Petroleum engineering syllabus

Petroleum engineering examinations

Group A - Compulsory examinations (seven required)

24-Pet-A1 Principles of Stratigraphy and Sedimentation

Sedimentary processes, environments and facies; properties and classification of sedimentary rocks; stratigraphic code, nomenclature and the stratigraphic column; stratigraphic relationship and interpretations.

Textbooks (most recent edition is recommended):

Primary Text:

- Boggs, S. Principles of Sedimentology and Stratigraphy, 3rd edition, Pearson.

Secondary Text:

- Krumbein, W.C. and Sloss, L.L. Stratigraphy and Sedimentation. W.H. Freeman & Co.
- Walker, R.G. (Editor), Facies Models. Geoscience Canada Reprint Series 1, Geological Association of Canada.
- Prothero, D.R., Interpreting the Stratigraphic Record. W.H. Freeman & Co.

24-Pet-A2 Petroleum Reservoir Fluids

Qualitative and quantitative phase behaviour of hydrocarbon reservoir fluids, including natural gases and oil, PVT data and equations of state of ideal and non-ideal gases and liquids. Properties of gases, oil, and oilfield water. Reservoir fluid studies and the application of fluid properties for compositional analyses. Phase separation and gas-liquid equilibria.

Textbooks (most recent edition is recommended):

Primary Text:

- McCain Jr., W.D. The Properties of Petroleum Fluids, 3rd edition. The Petroleum Publishing Co., Tulsa, Oklahoma.

Secondary Text:

- Amyx, J.W. Bass, D.M. and Whiting, R.L. Petroleum Reservoir Engineering. McGraw Hill, Toronto.

24-Pet-A3 Fundamental Reservoir Engineering

Rock porosity and absolute permeability: definition, measurement, and models. Rock-fluid interactions: interfacial tension, wettability, relative permeability, capillary pressure. Single and multiphase flow through porous media. Steady and unsteady Darcy flow of single fluid. Immiscible and miscible flows. An introduction to oil and gas material balance equations, and drive indices.

Textbooks (most recent edition is recommended):

Primary Text:

- Dake, L., Fundamentals of Reservoir Engineering, Elsevier, Amsterdam.
- Terry, R.E., Brandon, R., Craft, B.C., and Hawkins, M.S. Applied Petroleum Reservoir Engineering. Prentice-Hall, Englewood Cliffs, N.J.

Secondary Text:

- Amyx, J.W., Bass, D.M., and Whiting, R.L. Petroleum Reservoir Engineering. McGraw-Hill, Toronto.

24-Pet-A4 Oil and Gas Well Drilling and Completion

Drilling rig types, components and selection. Rotary drilling, drilling fluids, drilling hydraulics, penetration rates, and drilling operations. Coring and core analyses, drillstem testing, casing design and seat selections. Formation damage. Cementing procedures, and well completion. Special topics including directional drilling, blowout control, hole stability, planning and cost control, underbalanced drilling, coiled tubing drilling, offshore drilling operations, and environmental aspects.

Textbooks (most recent edition is recommended):

Primary Text:

- Bourgoyne, A.T., Millheim, K.K., Chenevert, M.E., and Young, F.S. Applied Drilling Engineering. Society of Petroleum Engineers, Richardson, TX.

Secondary Text:

- Gatlin, C., Petroleum Engineering, Drilling and Well Completion. Prentice-Hall, Englewood Cliffs, N.J.

24-Pet-A5 Petroleum Production Operations

Principles of oil and gas production mechanics. Reservoir Inflow performance. Wellbore hydraulics and multiphase flow. Nodal analysis for production optimization. Acidizing and hydraulic fracturing. Artificial lift including sucker-rod pumping, electrical submersible pumps, progressive cavity pumps, and gas lift. Wellbore damage, workover operations and stimulation methods. Surface facilities: storage, separators, flow measurement, and produced water treatment and disposal.

