Petroleum Geophysics

1.1. Course Number: GE422

1.2. Contact Hours: 2-0-2   Credits: 8

1.3. Semester Offered: 4th Year-Even

1.4. Prerequisite: Petroleum Geology, Seismic Methods, and Gravity & Magnetic methods

1.5. Syllabus Committee Members: Dr. Satish Sinha and Dr. Piyush Sarkar

2. **Objective:** Knowledge of implications for geophysical methods for petroleum exploration. Know how to recognize responses from components of sedimentary reservoirs in their geophysical datasets. Understand how to use analyze petrophysical data to predict geophysical responses of identifying the blind target zones and structures.

3. **Course Content:**   Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topics	Lectures
1	Introductions	Physical properties of minerals and rocks, Definition of petroleum, mechanism for generation of petroleum, Traps etc. Basic principles of geophysical exploration. Geophysical Methods for petroleum exploration.	3
2	Seismic Methods	Seismic velocity in rocks and methods of its determination. Preparation of depth map from time horizons. Basic concepts, definitions and objective of seismic stratigraphy, seismic attributes analysis, seismic sequence analysis – interpretation of depositional environment and lithology, seismic facies analysis, seismic reflection character analusis, Introduction to 3 D volume based interpretation.	8
3	Gravity and Magnetic Method	Theory of gravity and magnetic exploration methods, Instrumentation, data acquisitions and data reduction, interpretation of gravity and magnetic anomaly, Mapping of subsurface structure (salt dome, faults, etc.)	4
4	Well logging methods	Principles of well logging methods, Archie's law for Clean sand interpretation, Electrical and Porosity logging. Log characteristics for identification of electrofacies and depositional environment, Resistivity vs. porosity and porosity log Cross plotting for identification of matrix and porosity, Overpressure zone detection from sonic, density and Resistivity log responses.	7
5	Controlled source	Introduction to Controlled-Source Electromagnetic Surveys, Sources, Receivers, Acquisition Configurations and	8

	electromagnetic methods (CSEM)	Source Time Functions, Deep Water CSEM, Land CSEM, Forward and Inverse Modelling of CSEM Data	
		Total	**30**

List of experiments
- Handing of gravimeter and magnetometer.
- Interpretation of resistivity sounding data.
- Determination of velocities and depth of the interface by refraction method.
- Handling of surveying instruments- theodolite, dumpy level, microptic alidade, electronic distance measuring devices, GPS.
- Preparation of site map with the help of plane table.
- Cross plotting of log data to locate the overpressure, fracture and hydrocarbon zone.

4. **Readings:**

   4.1. **Textbook:**

   - Dobrin & Savit : Introduction to Geophysical Prospecting
   - Telford et al : Applied Geophysics
   - Anton Ziolkowski: Introduction to controlled-source electromagnetic methods

   4.2. **Reference Books:**

   - Parasnis : Principle of Applied Geophysics
   - Sharma : Geophysical Prospecting for Geologists and Engineers
   - Israel & Krebs : Nuclear Radiation in Geophysics

5. **Outcome of the course:**

   The purpose of this course is to facilitate the latest developments in our understanding of the geophysical responses of petroleum systems using different geophysical field methods. The course discusses the petroleum system concept and considers these ideas in a geophysical context. The geophysical responses of key reservoir parameter are considered from first principles. Physical property contrasts expected to be associated with different components are described and new methods of analyzing petro-physical data are demonstrated.