measurement and detection of abnormal pressures.

Spatial and temporal distribution of hydrocarbons, Model approach to exploration stratigraphy with reference to petroliferous basins. Seismic stratigraphy and seismic modeling for hydrocarbon detection.

Tectonics, sedimentation and exploration history of important world occurrences.

Geological Risk analysis
.

Reference Books:

Jahn, F. Cook, Graham, M.: Hydrocarbon Exploration and Production, Elsevier, 1989.

Coffeen, J. A.: Interpreting Seismic Data, Penn Well, 1984.

Dikkers B. J.: Geology in Petroleum Production, Elsevier Pubs.
Magara K.: Geological Models and Petroleum Entrapment, Elsevier Applied Scinet Pubs.

Visher G. S.: Exploration Stratigraphy, 2nd Edition.

512104 **Elective I**

b. Reservoir Petrophysics

Teaching Scheme:	Examination
Scheme:	
Lectures: 4 Hours/Week	Paper: 100 Marks
	Duration: 3 Hours.

Conventional methods of interpretation of well logs and recent developments in petrophysics. Qualitative and quantitative estimation of different parameters.

Porosity- Permeability relationship, empirical equations, correlation Formation Resistivity and Water Saturation, Capillary Pressure and Wettability, Borehole Environment.

Darcy's Law: Flow of fluids in porous media, flow of gas in porous media, flow in multiple permeability rocks with or without cross flow. Relative permeability.

Classification and properties of reservoir fluids

Effect of Stress on Rock Properties

Fluid Rock Interactions: Importance of near wellbore permeability, types of fines, effect of fines migration, critical velocity concept, identification of permeability damage.

Reference Books:

Tiab, D. and Donaldson, E. C. : Petrophysics, Gulf Publishing Co., 1996.
Lake, L. : Enhanced Oil Recovery, PennWell Pub., 1991.

Cossentino, Intergraded Petroleum Studies, Technip, 2001.

Asquith George & Krygowski Daniel: Basic Well Log Analysis. USA. AAPG, 2004

Supplemental papers from the literature

512104 **Elective I**

c.)Oil and Gas Field Development

Teaching Scheme:
Scheme:
Lectures: 4 Hours/Week

Examination

Paper: 100 Marks
Duration: 3 Hours.

Review of various geological, reservoir engineering and petroleum production principles and methods with reference to oil and gas field development. Drainage of oil and gas reservoirs by wells.

Theoretical fundamentals of oil field development. Necessity and scope of development plan. Various stages in the life of oil and gas field development. Requirement of data sources.

Various field data sample collection. Well surveys. Laboratory analysis. Creation of integrated approach for statistical. Technical and cost database.
Hydrocarbon reserves in place. Planning for field exploitation under natural mechanism. Well spacing and location. Well Performance. Field production performance evaluation.

Need of additional energy for pressure maintenance of a reservoir. Techniques for various artificial lift methods. Field evaluation for EOR. Field development with application of secondary and tertiary recovery.

Field development with reservoir management. Application of mathematical modeling and computer simulation for optimum field development.
Economics of field development. Consideration of down stream utilization and consumption.

Special consideration for gas field developments.

Development of marginal fields. Indian Scenario.

Planning of various surface installations, Group Gathering Stations. Pipe line transportation of oil and gas. Pumping stations. Use of SCADA / DCS. Future field expansion. The ecological and environmental aspects. hazard and remedies

Reference Books

Santkumar, Oil and Gas Field Development. 2000 India

Laxman Singh, Oil and Gas Fields of India. Indian Petroleum Publishers. 2000

Supplemental papers from the literature

512104 **Elective I**

d) Petroleum Business Strategies and Risk Analysis

Teaching Scheme:	Examination
Scheme:	
Lectures: 4 Hours/Week	Paper: 100 Marks Duration: 3 Hours.

Introduction to upstream economic analysis, energy overview of India.

Time Value of Money, cash flow analysis, capital budgeting techniques, general probability, elements of oil and gas project cash flows.

Reserves classification methods, quantification, assessment of geoscience and reservoir engineering uncertainties.Assessment of reserves, production and demand in international market.

