Principles of mineral exploration: Importance of mineralogy, grain size-shape and texture in exploration. Mineral identification and analytical techniques. Sampling techniques, drilling and logging. Estimation of grade in samples.

UNIT – III (9 Hours)
Detailed content
Prospecting and exploration: Surficial survey methods and applications. Geochemical survey methods and applications. Geophysical survey methods and applications. Remote sensing methods and applications

Unit – IV (9 Hours)
Detailed content
Importance of drilling and logging in exploration: Core and non-core drilling. Basic parts of drilling machine. Types of drilling techniques. Planning and location of bore holes on ground.

Unit – V (9 Hours)
Detailed content
Principles of reserve estimation: Reserves estimation methods and models. Critical geological data to be considered. Factors affecting reliability of reserve estimation and types of errors. Evaluation of sampling data: mean, median, mode, standard deviation and variance.

Practical Component- (30 Hours)
Exercises based on Evaluation of data Average grade and reserve estimation techniques. Geological cross-section and borehole problems.

Essential/Recmmended readings
Moon, C.J., Whateley, M.K.G. & Evans, A.M. 2006. Introduction to Mineral Exploration, Blackwell Publishing.
Haldar, S.K., 2013. Mineral Exploration – Principles and Applications. Elsevier Publication.

Recommended readings
Moon, C.J., Whateley, M.K.G. & Evans, A.M. 2006. Introduction to Mineral Exploration, Blackwell Publishing.
Haldar, S.K., 2013. Mineral Exploration – Principles and Applications. Elsevier Publication.
Arogyaswami, R.P.N.(1996. Courses in Mining Geology. 4th Ed. Oxford-IBH.
Clark, G.B. 1967. Elements of Mining. 3rd Ed. John Wiley & Sons.

or

DSE-4: Research Methods in Geoscience (L3, P1)
Credits: 4
Theory: 45 hours
Practical: 30 hours

Learning Objectives
Main objective of this course to provide an introduction to research methods relevant to geoscience through lectures and practical training about literature review, proper referencing and citation, professional ethics, geoscience hypotheses, analytical techniques, data analysis, preparation of scientific reports and proposals.

Learning outcomes
After successful completion of this course, students will have a basic understanding and skill to develop a research plan related to critical issues in geoscience. The students will also be able to develop skills to synthesise scientific ideas and appreciate the scope of research work in geoscience.

SYLLABUS OF DSE-4

Research Methods in Geoscience (4 credits)

Theory (45 hours)

UNIT – I (9 Hours)

Detailed Content

Fundamentals of research in geoscience: Concept and definitions of research issues in geoscience, types of research in geosciences, testing of hypothesis in geosciences, literature survey of scientific articles relevant to geoscience, critical gaps and key questions to resolve through scientific research in geoscience.

UNIT –II (9 Hours)

Detailed Content

Planning and development of research work: Defining major objective and sub-objectives of geological research in a particular field. Assessment of required methodologies and experimental setups. Types of field and laboratory data, time period and key millstones of the progress, synthesis of acquired data and writing of thesis.

UNIT –III (9 Hours)

Detailed Content

Analytical techniques: Geological fieldwork and collections of representative samples, sample preparation, petrographic techniques, mineralogical and geochemical analytical techniques.

UNIT –IV (9 Hours)

Detailed Content

Data handling and statistical treatments: Basic statistical methods, correlation and regression, principal component analysis, factor analysis, cluster analysis, making of different geological maps and figures using software's.

UNIT –V (9 Hours)

Detailed Content

Writing of thesis and scientific reports: Review of concerned geoscience research articles. Introduction, significance and utility of the concerned geoscience research. Easy to follow stepwise chapters on different aspects of the research work. Synthesis and interpretations, conclusions, referencing, bibliographies, ethics and plagiarism.

Practical: 30 hours

Students will be exposed to basic instrumentation facilities and their working, such as thin section preparation, petrographic analysis, mineralogical and geochemical analytical techniques and writing of project reports.

Essential readings

Lisle, R.J., Brabham, P., Branes, J. 2011. Basic Geological mapping, Wiley

Wilson M. J. 1987. A handbook of determinative methods in clay mineralogy. Blackie

Recommended readings

Lindholm, R.C. 1963. A practical approach to Sedimentology, Allen & Unwin
Faure, G. and Mensing, T.M.2009. Isotopes principles and Applications. Willey.

Jackson M. (1975) Soil Chemical Analysis–Advanced Course: 10th printing, published by author, Dept. Soil Science, University of Wisconsin, Madison, Wisconsin.

Or

Application of Hydrogeology in Industries and Mining (L3, P1)
Credits: 4
Theory: 45 hours
Practical: 30 hours

Learning Objectives
The course introduces the students to the legal and constitutional framework of ground water governance in India. It aims to provide knowledge about the scientific processes and protocols involved in impact assessment and comprehensive hydrogeological studies for developmental projects involving groundwater extraction.

Learning outcomes
After completing the course, students will become familiar with the salient aspects of India's ground water governance framework. They will develop an understanding of the groundwater resources estimation methods, and acquire basic skill to undertake impact assessment, comprehensive hydrogeological and water audit studies for developmental projects involving groundwater extraction. Learners will be trained to write professional grade Impact Assessment Report, Comprehensive Hydrogeological Report and Water Audit Report. They will be skilled with capability of formulating and processing No Objection Certificate (NOC) application for ground water extraction.

SYLLABUS OF DSE-4
Application of Hydrogeology in Industries and Mining (4 credits)

Theory (45 hours)

Unit 1: (9 hours)
Detailed content
Ground water governance: Ground water ownership: The Indian Easement Act 1882. Constitutional provisions regarding ground water. National Water Policy. Environment Protection Act 1986 – Central Ground Water Authority (CGWA) and State Ground Water Regulatory Bodies. National Green Tribunal.

Unit 2: (9 hours)
Detailed content
Guidelines to regulate and control ground water extraction in India: Preamble and background: exemptions from seeking No Objection Certificate, Drinking & Domestic use for Residential apartments/ Group Housing Societies/ Government water supply agencies in urban areas, Agriculture Sector, Commercial Use, Industrial Use, Mining Projects, Infrastructure projects, Ground water abstraction/ restoration charges, Bulk Water Supply, Abstraction of Saline ground water, Protection of Wetland Areas, General compliance conditions in No Objection Certificate, Monitoring of compliance of No Objection Certificate Conditions, Renewal and extension of No Objection Certificate, Delegation of powers against illegal ground water withdrawal, Ground Water Level Monitoring, Environmental Compensation, Provision of penalty and other important conditions. No Objection Certificate Application Portal (NOCAP). Water Audit Report. Accreditation of Ground Water Professional.