The Department of Earth Sciences will offer an **M.Tech course in Exploration Geoscience** from 2010-11 session. This course is aimed at producing geologists with specialized training in exploration of earth resources including minerals, petroleum and ground water.

**Eligibility:**

M.Sc Geology/Applied Geology/Marine Geology with minimum 55% mark or equivalent grade.

**Course Structure:**

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EASC-611: Mineral Exploration  4 Credit

Ore forming processes and ore deposit types. Lithological and geochemical characteristics of ore deposits. Distribution of ore deposits in space and time.

Selection of area for prospecting. Stages of geological prospecting, regional and detailed exploration; objectives and practices of these stages.

Prospecting criteria for important ore types: magmatic sulphides and chromite; pegmatic deposits of Sn and rare metals; magmatic, meteoric, sea water and other hydrothermal deposits of Au-Ag, base metals, W-Mo, U; skarn deposits; sedimentary and supergene deposits.


Texts/References

Gravity method: Gravitational force; Gravitational acceleration; Gravitational potential, Earth’s gravitational field, Collections; corrections and presentation of Gravity data, Regional and residual anomalies, Gravity anomaly over buried objects of known shape: sphere, cylinder, Gravity corrections: Free-air correction, Bouguer correction, Latitude correction, Terrain correction. Interpretation of gravity anomalies with case studies.

Magnetic method:Geomagnetic field, Induced magnetism, Remanent magnetism, Susceptibility, Field survey method, Equipment, Data processing, Qualitative and quantitative interpretation of magnetic data.

Electrical Methods: Electrical properties of rocks, Flow of current through ground surface, Apparent resistivity, Electrode arrangements, VES and CST and their qualitative interpretation, Quantitative interpretation of VES curves with case studies.

Electromagnetic methods: Electromagnetic spectrum and induction, EM frequency and depth of penetration, EM response of conductors, Classification of EM methods and their description: Telluric current method, Magnetotelluric method, CSMT/CSAMT, Tilt angle method, Turam method, VLF method, Transient EM methods, Ground Penetrating Radar,

Induced Polarization Methods: Earth’s polarization, IP measures, Time and frequency domain techniques, Field surveys, Equipments, Data acquisition and interpretation.

Seismic Methods: Basic principles, Types of seismic waves and their propagation characteristic, Seismic velocities in Earth’s materials, Refraction and reflection seismic methods: Basic principal, field procedure, data acquisition and interpretation, Siesmic startigraphy, Detection of hydrocarbons.

Radiometric Methods: Basic principles, Radioactive elements in rocks, Gamma ray spectrum and spectrometer, Radon sniffer, Data collection and interpretation.

Thermal methods: Thermal conductivity of rocks and minerals, Temperature measurements, Field surveys, Interpretation.

Borehole geophysics and tomography: Different geophysical logs, Equipment; measurements and interpretation, Earth imaging and electrical resistance, Seismic and radio-tomography,

Airborne, marine and satellite geophysics: Airborne survey, Data acquisition, Equipment, Measurement, Data processing and interpretation, Marine geophysics, Satellite-gravity-magnetic and thermal imagery.
**Texts/References**
TS Ramakrishna. Geophysical Practice in mineral exploration and mapping (Geological Society of India, Memoir 62), 2006.
dvantages of Remote Sensing over conventional surveys. Aerial Remote Sensing
concepts, Aerial vs Satellite Remote Sensing.

energy, source, energy interaction with atmosphere and earth objects and spectral
response pattern. Spectral, spatial, temporal and radiometric resolution. Platforms,
Sensors. Data acquisition mechanisms of satellites.

interpretation. Image rectification and restoration – Image enhancement - image
classification and image interpretation – image merging

Geoinformatics. Definition & Concepts. Input Sources (Satellite, Aerial & Ground
based). Computer based Geospatial data base generation. Data modeling on Natural

Remote sensing applications in mineral, petroleum and groundwater exploration.

**Practical:** Study of Different Satellite Data Products. Techniques of Visual
interpretation. Techniques of digital image processing. Satellite data interpretation for
resources mapping. Satellite data interpretation for various hazard zone mapping.
Onscreen Digitization, Editing, Labeling and Preparation of vector layers. Generation of
non-spatial and spatial data base. GIS Analyses (Buffering and Overlay)

**Texts/References**

American Society of Photogrammetry, Manual of Remote Sensing, ASP Falls Church,
Virginia, 2nd Volume, 1983.
Edition.
Sabins, F.F.Jr., Remote Sensing Principles and Interpretation, Freeman, Sanfrancisco.
1978.
Ramasamy, SM., Remote Sensing in Geology, Rawat Publishers
Introduction to organization and description of data: distributions and joint distributions; Introduction to Probability, discrete and continuous probability distributions, Introduction to statistical inference sampling distributions, point and interval estimation, hypothesis testing involving one and two univariate populations. Linear models for analysis of variance. Linear and multiple regression. Introduction to multivariate techniques, PCA, factor analysis, linear discriminant analysis.