Inflation and cost escalation, oil market and OPEC, share of non OPEC countries in oil production,

International oil and gas pricing mechanism. Geopolitics.

Petroleum Fiscal System, classification and analysis. Reserves Auditing.

Accounting systems for oil and gas

Project Economic Evaluation and Petroleum economic models. Decision analysis, Valuation of petroleum properties

Reference Books:

Abdel-Aal, H. K. Bakr, A. B. Al-Sahlawi, M. A. : Petroleum Economics and Engineering, Dekrer Publication, 1992.

Cronquist, C., Estimation and Classification of Reserves of Crude Oil, Natural Gas, and Condensate, SPE (2001)

Johnston, D, “International Exploration Economics, Risk, and Contract Analysis”, Pennwell Books, 2003.

Seba R. D., “Economics of Worldwide Petroleum Production”, OGCL Publications, USA, 1998.

Thompson R. S. and Wright J. D., “Oil Property Evaluation”, 2nd Edition, Thompson-Wright Associates, 1985.

512105 Elective II

a.) Modern Completion Technology

Teaching Scheme:
Lectures: 4 Hours/Week

Examination Scheme:
Paper: 100 Marks
Duration: 3 Hours

Well completion: types of wells, completion functions, types of completion Well completion design

Mechanical aspects of well testing, Subsurface completion equipment and accessories, Well Head Equipment, Interval selection consideration and optimization of tubing dimensions for maximum Production, Special consideration for horizontal and multilateral completions, Perforation of oil and gas wells, Sand Control, Reservoir stimulation

Data acquisition, SCADA systems,

Completion technology for unconsolidated formations, Intelligent completion equipment, Tubing string design (dimension, materials, connections,) based on pressure-temp. Operating conditions, safety requirements,

HPHT and horizontal well completions, Work over equipment: Wire Line, Snubbing Unit, Coil Tubing, Completion and Work over design and execution,

Deepwater completions. Recent trends.

Reference Books

Reservoir Stimulation, Dowell-Schlumberger

Gatlin, C.: *Petroleum Engineering, Drilling and Well Completions*, Prentice-Hall, Inc. (1960).

Gidley, J.L., *Recent Advances in Hydraulic Fracturing Monograph, Vol. 12,* SPE Richardson (1990).

Completion Technology for Unconsolidated Formations, Second edition, 1995.

Williams, et.al.: *Acidizing Fundamentals*, SPE Monograph No. 6, SPE

Supplemental papers from the literature

512105 Elective II

b) Well Planning and Design

Teaching Scheme:	Examination
Scheme:	
Lectures: 4 Hours/Week	Paper: 100 Marks
	Duration: 3 Hours

Collection and preparation of data for well planning, Prediction of pore pressure and fracture gradient, Selection of well location, well trajectory, hole geometry and casing seats, Bit, mud, casing and cement plan, Completion effects on well planning, Rig sizing and selection, Well cost estimation and AFE preparation

Well selection, reservoir evaluation, costing

AFE selection, geological input, testing and completion requirement, drilling consideration,

Well plan organization and data gathering, Well Dynamics,Rig design consideration

Reference Books

Borgoyne, A. T., Chenevert, M. Milheim, K., Young, F. S.: Applied Drilling Engineering, SPE Textbook Series, 1985.

Denis Perrin, “Well Completion and Servicing” ISBN 2-7108-0765-3

Economides M et al. Editor by Petroleum Well Construction John Wiley and Sons, 1998

Craft B.C et al "Well Design - Drilling and Production”. Prentice-Hall, 1962,

Schechter R.S., “Oil Well Stimulation” Prentice Hall,1992

Supplemental papers from the literature

512105 Elective II

c) Well Testing and Analysis

Teaching Scheme:	Examination Scheme:
Lectures: 4 Hours/Week	Paper: 100 Marks Duration: 3 Hours.

Fluid Flow in Porous Media: Derivation of diffusivity equation, solutions of the equation, dimensionless quantities.

Pressure Build-up Tests: Procedure, analysis, multirate analysis, effects of fault, partial penetration, deviated wells.

Pressure Drawdown Tests: Procedure, analysis, multirate analysis.

