

PE6050 - OIL AND GAS EXPLORATION METHODS

Total Hours: 50

Faculty: Dr. Rajesh R Nair

COURSE STRUCTURE

I. FUNDAMENTAL CONSIDERATIONS

(5 Hrs.)

- Stress - Strain Relationship
- Elastic Coefficients
- Seismic Waves
- Huygen and Fermat principles
- Snell's Law in Refraction

II. SEISMIC REFRACTION METHOD

(5Hrs.)

- Fundamentals
- Two Horizontal Interfaces
- Dipping Interfaces
- The Non ideal Subsurface
- The Delay-Time Method
- Field Procedures & Interpretation

III. SEISMIC REFLECTION METHOD

(5 Hrs.)

- A Single Subsurface Interface
- Analysis of Arrival Times
- Normal Move out
- Determining of Velocity & Thickness

- Dipping Interface
- Common Field Procedures
- Velocity Analysis
- Applications in Petroleum exploration

-----**FIRST QUIZ – 01.09.2015 (Tuesday)**-----

IV. EARTHQUAKE SEISMOLOGY

(3 Hrs.)

- Definition and Historical review
- Classification of Earthquakes
- Earthquakes: Where and Why
- Causes of Earthquakes
- Earthquake Epicenter & Hypocenter
- Magnitude & Intensity

V. ELECTRICAL METHOD

(4 Hrs.)

- Electrical properties of rocks
- Apparent & True resistivity
- Electrode configurations
- Electrical soundings & Profiling
- Applications in groundwater exploration

-----**SECOND QUIZ – 13.10.2015 (Tuesday)**-----

VI. GRAVITY PROSPECTING

(4 Hrs.)

- Fundamental principles

- Measurements
- Data reduction
- Isostasy and crustal thickness
- Interpretation&Applications

VII. MAGNETIC METHOD

(3 Hrs.)

- Basic concepts
- Description of the magnetic field
- Source of magnetic anomalies
- Interpretation&Applications

VIII. Geostatistics

(5 Hrs.)

- Introduction to Geostatistics
- Applied Reservoir Characterization
- Stochastic Methods for Reservoir Modeling

VIII. Problem Sets and Field Training Exercises

(18 Hrs.)

----- **END-SEMESTER EXAMINATION – 19.11.2015 (Thursday)** -----

Grading:

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| 1. FirstQuiz | 25% |
| 2. Second Quiz | 25% |
| 3. Problem Sets and Field Training exercises | 10% |
| 4. End-Semester Examination | 40% |

Recommended references:

Burger, H. R., Sheehan, A. F., & Jones, C. H. (2006). *Introduction to applied geophysics: Exploring the shallow subsurface*. WW Norton.

Kearey, P., Brooks, M., & Hill, I. (2013). *An introduction to geophysical exploration*. John Wiley & Sons.

Sheriff, R. E., & Geldart, L. P. (1995). *Exploration seismology*. Cambridge university press.

Telford, William Murray, Lloyd P. Geldart, and Robert E. Sheriff. *Applied geophysics*. Vol. 1. Cambridge university press, 1990.

Points to keep in mind:

Group study

- Interaction with peers and instructors.
- Discussions with TA.

Ask questions

- Read ahead.
- Feel free to ask questions.
- Make comments or just express your opinions.

Think

- Ponder over all kinds of problems.
- Strive for 100% on the assignments utilizing all the resources and opportunities available to you.

Expanding your mind

- Expand your mind.
- Be persistent
- Don't give up, hang in there.
- If you have questions, ask the instructor or the TA.

Make it a game to master new skills and knowledge. Be courageous in facing new challenges.

"Excellence is a continuous process and not an accident." - A. P. J. Abdul Kalam

Overview

- ✓ Interdisciplinary physical science concerned with the nature of the earth and its environment and as such seeks to apply the knowledge and techniques of physics, mathematics and chemistry to understand the structure and dynamic behavior of the earth and its environment.
- ✓ Science which deals with investigating the Earth, using the methods and techniques of Physics.

The physical properties of earth materials (rocks, air, and water masses) such as density, elasticity, magnetization, and electrical conductivity all allow inference about those materials to be made from measurements of the corresponding physical fields - gravity, seismic waves, magnetic fields, and various kinds of electrical fields. Because Geophysics incorporates the sciences of Physics, Mathematics, Geology (and therefore Chemistry) it is a truly multidisciplinary physical science.

Exploration Geophysics

Physical principles are applied to the search for, and evaluation of, resources such as oil, gas, minerals, water and building stone.

Geophysical Exploration Techniques

1. **Passive Methods** (Natural Sources): Incorporate measurements of natural occurring fields or properties of the earth. Ex. SP, Magneto-telluric (MT), Telluric, Gravity, Magnetic.
2. **Active Methods** (Induced Sources): A signal is injected into the earth and then measure how the earth respond to the signal. Ex. DC. Resistivity, Seismic Refraction, IP, EM, Mise-A-LA-Masse, GPR.

Common Applications

- Oil and Gas Exploration
- Mineral Exploration
- Geotechnical and Engineering Studies
- Geostatistical Reservoir Modeling
- Integrated Reservoir Characterization
- Model Realization Optimization/Uncertainty Assessment in 3D Reservoir Modeling
- Reservoir Management