Textbooks (most recent edition is recommended):

Primary Text:

- Economides, M., A.D. Hill, C. Ehlig-Economides, and D. Zhu. Petroleum Production Systems. Prentice Hall, Inc., Upper Saddle River, NJ.
- Allen, T.O. and A.P. Roberts, Production Operations, Vols. 1 & 2. Oil & Gas Consultant International (OGCI), Inc., Tulsa, OK.
- H.D.Beggs. Production Optimization Using NODAL* Analysis. Oil & Gas Consultant International (OGCI), Tulsa, OK.

Secondary Text:

- Kumar, S, Gas Production Engineering. Gulf Publishing Co., N.B.
- Nind, T.E.W., Principles of Oil Well Production, McGraw-Hill Book Co., New York.
- Dake, L., Fundamentals of Reservoir Engineering, Elsevier, Amsterdam.

24-Pet-A6 Well Logging and Formation Evaluation

Theory, engineering, and applications of measurements of physical properties of the near-wellbore formation. Types of well logging devices. Conventional logging interpretation and its applications in oil and gas reservoirs. Introduction to geophysical interpretation.

Textbooks (most recent edition is recommended):

Primary Text:

- Bassiouni, Z. Theory, Measurement, and Interpretation of Well Logs. Society of Petroleum Engineers (SPE), Richardson, TX.

Secondary Text:

- Helander, D.P., Fundamentals of Formation Evaluation. Oil and Gas Consultants International Inc., Harvard, Tulsa, OK.
- Serra, O., Fundamentals of Well-Log Interpretation, Volume 1: The Acquisition of Logging Data. Elsevier, New York, N.Y.
- Ellis, D.V., Well Logging for Earth Scientists. Elsevier, Amsterdam.
- Dewan, J.T., Essentials of Modern Open-Hole Log Interpretation. Penn Well Books, Tulsa, OK.
- Log Interpretation Principles/Applications. Schlumberger, Canada.
- Log Interpretation Charts. Schlumberger, Canada.
- Lines, L.R. and R.T. Newrick, Fundamentals of Geophysical Interpretation, Number 13 (2004). Geophysical Monograph Series. Society of Exploration Geophysicists (SEG); Houston, TX.

24-Pet-A7 Secondary and Enhanced Oil Recovery

Classification of EOR methods. Areal, vertical, and volumetric sweep efficiencies; Trapping and mobilization of residual oil. Predictive models for immiscible displacement. Frontal advance theory and Buckley-Leverett-Weldge approach. Chemical (alkaline, polymer, surfactant, micellar injection) flooding. Miscible-immiscible gas (hydrocarbon and CO2) injection. Thermal recovery techniques.

Textbooks (most recent edition is recommended):

Primary Text:

- Green, D.W. and Willhite, G.P. Enhanced Oil Recovery, SPE Text Series Vol. 6, Society of Petroleum Engineers, Richardson, TX.
- Craig, F.F. The Reservoir Engineering Aspects of Water Flooding. Monograph No. 3, Society of Petroleum Engineers of AIME.
- Stalkup, Fred. Miscible Displacement. Monograph No.8, Henry Doherty Series, Society of Petroleum Engineers of AIME.
- Prats, Michael. Thermal Recovery. Monograph No. 7, Henry Doherty Series, Society of Petroleum Engineers of AIME.

Secondary Text:

- Craft, B. C. and Hawkins, M.S. (revised by Terry, R.E.). Applied Petroleum Reservoir Engineering, Englewood Cliffs, N.J.

Group B - Optional examinations (two required)

24-Pet-B1 Natural Gas Engineering

Reserves estimation. Steady, transient, Darcy and non-Darcy gas flow through porous media; well testing, buildup and drawdown tests. Gas well deliverability and well interference. Decline curve analysis. Development and production of unconventional gas reservoirs (coal beds, hydrates, tight sand, and shale gas). Gas flow measurements, flow through conduits, and surface facilities.