Type Curve Analysis: Need, procedure, types of well that can be analyzed, typical examples using at least three different type curves.

Drill Stem Test: Detailed procedure, analysis, equipment used.

Other Well Tests: Gas well tests, interference tests, fractured well test, horizontal well tests.

Production testing equipment and well head equipment.

Software used to analyze above tests.

Reference Books:

Beggs D S. Gas Production Operations. OGCI Publications. 2002

Earlougher, R. C.: Advances in Well Test Analysis, SPE Monograph, 1977.

Lee, W. J.: Well Testing, SPE Textbook Series, 1982.

Mathews, C. S., Russel, D. G. : Pressure Build-up and Flow Tests in Well, SPE Monograph, 1967.

Streltsova, T. D.: Well Testing in Heterogeneous Formations, John Wiley and Sons, 1988.

512105 Elective II

d) Well Control

Teaching Scheme:	Examination Scheme:
Lectures: 4 Hours/Week	Paper: 100 Marks Duration: 3 Hours.

Review of drilling operations, fluids and functions, associated problems, causes of kicks, geology of normally / overpressured zones.

Review of rig hydraulics, pressure control procedures, kick indications, fluid dynamics in well control, problems and procedures in well control, underbalanced well control techniques.

Surface and subsurface equipment, valves, Blowout Preventors (BOP), BOP control system, operations, design considerations, blowout contingency planning, relief well design and operations.

Well control during testing, cementation operations, Well completion operations in abnormally pressured zones.

Offshore well control operations: Methodology, equipments, procedures, special considerations, multiwell hydraulic control system for sub sea completions.

Safety Procedures.

Case Studies.

Reference Books:

Grace, D. G.: Advanced Blowout and well control, Gulf Pubs., 1994.

Adams, N., Kuhlman : Kicks and Blowout Control, PennWell Books, 1994.

Goins, W. C. Sheffield, Riley : Blowout Prevention, Practical Drilling Technology, Volume I, Gulf Pubs., 1983.

Adams, N.: Well Control Problems and Solutions, Petroleum Pubs., Co., 1980.

512106 **Laboratory Practices I**

Teaching Scheme: Examination Scheme:
Practicals: 6 Hours/Week Term Work: 50 Marks

Each candidate should perform at least six experiments from the list of experiments given below and submit the journal, which will form the term work for the subject.

1) Experiments based on log interpretation, preparation and evaluation of log cross-section
2) Use of any standard log interpretation software.
3) Core flooding studies
4) Geological description well cuttings/cores.
5) Study of radioactive and electrical properties of rocks
6) .Data analysis of Pressure transient tests a) Pressure buildup b) Pressure draw down
7) Gas well testing data analysis a) Flow after flow test b) Modified isochronal test.
8) Study of typical step-by-step procedure for casing policy design.
9) Design of sand control system.
10) Design of a typical well completion job.
11) Study of any one of the standard software in petroleum engineering with respect to data input, data analysis and interpretation.
12) Study and design of gas lift string.
13) Study of multiphase flow regimes with their characteristics
14) Well Control Operations and Blowout Prevention assembly. Well Control methods and engineering Calculations. Control system.
15) 15. Directional Drilling and deviation control.

512107 Seminar I

Teaching Scheme: Examination Scheme:
Practicals: 1 Hour/Week Term Work: 50 Marks

Each student is required to deliver a seminar in the first semester.

Topic of the seminar should be based on current trends in advanced research emphasizing literature review. A seminar report of about 30 typed pages should be submitted under the supervision of teacher. Available case studies may also be incorporated.

512108 GIS and Computer Applications in Petroleum Industry

Teaching Scheme: Examination Scheme:
Lectures: 4 Hours/Week Paper: 100 Marks
Duration: 3 Hours.

Overview of operations of upstream oil industry.

Introduction to GIS, Spatial Data Models, Spatial Data Structures, Spatial Data Inputs, Visualization and Query of Spatial Data, Spatial Data Transformations, Tools for Map Analysis: single and multiple maps,

Geostatistics in data handling.

Environmental assessment. Petroleum industry case studies

Applications of different software used in Petroleum Industry.

