

## Formation Evaluation

- 1.1 Course Number: PE321
- 1.2 Contact Hours: 3-0-2 Credits:11
- 1.3 Semester-offered: 3<sup>rd</sup> Year-Odd
- 1.4 Prerequisite: An overview of petroleum geoscience and petroleum engineering practices would be useful.
- 1.5 Syllabus Committee Member: Dr. Satish Kumar Sinha
2. **Objective:** The purpose of this theoretical and practical course is to give broad understanding of petrophysical and transport properties of rocks. The students will learn various well logging techniques used in the oil and gas industry for determination of lithology, porosity, fluid content and its saturation, permeability etc. and applications of these results in reservoir evaluation.

3. **Course Content:**

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topic	Lectures
1	Introduction	Methods of gathering formation properties data: Mud logging, Coring, wireline logs, LWD/MWD, Open hole logging, cased hole logging History of wireline logs, Modern logging techniques Logging operations, data acquisition, processing, and log presentations	3
2	Borehole Environment	The Borehole Environment, Pressures in the borehole, Drilling Mud, Invasion of drilling fluids Temperature and Caliper Logs Review of common rock forming minerals in sedimentary rocks, classification of rocks, porosity, permeability, saturation.	4
3	Resistivity Logs	Spontaneous Potential (SP) logs, principles and applications; Resistivity theory and Archie Equations, Modern Electrical Logging Tools, Estimation of fluid saturations; Effects of clays on log measurements.	10
4	Radioactive Logs	Natural Gamma Ray logging: Principles and applications of total and spectral Gamma Ray logging; Formation density and litho-density logs: Principles and applications; Neutron Logging: Principles and applications.	8
5	Sonic Logging	Principles of sonic logging and applications; Cementing Quality monitoring;	4
6	Fluid testing and Pressure measurement	Permeability, relative permeability and Capillary pressures; Fluid Testing and Pressure logs; DST and formation interval tests; Production Logging Tools.	6

7	Advance Logging Tools	Image logs, NMR logs, Sonic Scanner	5
		<b>Total</b>	<b>40</b>

### Laboratory Work:

1. How to read well logs and its presentation
2. Pattern recognition and correlation of well logs
3. Estimation of Shale content; Gross Pay vs. Net Pay
4. Estimation of porosity from a single log
5. Multiple porosity methods
6. Water Saturation determination
7. Gas Sand Interpretation
8. Identification of lithologies and crossplots
9. Stock Tank Original Oil In Place (STOOIP) calculation
10. Image log interpretation

### 4. Readings

#### 4.1 Textbook:

1. Darling, T., 2005, "Well Logging and Formation Evaluation", Gulf Pub.
2. Lynch, E. J., 1971, "Formation Evaluation", Harper International Publication

#### 4.2 Reference books:

1. Bassiouni, Z., 1994, "Theory, Measurement, and Interpretation of Well Logs", SPE Textbook Series Vol. 4.
2. Rider, M., 2004, "The Geological Interpretation of Well Logs", Rider-French Consulting, Ltd.
3. Ellis, D. V., 1987, "Well Logging for Earth Scientists", Elsevier Science Publishing Company.
4. Luthi, S. M., 2001, "Geological Well Logs: Their use in reservoir modeling", Springer-Verlag.
5. Hearst, J. R., and Nelson, P. H., and Paillet, F. L., 2000, "Well Logging for Physical Properties: A handbook for geophysicists, geologists and engineers", John Wiley and Sons, Ltd.
6. Ransom, R. C., 1995, "Practical Formation Evaluation", John Wiley and Sons, Ltd.
7. Formation Pressure Evaluation, Reference Guide from Baker Hughes
8. Log Interpretation Principles/Applications, Reference book from Schlumberger
9. Cased Hole Log Interpretation, Reference book from Schlumberger
10. Fundamentals of Formation Testing, Schlumberger

### 5 Outcome of the Course:

- Know the logging operations and data acquisition for logging while drilling and open hole logging.

- Know the physics of various logging tools.
- Describe different rock properties such as porosity, permeability and saturation based on basic definition.
- Interpret individual and combination of wire-line log data for lithology and fluids
- Interpret different wire-line log data by cross-plotting
- Estimate hydrocarbon volume in the reservoir based on reservoir properties
- Know the main applications and limitations of the different measurements
- Perform a quick qualitative interpretation to determine possible interest zones