Course Type	Course Code	Name of Course	L	T	P	Credit
DP	NGPC518	Mathematical Functional Analysis Practical	0	0	2	1

Course Objective
The primary objective of the course is to introduce fundamental and advanced aspects of time series analysis techniques for geo-record analysis and processing.
Learning Outcomes
• Practical knowledge on geophysical/geological time/space series data analysis. • Practical knowledge on periodicity, how to design a filter, algorithm for signal enhancement and noise removal. • Practical knowledge on signal processing techniques for exploration of geoscience.

Unit No.	Description of Lectures	Lecture Hrs.	Learning Outcomes
1.	Compute DFT coefficients of a time series and estimate energy spectra	2	Time series analysis and processing techniques
2.	Compute convolution and cross correlations of two time series.	2	Time series analysis and processing techniques
3.	Investigate the effect of various windows in reducing the energy leakage. Estimate energy spectrum of a signal from auto correlation function	2	Time series analysis and processing techniques
4.	Compute FFT of a signal and investigate the effects of padding zeroes to a short time series in estimated energy spectrum.	2	Time series analysis and processing techniques
5.	Compute the responses of Butterworth and Chebyshev filters and evaluate their performances.	2	Time series analysis and processing techniques
6.	Design a notch filter to eliminate power line frequency from an observed signal. Design a spiking deconvolution filter using i) spectral division and ii) Wiener filtering.	2	Time series analysis and processing techniques
7.	Investigate the properties of different types of wavelets and converting a mixed phase wavelet to a minimum phase wavelet	2	Time series analysis and processing techniques
8.	Generate synthetic seismogram.	2	Time series analysis and processing techniques

9.	Cepstral analysis of a signal to distinguish between primary and an echo	**2**	Time series analysis and processing techniques
10.	Wavelet transform and decomposition technique for de-nosing of the time series.	**2**	Time series analysis and processing techniques
11.	Design of commonly used signal enhancement filters, viz. upward and downward continuations, second vertical derivation.	**2**	Time series analysis and processing techniques
12.	Compute 2D FFT and estimating radial spectrum. Compute the frequency response of a source/receiver array.	**2**	Time series analysis and processing techniques
13.	Compute the probability density function, mean and variance of a given random signal	**2**	Time series analysis and processing techniques
14.	Revision of all processing techniques	**2**	Revision
	Total:	**28**	

Text Books

1. Bath, M., 1974. Spectral Analysis in Geophysics. Elsevier, Amsterdam, Netherlands.
2. Gubbins D., 2004, Time series analysis and inverse theory for geophysicists, Cambridge University Press.

Reference Books

1. Baskakov, S. 1986, Signals and Circuits, Mir Publishers
2. Beauchamp, K.G., 1975. Walsh Functions and their Applications. Academic Press, New York, NY 236pp.
3. Blakeiy, Richard J., 1995, Potential Theory in Gravity and Magnetic Applications, Cambridge University Press.
4. Dimri, V. P., 1992, Deconvolution and Inverse Theory: Applications to Geophysical Problems, Elsevier Science.
5. Kanasewich, E. R., 1975, Time Sequence Analysis in Geophysics, The University of Alberta Press
6. Naidu, P. S., and Mathur, M. P., 2012, Analysis of Geophysical Potential Field: A Digital Signal Processing Approach: Elsevier
7. Robinson, E. A., 1967, Statistical communication detection with special reference to digital data processing of radar and seismic signal: GriffIn
8. Robinson, E. A., 1981, 'Time Series Analysis and Application: D. Reidel Yilmaz, 0. Seismic Data Processing, Society of Exploration Geophysicists.