Reference Books:

Burrough, P A and McDonnel R A, Principles of Geographic Information System, Oxford Univerosty Press, 1998

Demers, M. N.: Fundamentals of Geographic Information Systems, John Wiley and Sons, 1999.

Longley, P. A., Goodchild, M. F. MaGuire, D. J. Rhind, D. W. Geographical Information Systems and Science, John Wiley and Sons, 2001.

Fanchi, J. R.: Applied Reservoir Simulation, Gulf Pub., 1997.

Supplemental papers from the literature

512109 Environmental Management Technology and Safety Measures

Teaching Scheme:	Examination Scheme:
Lectures: 4 Hours/Week	Paper: 100 Marks Duration: 3 Hours.

Quality Environment Management**:** Planning and resource allocation, performance and review, compensation, quality practices

Components of Environment and Current Environmental Issues, Air Pollution and Control Methods, Meteorological Aspects of Air Pollutant Dispersion, Sources and Classification of Water Pollutants, HAZOP analysis,

Environmental control in Petroleum Industry, Drilling and production operations and environmental impact of discharge in the onshore and offshore areas, produced water and treatment. Planning for environmental protection.

Wastewater Treatment Technologies, solid waste disposal, hazardous waste, oilfield waste management. Operational practices and procedures

Accidents in oil industry and environmental degradation, contingency plans, disaster management

Integrated Environmental Biotechnology in Petroleum Industry,

Environmental Regulations, sensitive habitants, Health and Safety laws, quality assurance.

Decommissioning of oil and gas installations

Reference Books:

Boyce, A., “Introduction to Environmental Technology”, John Wiley and Sons, 1996

Duhalt V R and Ramirez-Quintero R, Petroleum Biotechnology: Principles and Perspectives, Elsevier, 2004.

Evans, G M and Furlong, J C, Environmental Biotechnology: Theory and Applications, John Wiley and Sons, 2001.

Orzu Orszulik, “Environmental Technology in oil Industry”, Springer – Verlag, 1996.

Reis, J. C.: Environmental Control in Petroleum Engineering, Gulf Pubs. 1996.

Kletz T, Learning from Accidents, Gulf Professional Publishing, 2001.

Supplemental papers from the literature

512110 Advanced Natural Gas Engineering

Teaching Scheme:	Examination Scheme:
Lectures: 3 Hours/week	Paper: 100 Marks Duration: 3 Hours.

Properties and Measurement of Natural Gas:

Phase behavior fundamentals, qualitative and quantitative phase behavior, vapor liquid equilibrium.

Equation of state, critical pressure and temperature determination. Gas compressibility, viscosity and thermal conductivity, formation volume factor.

Gas flow measurement, and fundamentals,

Gas Reservoir Performance

Steady State Flow of Gas in Production Tubing

Temperatures profiling in flowing gas systems.

Natural gas processing Gas Compression

Gas Gathering and Transport

Installation, operation and trouble shooting of natural gas pipelines

Books

Beggs, D, H, Gas Production Operations. Edition Technip. 1984

Chaudhary, Amanat U, Gas well Testing Handbook, Elsevier, 2003

Lee, J, Wattenbarger, R. A., “Gas Reservoir Engineering”, Society of Petroleum Engineers, TX, USA, 1996.

Ikoku, Chi, “Natural Gas Production Engineering”, John Wiley and Sons, 1984.

Kumar Sanjay, “Gas Production Engineering”, Gulf Professional Publishing, TX, USA, 1987.

Mokhatab, s, Poe, W A and Speight, J G, Handbook of Natural Gas Transmission and Processing, Gulf Professional Publishing, 2006.

512111 Elective III

a. Artificial Lift Techniques

Teaching Scheme:	Examination Scheme:
Lectures: 4 Hours/Week	Paper: 100 Marks Duration: 3 Hours.

Workover Operations: Sand control, paraffin and asphaltene control and removal, causes of formation damage, remedial measures, scale removal. Necessary equipment.

Well Inflow and outflow performance and multiphase flow in pipes. Flow assurance

Gas Lift: Types, design of continuous and intermittent lift, gas lift valve design, performance prediction and optimization.

