Course Code	Course Title	ECTS Credits
OGEE-560	Geophysical Methods	7.5
Prerequisites	**Department**	**Semester**
None	Engineering	Fall, Spring
Type of Course	**Field**	**Language of Instruction**
Required	Oil, Gas and Energy Engineering	English
Level of Course	**Lecturer(s)**	**Year of Study**
2nd Cycle	Dr. Paul Featherstone	1st
Mode of Delivery	**Work Placement**	**Co-requisites**
Face-to-face	N/A	OGEE-510

Objectives of the Course:

The main objectives of the course are to:

- Introduce the students to the concepts of wave theory and seismic waves.
- Explain the difference between deep seismic and near surface survey analysis.
- Teach the students to handle basic calculations with refracted and reflected seismic waves.
- Evaluate and analyze data of recorded seismic waves from the field so as to interpret the position of possible hydrocarbon reserves in sedimentary basins.
- Review the concepts of gravitational methods in geophysical exploration.
- Discuss explorational methods that rise from the magnetic anomalies of the earth's geodynamic system.
- Manage numerical calculations with geo-electrical methods.
- Illustrate formation evaluation from well logging.
- Compute parameters from the various electric logs (Normal, lateral, later, induction, spontaneous potential and micro logs).
- Introduce the students to radioactivity logging (Natural gamma radiation, gamma-ray density and neutron-gamma-ray) and extract parameters for calculations.
- Compare the level of accuracy of the log methods (electric, radioactivity and sonic).
- Conduct Software/numerical simulations.

Learning Outcomes:

After completion of the course students are expected to be able to:

1. Classify the basic types of seismic waves (Compressional, Shear, Rayleigh and Love).
2. Perform calculations utilizing Snell's law and understand the importance of transmission and reflection coefficients.
3. Explain the reflection and refraction of waves from single and multi-layer structures in horizontal and dipping configurations.

4. Compute parameters like velocity, layer thickness and dip angle of layers from reflection and refraction analysis.
5. Practice numerical calculations of the following methods: plus minus, normal moveout, root mean square velocities (RMS) and travel two way times.
6. State the concept of stacking for data enhancement, seismic migration, 3D seismic reflections and filtering of seismic data.
7. Examine the Bouguer gravity and the concepts of gravitational attraction of structures with simplified geometry (Sphere, Cylinder, Plate).
8. Perform calculations and understand the concepts of anomalies caused by magnetized structures (horizontal and inclined plates).
9. Compute data with the following methods: Dipole models, irregular 2D models and compound 3D models so as to gain knowledge in interpreting magnetic anomalies.
10. Estimate with geo-electrical methods the depth of targets (hydrocarbons). The output of these methods basically includes the analysis of electrical resistivity of measurements obtained with the following methods: Barnes parallel resistor method, cumulative resistivity inversion method, characteristic curves method and electromagnetic surveying.
11. Understand the methods of electric logging and radioactivity logging for formation evaluation. Specifically the students will identify the lithology of the well, bed thickness, porosity, water/hydrocarbon saturation and permeability of the formation from the various logs (electric, radioactivity and sonic).

Course Contents:

- Introduction to wave theory.
- Seismic waves and how they can be measured (seismometers).
- Recording of seismograms.
- The Refracted seismic waves.
- The Reflected seismic waves.
- Data processing from seismograms
- Interpretation of processed data.
- General description of other geophysical methods (gravitational, magnetic and geo-electrical).
- Introduction to formation evaluation.
- Different types of well logging.
- Electrical logging (Normal logs, lateral logs, later logs, induction logs, spontaneous potential logs and micro logs).
- Radioactivity logging (Natural gamma radiation logs, gamma-ray density logs and neutron-gamma-ray logs).
- Sonic logging.

Learning Activities and Teaching Methods:

Lectures, In-class Exercises, Quizzes, Demonstration Videos.

Assessment Methods:

Assignments, Exercises, Projects, Midterm Exam and Final Exam.

Required Textbooks / Reading:

Title	Author(s)	Publisher	Year	ISBN
Basic Exploration Geophysics	Robinson S. Edwin and Coruh Cahit	Wiley	1998	047187941X

Recomended Textbooks / Reading:

Title	Author(s)	Publisher	Year	ISBN
An Introduction to Geophysical Exploration	Kearey Philip, Brooks Mike and Hill Ian	Wiley	2013	1118698932
Field Geophysics 3rd Edition	Milsom John	Wiley	2003	0470843470