**Texts/References**

Harry Frank and Steven C. Althoen  “Statistics concepts and applications” Cambridge University Press (1994)

**Text/References**

Davis and Reynolds: *Structural Geology of Rocks and Regions.*
Ragan: *Structural Geology: An Introduction to Geometrical Techniques.*
McKlay: *Thrust Tectonics and hydrocarbons*
Pollard and Fletcher: *Fundamentals of Structural Geology*
Burbank and Anderson: *Tectonic Geomorphology*

Micropalaeontology: Introduction to micropalaeontology; sampling methods and sample processing techniques for micropalaeontological studies; brief description of major microfossil groups used in hydrocarbon exploration; environmental significance of microfossils and paleo-environmental interpretation; biostratigraphic classification, dating and correlation of stratigraphic sequences by microfossils; application of micropalaeontology in sequence stratigraphy with special reference to Indian sedimentary basins.

**Text/References**


Bignot, G, Elements of Micropaleontology, Graham & Trotman, London, 212p, 1985


EASC-621: Petroleum Exploration 4 Credit

Origin of petroleum and natural gas; Physical and chemical properties of petroleum and related substances; conversion of organic matter, migration and accumulation of oil and gas; Traps and trapping mechanism; characteristics of source rocks, reservoir rocks.

Types of petroliferous basins and their relation to hydrocarbon potential. Geographic and stratigraphic distributions of oil and gas.

Methods and techniques for petroleum exploration, Surface indications and direct detection of hydrocarbons. Sub-surface geological methods and mapping techniques; brief idea about geologic interpretations of seismic data. Drilling methods, drilling equipments, drilling fluids, well-logs; subsurface mapping techniques. Reservoir management; non conventional gas hydrates and coal bed methane. Estimation of reserves and resources. Petroleum economics, production and development geology.

Texts/References

Hydrological cycle—precipitation, runoff, base flow, infiltration, evaporation, transpiration. Aquifer characteristics: Hydrological properties of rocks—porosity, permeability, storativity, specific yield and specific retention.

Introduction to theory of groundwater flow; flow nets; regional groundwater resource estimation; well hydraulics; role of groundwater in geologic processes.

Trans-boundary aquifers, groundwater quality, saline water intrusion, groundwater contamination.

Groundwater exploration: Surface and subsurface geological, geophysical and remote sensing methods, hydrogeomorphic mapping using various remote sensing techniques.

Water well construction techniques: Methods for sedimentary and hard rock terrain; Pumping test—procedures and analysis of data.

Artificial recharge of groundwater. Groundwater modeling, groundwater law, watershed management. Rain water harvesting techniques and designing for various terrain conditions.

Texts/References

Part 1: Geological & Geochemical Exploration


Part 2: Geophysical Exploration

EASC-624: Modern Analytical Methods in Geoscience 3 Credit

Concepts in analytical chemistry; Classical and rapid methods of analyses; Atomic absorption spectrometry; Inductively coupled plasma-emission & mass spectrometry; X-ray diffraction analysis; X-ray fluorescence analysis; electron probe micro analysis and other surface analytical techniques; neutron activation analysis, mass-spectrometry.

Texts/References

Introduction to nuclear systematics, analytical techniques and mass spectrometry, equations of radioactive decay and radiogenic growth. Application of K-Ar, Rb-Sr, Sm-Nd, Re-Os, U-Th-Pb systematic in geochronology, petrogenesis and oreogenesis. Introduction to stable isotope geochemistry, O and H isotopes in the hydrosphere, atmosphere and lithosphere, C and S isotopes and in the Earth’s reservoirs and their applications in ore geology. Fundamentals of cosmogenic nuclides and their applications.

Text/References

Basic Principles: Conventional Surveying and mapping (Chain survey, Plane Table survey, Surveying with Theodolite), Topo sheet reading- Definition and Nature of Cartography - History - Cartographic problems


Cartography: Map Projection Types of Map projections (Conical, Polyconic, Cylindrical, Equal area or Lamberts cylindrical, Mercators, Zenithal, Gnomonic) Map compilation - Map Design & Layout - Lettering & Toponomy - Mechanics of map construction. Computer Assisted Cartography: Input data types (point, line, polygon and Raster data) - Data source (Toposheet, Aerial Photo, Magnifier, Stereoscope, Video Camera, Digitiser board, Scanners) - Modelling Devices (Computer, Photo writer, Plotter) - Cartographic processes (Contouring, Density slicing, 3D Projection, Area Calculation, Volume Estimation) - Storage Devices - Output devices - Special Merits of Digital Cartography.


Texts/References

Campbell, J 1984: Introductory Cartography, Printers Hall Englewood Cliffs, N.J
Qiheyans: Map Projection transformation, Principles and its Applications
P.J.G. Teunissen & A. Kleusberg (Eds) 1998: GPS for Geodesy, Springer Verlag, Germany
EASC-711: Professional Training 6 Credit

Intensive field and laboratory training in exploration geoscience including mineral exploration and mining practices, petroleum well logging and related well site operations, groundwater exploration and aquifer modeling, geotechnical and geo-environmental investigations etc. Training will be conducted through professional organisations engaged in exploration of mineral, groundwater and petroleum resources.

EASC-712: Mini Project 8 Credit

Individual project work on exploration geoscience. One faculty member of the Department will be assigned as the Supervisor. The mini project will be a prelude to the M.Tech dissertation.

EASC-713: Seminar 4 Credit

Seminar on a selected topic in exploration geoscience including preparation of a write-up and presentation document, and delivery of seminar talk.

EASC-721: Dissertation 15 Credit

Individual project work on exploration geoscience. One faculty member of the Department will be assigned as the Supervisor.

EASC-722: Viva-voce 3 Credit

General viva-voce examination covering all the courses offered in the M.Tech Exploration Geoscience programme.