Pump Assisted Lift: Sucker Rod Pumps. Electrical Submersible pumps. Plunger Lift

Hydraulic Fracturing, Acidizing. Acid Fracturing: Design of an acid fracturing job, predicting depth of penetration in carbonate and sandstone reservoirs.

Production Optimization,

Reference Books:

American Petroleum Institute, API Gas Lift Manual, third Edition, 1994.

Brown, K.: *Technology of Artificial Lift, Vol. 1 - Vol. 4,* Penn Well Publishing Co., Tulsa (1984).

Allen, T.O., and Roberts, A.P.: Production Operations Vol. 1 and 2: Well Completions, Work over and Stimulation, fourth edition, OGCI (1993).

Economides, M., Hill, A.D., and Ehlig-Economides, C.: *Petroleum Production Systems,* Prentice Hall (1994).

Guo B, Lyons, W C, and Ghalambar Ali, Petroleum Production System: A computer Assisted Approach, Elsevier, 2007

512111 Elective III

b) Advanced Stimulation Techniques

Teaching Scheme:	Examination
Scheme:	
Lectures: 4 Hours/Week	Paper: 100 Marks Duration: 3 Hours.

Reservoir Stimulation in Petroleum Production,

Formation Characterization: Well and Reservoir Testing, Rock Mechanics, Well Logs.

Basics of Hydraulic Fracturing, Mechanics, Fracturing Fluid Chemistry and Proppants, Performance of Fracturing Materials, Fracture Evaluation Using Pressure Diagnostics,

Fracture Treatment Design, Fracturing Operations, Post-Treatment Evaluation and Fractured Well Performance

Introduction to Matrix Treatments, Formation Damage: Origin, Diagnosis and Treatment Strategy, Additives in Acidizing Fluids,

Fundamentals of Acid Stimulation, Carbonate Acidizing Design, Sandstone Acidizing. Fluid Placement and Pumping Strategy, Matrix Stimulation Treatment Evaluation

Books

Reservoir Stimulation, Dowell-Schlumberger, 2004.

Gidley, J.L., Recent Advances in Hydraulic Fracturing Monograph, Vol. 12, SPE Richardson (1990).

Bourgoyne, A.T. Jr., Millheim, K.K., Chenevert, M.E., and Young, F.S. Jr.: *Applied Drilling Engineering Textbook Vol. 2*, SPE (1991).

Mitchell, Bill: Advanced Oilwell Drilling Engineering Handbook, Tenth edition, Mitchell (1995).

Williams, B.B., Gidley, J.L. and Schechter, R.S.: Acidizing Fundamentals, Monograph Series, Richardson, Texas, USA, Society of Petroleum Engineers (1979) 6.

Economides, Hill and Economides: Petroleum Production Systems

512111 Elective III

c) Enhanced Oil Recovery

Teaching Scheme:	Examination Scheme:
Lectures: 4 Hours/Week	Paper: 100 Marks Duration: 3 Hours.

Reservoir Engineering concept of Enhanced Oil Recovery (EOR) classification, comparative performance of different methods. Screening process and technical constraints.

Basic equations for fluid flow in permeable media, mass conservation, energy equations, and momentum equations.

Phase behavior, fluid properties, displacement efficiencies, volumetric sweep efficiency.

Chemical EOR Methods: Polymer, surfactant polymer, alkaline.

Gas Processes: Miscible, immiscible, carbon dioxide, nitrogen, LPG.

Thermal Processes: Hot water, steam flooding, insitu combustion.

Other EOR Processes: Microbial, huff and puff, Water Alternating Gas (WAG), Steam Assisted Gravity Drainage (SAGD).

Case histories from Petroleum Literature.

Reference Books:

Lake, L.: Enhanced Oil Recovery, PennWell Pub., 1991.

Donaldson, E. C., Chilngarian G. V., and Yen, T. F.: Enhanced Oil Recovery-I, Elsevier Pub., 1985.

Latil, M. : Enhanced Oil Recovery, Gulf Pub., 1980.

Green, D.W. and Willhite, G.P.: Enhanced Oil Recovery, SPE, 2003.

