

Petroleum Exploration and Prospecting

1.1 Course Number: PE322

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

1.3 Semester-offered: 3rd Year-Odd

1.4 Prerequisite: Petroleum Engineering Practices / Petroleum Geology

1.5 Syllabus Committee Member: Dr. Satish Kumar Sinha

2. **Objective:** This course is offered to build foundations of the geological and geophysical methods used in hydrocarbon exploration and prospecting. In the previous geology courses, students have been taught about rocks, sedimentary processes, structural geology and petroleum geology. In this course, the students will learn about the geophysical techniques and data interpretation involved in finding oil and gas, how to select an exploration area and generate prospects for drilling. Various geophysical methods (with emphasis on the seismic methods) will be covered in this course and the students will learn how to integrate geological and geophysical information for oil and gas exploration. There will be several class projects in this course. Groups of students will be working in different teams for various sedimentary basins. Students are required to submit their progress reports every two weeks and the final report will be due towards the end of the semester.

3. **Course Content:**

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topic	Lectures
1	Fundamentals of Seismic Method	Foundation of seismic waves propagation and signal processing Seismic Waves, Snell's Law, Seismic wave velocities and rock densities, Impedance, Reflection Coefficient, Synthetic Seismogram, Signal and noise, Fourier analysis of a signal	6
2	Seismic Data Acquisition and Processing	Seismic sources and receivers, 2D and 3D seismic, Land and Marine seismic, Borehole seismic Seismic processing steps (static corrections, NMO correction, Velocity Analysis, Stack, Migration) 4D seismic	6
3	Seismic Data analysis	Seismic Attributes, AVO and other direct hydrocarbon indicators	4
4	Potential Field Methods	Gravity and Magnetic methods: Principles of gravity and magnetic methods Acquisition and processing of gravity and magnetic data,	5

		Applications of gravity and magnetic data in basin analysis	
4	Basin Analysis	Tectonics and basin formation, Subsidence and compaction, sequence stratigraphy	5
		Total	26

Laboratory work:

1. Acquiring seismic data in the field
2. Understanding acquisition and processing parameters from seismic section panel. Shot point map for 2D seismic acquisition, picking a reflection and mapping a surface.
3. Creating contour maps
4. Getting familiar with seismic interpretation software KINGDOM / OpendTect
5. Mapping a horizon on 2D/3D seismic data
6. Mapping Faults
7. Creating time-depth chart from velocity panel and estimating depth of a horizon
8. Seismic to well tie using software
9. Time structure map to depth structure map
10. Extracting seismic attributes from 3D volumes

4. Readings

4.1 Textbook:

1. Fred Aminzadeh Shivaji Dasgupta, "Geophysics for Petroleum Engineers", Elsevier
2. W. M. Telford, L. P. Geldart and, R. E. Sheriff "Applied Geophysics", Cambridge University Press
3. Allen, P. A and Allen, J. R., Basin Analysis: Principles and Applications, Blackwell Publishing

4.2 Reference books:

1. R. E. Sheriff and L. P. Geldart, "Exploration Seismology", Cambridge University Press
2. Oz Yilmaz, "Seismic Data Analysis (Vol I and II)", SEG Publication
3. G. Mavko, T. Mukerji and J. Dvorkin, "The Rock Physics Handbook", Cambridge University Press
4. P. Kearey, M. Brooks and I. Hill, "An Introduction to Geophysical Exploration", Wiley-Blackwell
5. Journals from the American Association of Petroleum Geologists
6. Journals from the Society of Exploration Geophysicists
7. Journals from the Society of Petroleum Engineers

5 Outcome of the Course:

- Know the process of imaging subsurface with reflection and refraction seismic
- Understanding of various geophysical data and its role in petroleum exploration
- Hands-on experience in interpreting seismic data with industry standard software
- Creating structure map for drilling location