Textbooks (most recent edition is recommended):

Primary Text:

- Lee, John and Robert A. Wattenbarger. Gas Reservoir Engineering. Society of Petroleum Engineers, Richardson, Texas.
- Katz, Donald L. and Robert L. Lee. Natural Reservoir Engineering: Production and Storage. Society of Petroleum Engineers, Richardson, Texas.

Secondary Text:

- Ikoku, C.U. Natural Gas Reservoir Engineering. John Wiley & Sons. Krieger P.

24-Pet-B2 Oil and Gas Evaluation and Economics

Principles of property evaluation as a function of resource type, economics, technology, risk, and policies. Investment decision-making tools. Cost estimation for petroleum exploration, drilling, production, and development. Proration, value of money, evaluation nomenclature, payout time, profit ratio, rate of return, capital cost allowance, taxation, and oil and gas unitization theory. Canadian and international oil and gas regulations. Global and regional factors impacting oil and gas prices.

Textbooks (most recent edition is recommended):

Primary Text:

- Campbell Petroleum Series. Analysis and Management of Petroleum Investments: Risk, Taxes and Time. Pennwell Publishers, OK.

Secondary Text:

- Mineral Property Economics, Vol. 2 and 3 - The Campbells. Campbell Petroleum Series.

24-Pet-B3 Petroleum Geology

Description of clastic (sandstone) and carbonate (limestone) reservoir rocks. Hydrocarbon origin and migration. Geologic mapping: creating contour maps and cross sections to visualize subsurface structures. Geography of petroleum and natural gas in Canada, North America, and the world.

Textbooks (most recent edition is recommended):

- North, F.K. Petroleum Geology. Allen and Muir, Winchester, MA.

24-Pet-B4 Well Testing

Basics of well test interpretation: diffusivity equation, skin, wellbore storage, radius of investigation; different flow regimes: transient, pseudo-steady state, steady state. Interpretation of drawdown and buildup data for estimating formation permeability, skin, reservoir pore volume, and average reservoir pressure. Superposition; fault and dual porosity systems; derivative analysis; gas well testing.

Textbooks (most recent edition is recommended):

Primary Text:

- Lee, J., Rollins, J.B., and Spivey, J.P. Pressure Transient Testing, SPE Textbook Series Vol. 9, Society of Petroleum Engineers, Richardson, TX.
- Horne, R. N. Modern Well Test Analysis. Petroway Inc.

Secondary Text:

- Earlougher, R. C. Advances in Well Test Analysis. SPE Monograph No. 5.
- Lee, John. Well Testing. SPE Textbook Series Vol. 1.

24-Pet-B5 Reservoir Mechanics

Advanced reservoir engineering principles including estimation of reserves; analysis and prediction of reservoir performance using material balance and decline curve analysis; combined drive mechanisms including unsteady state water influx; Naturally fractured reservoirs. Statistical analysis of unknowns from production history.

Textbooks (most recent edition is recommended):

Primary Text:

- Craft, B.C. and Hawkins, M.S. (revised by Terry, R.E.). Applied Petroleum Reservoir Engineering. Prentice-Hall, Englewood Cliffs, N.J..

24-Pet-B6 Petroleum Reservoir Simulation

Basics of numerical reservoir simulation and numerical solution of partial differential equations. Simulation methods as applied to specific problems in petroleum reservoir behavior. Applications on primary, secondary and tertiary recovery phases of petroleum production using reservoir simulation tools.

24-Pet-B7 Advanced Drilling Technology

Recent advances in drilling technologies. Drilling equipment and tools. Drilling optimization and troubleshooting, directional drilling and deviation control, design aspects of horizontal and multilateral well drilling. Measurement while drilling, drill string mechanics, bottomhole assembly design, tubular stability, drag and torque problems. Wellbore stability and mechanics. Drilling in high-pressure high-temperature (HPHT) environments.

24-Pet-B8 Petroleum Field Safety and Environmental Impact

Review of safety issues, including blowouts, fires, and other hazards; hydrate formation and decomposition; H2S and other toxic gases. Coverage of safety standards, the impact of petroleum operations on the environment, and the handling, safe transportation, and disposal of petroleum wastes.