Supplemental papers from the literature

512111 Elective III

d) Advanced Offshore Technology

Teaching Scheme:	Examination Scheme:
Lectures: 4 Hours/Week	Paper: 100 Marks Duration: 3 Hours.

Introduction: sea and sub sea environment, water depths, waves, wind and ocean currents. introduction to offshore oil and gas system.

Offshore Structures. Deep Offshore Drilling and Cementing: Procedures, equipment, rig hydraulics, casing support systems, well cementing jobs.

Overview of subsea systems.

Methods of Station Keeping: Mooring systems, dynamic positioning, tensioning systems, surface motion compensation.

Testing: Downhole testing equipment, methods and types of test analysis. Production testing, completion and abandonment.

Transportation: Offshore pipelines, tankers, offshore separation facilities and storage.

Environmental Assessment.

Diving System: History, commercial diving, physiological constraints, diving capabilities and equipment, safety procedures.

Reference Books:

Lyons W C and Plisga G J (Editors), Standard Handbook of Petroleum and Natural Gas Engineering. Gulf Professional Publishing. 2005

Stewart H. R. : Drilling and Producing Offshore, PennWell Pubs.

Mazurkiewiez, B. K. : Offshore Drilling Completion and Production, ETA Offshore Seminars, PennWell Pubs., 1972.

Sheffield, R. Floating Drilling, Euipment and its use, Practical Drilling Technology, Volume-2, Gulf Publishing Co.

Mazurkiewiez, B. K. : Offshore Platforms and Pipelines, Trans Tech Pubs., 1987.

512112 Elective IV (Open)

a) Piping Engineering and Technology

Teaching Scheme:
Lectures: 3 Hrs/Week

Examination Scheme:
Paper: 100 Marks.
Duration: 3 Hrs.

Pipeline systems definition and applications, codes and standard related to pipelines. Pipeline hydraulics: single phase gas and liquids, multiphase fluids and heavy /waxy crude. Design considerations for strength, stability and installation. Pipeline materials and components. design aspects, covering such issues as risers, slug catchers, pigging facilities, etc. Basic design considerations for pipeline facilities. Pipeline construction for cross country and offshore systems focusing on welding. Pressure testing, pre-commissioning and commissioning Pipeline integrity aspects including inline inspection. Leak detection and emergency planning considerations

Flow through pipe, Flow through perforated pipes and porous media. Two phase flow. Line sizing for steam, vacuum, and slurry pipeline. Piping networks. Piping manifolds.

Piping systems for petroleum products, yard piping; fire fighting, distillation and heat exchangers. Long distance pipelines.

Corrosion and materials of construction. Flow measurement. Pipe stress analysis and pipe supports. Pipe racks. Fabrication, installation and testing. Statutory regulations and safety aspects. Thermal insulation. Costing for piping.

Environmental Assessment.

Reference books:

Macetta, John. “Piping Design Handbook”, M.Dekker , 1992

Young Boi, Pipelines and Risers. Volume 3. Elsevier Ocean Engineering Book Series, 2001.

Parker, M E and Peattie E G, Pipeline Corrosion and Cathodic Protection. Third Edition. Elsevier USA, 2001.

Supplemental papers from the literature

512112 Elective IV (Open)

b) Technology of Coal Bed Methane

Teaching Scheme: Examination Scheme:
Lectures: 4 Hours/Week Paper: 100 Marks
Duration: 3 Hours.

CBM: Fundamentals of coal geology, sedimentology of coal, coal measures, diageneiss of coal/kerogen, coal gas generation and composition, measuring gas content, gas composition and capacity, reservoir characteristics like porosity, permeability system, diffusion and fractures.

CBM well planning, drilling, formation evaluation, completion and production.

Well Testing: Completion design and technique and open hole completions, fractures and cavity completions, artificial lift design.

Production Fundamentals: Equipment planning and design, gathering, processing and transportation, efficiency dewatering technique, reducing producing bottomhole pressure matrix shrinkage impact, infill drilling.

CBM reservoir engineering aspects like simulation, development and prediction, gas in place, effects of ash and moisture, use of well logs, estimating of porosity and permeability.

Environmental and Safety aspects of CBM production.

