

# Petroleum engineering syllabus

## Petroleum engineering examinations

### Group A - Compulsory examinations (seven required)

#### 17-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, 5th edition. Merrill Publishing Co., Toronto, 2011. ISBN 0023117923.

Secondary Text:

- Krumbein, W.C. and Sloss, L.L., Stratigraphy and Sedimentation, 2nd edition. W.H. Freeman and Co., 1963. ISBN 0716702193.
- Walker, R.G. (Editor), Facies Models, 3rd edition. Geoscience Canada Reprint Series 1, Geological Association of Canada, 1992. ISBN 0919216498.
- Prothero, D.R., Interpreting the Stratigraphic Record. W.H. Freeman & Co., 1990. ISBN 0716718545.

#### 17-Pet-A2 Petroleum Reservoir Fluids

Phase behaviour of hydrocarbon fluid ideal and non-ideal gases, and liquids; qualitative and quantitative phase behaviour- PVT data and equations of state; properties of gases, oil, and water; reservoir fluid studies; application of fluid properties for compositional analyses; phase separation and reservoir behaviour; gas-liquid equilibria.

*Textbooks (most recent edition is recommended):*

Primary Text:

- McCain Jr., W.D., The Properties of Petroleum Fluids, 2nd edition. The Petroleum Publishing Company, Tulsa, Oklahoma, 1990. ISBN 0878143351.

Secondary Text:

- Amyx, J.W. Bass, D.M. and Whiting, R.L., Petroleum Reservoir Engineering. McGraw Hill, Toronto, 1960. (pp. 211 470). ISBN 0070016003.

#### 17-Pet-A3 Fundamental Reservoir Engineering (Physical Properties and Flow of Fluid through Porous Media)

Porosity and pore structure, fluid saturations, absolute permeability, interfacial tension, wettability, capillary pressure. Multiphase flow and relative permeability. Steady and unsteady Darcy flow of single fluid. Immiscible and miscible flows. An introduction to oil and gas material balance equations, drive indices. An introduction to performance prediction techniques and decline curve analysis.

*Textbooks (most recent edition is recommended):*

Primary Text:

- Dake, L., Elsevier, Fundamentals of Reservoir Engineering, 1980.
- Terry, R.E., Brandon, R., Craft, B.C. and Hawkins, M.S. , Applied Petroleum Reservoir Engineering, 3rd edition, 2015. Prentice-Hall, Englewood Cliffs, N.J., ISBN 978-0-13-315558- 7.

Secondary Text:

- Dake, L.P., Fundamentals of Reservoir Engineering, Elsevier, Amsterdam, 1978. ISBN-13: 978- 0-444-41830-2
- Amyx, J.W., Bass, D.M. and Whiting, R.L., Petroleum Reservoir Engineering. McGraw-Hill, Toronto, 1960. (pp. 36-210). ISBN 0070016003.

## 17-Pet-A4 Oil and Gas Well Drilling and Completion

Drilling rig types, components and selection. Rotary drilling, drilling fluids, drilling hydraulics, penetration rates, drilling operations, core and core analyses, drillstem testing, casing design and seat selections; formation damage; cementing procedures, and well completion. Special topics including: directional drilling; blowout control; logging and coring; 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 (1986, 2nd printing 1991). ISBN 9991135979.

Secondary Text:

- Gatlin, C., Petroleum Engineering, Drilling and Well Completion. Prentice-Hall, Inc., Englewood Cliffs, N.J., 1960. ISBN 0136621554.

## 17-Pet-A5 Petroleum Production Operations

Principles of oil and gas production mechanic. Reservoir Inflow performance. Wellbore hydraulics and multiphase flow. Decline curve analysis. Nodal analysis for production optimization. Acidizing and hydraulic fracturing. Artificial lift; Sucker-rod pumping; electrical submersible pumps; progressing cavity pumps; and gas lift. Oil and gas separation, wellbore damage, fluid movements patterns. Workover operations and stimulation methods, oil well cementing and through tubing logging. Surface facilities: storage, separators, emulsions, flow measurement.

*Textbooks (most recent edition is recommended):*

Primary Text:

- M. Economides, A.D. Hill, C. Ehlig-Economides, and D. Zhu. Petroleum Production Systems (2nd Ed.). Prentice Hall, Inc., Upper Saddle River, NJ, 2012. Tel 1-201-236-3290.
- T.O. Allen and A.P. Roberts, Production Operations, Vol. 1, 4th edition. Oil & Gas Consultant International (OGCI), Inc., Tulsa, OK, 1997.
- T.O. Allen and A.P. Roberts, Production Operations, Vol. 2, 4th edition. Oil & Gas Consultant International (OGCI), Inc., Tulsa, OK, 1997.
- H.D.Beggs, Production Optimization Using NODAL\* Analysis. Oil & Gas Consultant International (OGCI), Inc., Tulsa, OK, 2003.

Secondary Text:

- Kumar, S, Gas Production Engineering. Gulf Publishing Co., 1987. N.B.
- The following is out of print but is an excellent reference: Nind, T.E.W., Principles of Oil Well Production, 2nd edition. McGraw-Hill Book Co. Ltd., New York, 1981. ISBN 0070465762.

