

DISCIPLINE SPECIFIC CORE COURSE - DSC-20 (4)
Research and Analytical Methods in Geoscience (L3, P1)

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
DSC-20 Advanced analytical and computational techniques in geoscience	4	3	0	1	12th pass with science	Studied Earth System Science and Equivalent

Learning Objectives :

This course aims to:

- Impart knowledge of advanced instrumentation and laboratory techniques in geoscience.
- Train students in quantitative analysis and computational tools.
- Develop competencies in interpreting complex geoscientific datasets.

Learning Outcomes :

After completion of this course, students will be able to:

- Apply modern analytical techniques in geoscience.
- Use computational tools (Python / R / MATLAB) for data analysis.
- Analyze and interpret complex geological data using statistical methods.
- Integrate field, laboratory, and modeling approaches for holistic understanding.
- Write scientifically structured reports and research papers.

THEORY

(45 hours)

UNIT – I

(10 hours)

Types of research: conceptual, empirical, quantitative, qualitative, etc. Application of instrumentation and computational techniques in geoscience. Research ethics and publication standards

UNIT – II

(10 hours)

Field methods: Introduction to basic instruments and techniques used to collect sedimentary, structural, geomorphic and other data in field. Sample and type of samples, sampling theory.

UNIT – III

(12 hours)

Laboratory techniques - X-ray diffraction, X-ray fluorescence and induced couple plasma (ICP) analysis- principles and instrumentation (TA), Reciprocal lattice, Ewald's Sphere, Crystal field theory. Raman and Mossbauer spectroscopy, Microbeam techniques- SEM, EPMA, Atomic Force Microscope, electron beam-matter interaction, secondary and back-scattered electrons, Auger electrons, energy transitions and characteristic x-rays, EDS & WDS,

data generation, detection limits, matrix correction and data reduction, Total organic carbon analyzer, TL/OSL dating techniques, Fluid inclusion and analog and digital modeling.

UNIT – IV

(13 hours)

Quantitative methods: Basic Statistics- measures of central tendency, dispersion and asymmetry, simple and multiple correlation and regression; Plotting in Excel; Data collection and analysis; Interpolation techniques; Time series analysis; Standard error and error analyses.

Computing in Geosciences: Introduction to R/Python/Matlab. Information regarding software's used in different disciplines of geology. Testing hypothesis; Interpretation and Report writing.

PRACTICAL

(30 Hours)

Exercises using Python/R/MATLAB for data processing. Virtual or lab-based exposure to instrumentation data (e.g., SEM image interpretation). Integrating analytical and computational analysis

Essential/recommended readings:

Research Methodology: Methods and Techniques by C.R. Kothari, New Age International Publishers

Suggestive readings:

1. Matlab recipes for Earth Sciences by Marin H Trauth, Springer International Publishing.

Data Analysis in the Earth Sciences Using MATLAB by Gerard Middleton, This book is available for free on Mathworks website.

2. Python: Introduction to Scientific Programming with Python by Joakim Sundnes. This book is available for free from Springer

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.