Reference Books:

Fasett: Geology and Coal Bed Methane Resources of the Northern San Haun Basin, Rocky Mountain Associations of Geologists, 1991.

Gayer, R. Harris, I : Coal Bed Methane and Coal Geology.

Curl, S. J. : Methane Prediction in Coal Mines, IEA Coal Research.

Mastalerz, K. : Coal Bed Methane-Scientific, Environmental and Economic Evaluation, Kluwer Academic Pubs., 1999.

Mavor, M.J. et al: A Guide to Coalbed Methane Reservoir Engineering

512112 Elective IV (Open)

c) Unconventional Hydrocarbon Resources and Development Strategies

Teaching Scheme:	Examination Scheme:
Lectures: 4 Hours/Week	Paper: 100 Marks Duration: 3 Hours.

Resources of oil and gas as conventional hydrocarbon sources, scenario in a crude oil depleted world, alternatives available.

Non-conventional petroleum resources, Economic and environmental considerations of the above fuels.

Synthetic fuels: Nonconventional raw materials other than crude oil as feedstock. Strategic needs for synthetic fuels. Options such as methanol. ethanol. medium calorific value gas. Hydrogen.

Criteria for consideration as a nonconventional raw material for synfuel. description of raw materials. Description and characteristics of liquids and gaseous synfuel options.

Mass Energy Transformations. Energy, Economics and Environment. Introduction to conversion technologies:

Reference Books

Carroll John, Gas Hydrates, A Guide for Engineers. Elsevier USA, 2003

Kandiyoti R, Herod A and Bartle K, Solid Fuels and Heavy Hydrocarbon Liquids: Thermal Characterization and Analysis. Elsevier, 2006.

Fanchi J R, Energy: Technology and Directions for the Future .Academic Press, Elsevier. 2004

Supplemental papers from the literature

512113 Lab Practice II

Teaching Scheme: Examination Scheme:
Practicals: 6 Hours/Week Term Work: 50 Marks

Each candidate should perform at least two experiments from each group from the following list given below and submit the journal which will form the term work for the subject.

Group I: Study of Production Engineering design problems
Group II: Study of Geographical Information Systems.
Group III: Study of numerical solutions related to problems in Petroleum engineering using MATLAB or equivalent mathematical software package.
Group IV: Computer programming assignments for Reservoir Simulation.
Group V: (a) Conceptual and mechanical design of a simple experiment to illustrate a reservoir rock/fluid property.
(b) Study of corrosion of metals.
(c) Study of Gas Chromotography to analyse hydrocarbons.
(d) Study of properties of LPG.
(e)ASTM Distillation
(f) Chemical analysis of water.

512114 Seminar II

Teaching Scheme: Examination Scheme:
Practicals: 1 Hour/Week Term Work: 50 Marks

Each student is required to deliver a seminar in the second semester and submit a report of about 30 typed pages. Topic of the seminar should be based on the chosen discipline of research suggesting current trends in advanced research. It should be based on literature survey related to identified problem for research.

512115 Seminar III

Teaching Scheme: Examination Scheme:
Practicals: 4 Hour/Week Term Work: 50 Marks

Each student is required to deliver a seminar in the third semester based on the chosen discipline of research for dissertation work.

512114 Dissertation Stage I

Teaching Scheme: Examination Scheme:
Practicals: 18 Hours/Week Term Work: 50 Marks

Students, under the supervision of an internal teacher and/or an external teacher/guide, should, undertake a project in a specialized area of Petroleum Engineering. They should first undertake an extensive library search for articles/books/web sites on the required topic.

512114 Dissertation Stage II

Teaching Scheme: Examination Scheme:
Practicals: 18 Hours/Week Term Work: 200 Marks
Oral: 50 Marks

Students should, under the supervision of an internal teacher and/or an external teacher/guide undertake to do a project in a specialized area of Petroleum Engineering. They should first undertake an extensive library search for articles/books/web sites on the required topic. This work should be a solution to an original practical problem or original research work related to Petroleum Engineering. The final typed dissertation should clearly state the problem, work accomplished and conclusions. The typed dissertation work should be ready before the oral defiance.