Seismic Data Processing and Interpretation

1. **General**

1.1. Course Number: PE422

1.2. Contact Hours: 3-0-2 Credits: 11

1.3. Semester-offered: 4th Year - Odd

1.4. Prerequisite: Geophysical Data Acquisition and Design

1.5. Syllabus Committee Member: Dr. Satish Sinha, Dr. Piyush Sarkar

2. **Objective:** Knowledge on seismic wave theory. Knowledge on 2D and 3D seismic data Processing technique. Knowledge on 2D and 3D seismic data Interpretation

3. **Course Content:**

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topic	Lectures
1	Seismic wave theory	Fundamentals to seismic wave theory: Propagation of Seismic Waves in Linear and Nonlinear medium, Waveforms and their characteristics, N Layered case, continuous increase of velocity. Seismic attenuation, reflection and transmission coefficients, Knott and Zoeppritz equations.	8
2	Sampling Theory	Sampling Theorem and Analysis of Seismic signals, Convolution, Correlation Techniques and Inverse Filtering of Seismic Data, Seismic Inversion, Determination of Average Seismic Velocities,	6
3	Seismic Data Processing	Introduction to seismic data processing. Processing sequences-preparation of processing geometry, quality checks, true amplitude recovery, deconvolution, filtering, velocity analysis, Statics Corrections, NMO corrections, Stacking; Complex-trace analysis; Hilbert transform (instantaneous frequency; instantaneous phase); noise elimination through multichannel filtering, parameter optimization for generation final stacked section. Discrete time sequence; Z-transform, Linear system; Filtering system, Frequency alias; Nyquist frequency; Interpolating; Low-pass, high-pass, band-pass filters; Notch, Moving average; Gibbs effect; Spectral analysis, Zero Phase;	13

		Linear phase shift, DMO and migration AVO and attribute analysis. Anisotropy processing: HTI, VTI Mode. Converted Wave Processing.	
4	Seismic data interpretation	Introduction to seismic data interpretation: Overview of Seismic Stratigraphy. Wavelet analysis for seismic stratigraphic interpretation. Seismic sequence analysis and seismic facies analysis. Overview of Seismic Stratigraphy. Study of seismic section and other geological aspects of prospecting, structural interpretation, construction of isochron and isopach maps, thin bed resolution and pitfalls, LRLC interpretation, AVO and attribute analysis, Prospect evaluation & Ranking, Basis of seismic interpretation in workstation environment using standard packages.	13
		Total	**40**

Laboratory work:

1. Creating contour maps
2. Processing of Seismic data
3. Getting familiar with seismic interpretation software KINGDOM / OpendTect
4. Mapping a horizon on 2D/3D seismic data
5. Mapping Faults
6. Creating time-depth chart from velocity panel and estimating depth of a horizon
7. Seismic to well tie using software
8. Time structure map to depth structure map
9. Extracting seismic attributes from 3D volumes

4. Readings

Textbook:

1. Dobrin, M. B., and Savit, C. H., 1988, Introduction to Geophysical Prospecting (Fourth Edition), Tata McGraw Hill.
2. Telford, W. M., Geldart, L. P., Sheriff, R. E., and Keys, D. A., 1988, Applied Geophysics.

Reference books:

3. Parasnis, D. S., 1997, Principles of Applied Geophysics (Fifth Edition), Chapman and Hall.

4. Grifith, and King, Applied Geophysics for Engineers and Geologists.
5. Kearey, P., Brooks, M., and Hill, I., 2002, Introduction to Geophysical Exploration: BlackWell Scientific Publications.
6. Parasnis, D. S., 1997, Principles of Applied Geophysics (Fifth Edition), Chapman and Hall.
7. Evans, B., Field Geophysics: SEG Publications

5. Outcome of the Course:

The primary objective of the course is to introduce fundamental aspects of seismic data processing and interpretation technique which is vital part for applied geophysics study of any kind sub-surface geological study. The underlying physics and mathematics of the various seismic analysis methods are presented through theory and practical classes, giving students an appreciation of their limitations and potential for creating models of the subsurface.