## 17-Pet-A6 Reservoir Mechanics

Advanced reservoir engineering principles including estimation of reserves; material and volumetric balance; combined driving mechanisms including unsteady state water influx; mechanics in hydraulically fractured wells. Performance prediction techniques. Linear material balance and 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, 2nd edition. Prentice-Hall, Inc., Englewood Cliffs, N.J., 1991. (pp. 146-334, 360- 375, 391-424). ISBN 0130398845.

Secondary Text:

- Dake, L., Elsevier, Fundamentals of Reservoir Engineering, 1980.

## **17-Pet-A7 Secondary and Enhanced Oil Recovery**

The fluid displacement process. Trapping and mobilization of residual oil; displacement theory; linear waterflood calculations; viscous fingering; flood patterns and sweep efficiency. Buckley/Leverett theory. Analytical waterflood prediction models; black-oil reservoir simulation models; design engineering aspects of waterflooding. Miscible displacement methods and 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, 1998. ISBN 978-1-55563-077-5
- Craig, F.F., The Reservoir Engineering Aspects of Water flooding. Monograph No. 3, Society of Petroleum Engineers of AIME, 1976. ISBN 0895202026.
- Stalkup, Fred, Miscible Displacement. Monograph No.8, Henry Doherty Series, Society of Petroleum Engineers of AIME, 1983. ISBN 0895203197.
- Prats, Michael, Thermal Recovery. Monograph No. 7, Henry Doherty Series, Society of Petroleum Engineers of AIME, 1982. ISBN 0895203146.

Secondary Text:

- Craft, B. C. and Hawkins, M.S. (revised by Terry, R.E.), Applied Petroleum Reservoir Engineering, 2nd edition. Englewood Cliffs, N.J., 1991, (pp. 335-386) ISBN 0130398845

## **Group B - Optional examinations (two required)**

### **17-Pet-B1 Well Logging and Formation Evaluation**

Theory and engineering and applications of measurements of physical properties of the formation near the wellbore; types of well logging devices; conventional logging interpretation and its applications in oil, and gas reservoirs.

*Textbooks (most recent edition is recommended):*

Primary Text:

- Bassiouni, Z. Theory, Measurement, and Interpretation of Well Logs. Society of Petroleum Engineers (SPE), Richardson, TX, 1994.

Secondary Text:

- Helander, D.P., Fundamentals of Formation Evaluation. Oil and Gas Consultants International Inc., 1983. 4554 S. Harvard, Tulsa, OK., 74135. ISBN 0930972023.

- Serra, O., Fundamentals of Well-Log Interpretation, Volume 1 - The Acquisition of Logging Data. Elsevier Science Publishers, New York, N.Y., 1984. ISBN 0444421327.
- Ellis, D.V., Well Logging for Earth Scientists. Elsevier Science Publishing Co., 1987. ISBN 0135005620.
- Dewan, J.T., Essentials of Modern Open-Hole Log Interpretation. Penn Well Books, Tulsa, OK., 1983. ISBN 0878142339.
- Log Interpretation Principles/Applications. Available through local offices of Schlumberger of Canada, Current Issue.
- Log Interpretation Charts. Available through local offices of Schlumberger of Canada, Current Issue.

## 17-Pet-B2 Natural Gas Engineering

Estimation of reserves; flow measurements; flow through conduits; steady, transient, Darcy and non-Darcy flow through porous media; well testing, buildup and drawdown tests; deliverability; well interference. Decline curve analysis; and development of shale gas.

*Textbooks (most recent edition is recommended):*

Primary Text:

- John Lee and Robert A. Wattenbarger, Gas Reservoir Engineering. Order No. RESV TEXT005. Society of Petroleum Engineers in Richardson, Texas, Tel: 1-800-456-6863.
- Donald L. Katz and Robert L. Lee, Natural Reservoir Engineering: Production and Storage. Order No. PROD COM023, Society of Petroleum Engineers in Richardson, Texas, Tel: 1-800- 456-6863.

Secondary Text:

- Ikoku, C.U., Natural Gas Reservoir Engineering. John Wiley & Sons, 1991. Krieger Pr. ISBN 0894646400.

## 17-Pet-B3 Oil and Gas Evaluation and Economics

Oil and gas reserves, conservation, proration, value of money, evaluation nomenclature, payout time, profit ratio, rate of return, capital cost allowance, taxation, oil and gas unitization theory.

*Textbooks (most recent edition is recommended):*

Primary Text:

- Campbell Petroleum Series, Analysis and Management of Petroleum Investments: Risk, Taxes and Time, 2nd edition. Pennwell Publishers, 1991, OK 73072. ISBN 0685547779.

Secondary Text:

- Mineral Property Economics, Vol. 2 and 3 - The Campbells. Campbell Petroleum Series, 1980. ISBN 990667675.

## 17-Pet-B4 Petroleum Geology

Physical and chemical characteristics of formation waters, natural gas, and crude oil. Origin and modes of occurrence of each of these in the earth. 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 Inc., Winchester, MA, 1985. ISBN 041253830X.

## 17-Pet-B5 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, average reservoir pressure; superposition; effect of fault and double 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, 2003. ISBN 1-55563-099-5
- R. N. Horne, Modern Well Test Analysis, 2nd edition. Petroway Inc., 1995 (p.1-118). (FE COM 056 SPE Catalog).

Secondary Text:

- R. C. Earlougher, Advances in Well Test Analysis. SPE Monograph No. 5, 1977.
- John Lee, Well Testing. SPE Textbook Series Vol. 1, 1982.