M. Sc. Second Year (Semester IV)
GEOLOGY

M4GEO01-CT11 Core Course – XI : Metamorphic Petrology No. of Credits : 4

UNIT – I

Agents and kinds of metamorphism; metamorphic zones; grades; iso-grades; metamorphic facies; Fabric of metamorphic rocks formed under regional, dynamic and thermal metamorphisms; Classification of regional metamorphism based on P/T ratio.

UNIT – II

Principles of thermodynamics; Mineralogical phase rule; Diagrammatic representation of mineral paragenesis in: ACK, AKF and AFM diagrams; thermodynamics and kynetics of metamorphic reactions.

UNIT – III

Studies of metamorphic facies: zeolite facies; pumpellyite-prehnite facies; glucophane schist facies; greenschist facies; amphibolite facies; granulite facies, eclogite facies; albite-epidote hornfels facies; hornblende-hornfels facies; pyroxene-hornfels facies; sanidinite facies.

UNIT – IV

Principles of metasomatism and metamorphic differentiation; petrogenetic grids; pressure, temperature, time paths; mineralogical and textural changes accompanying progressive regional metamorphism of mafic, ultramafic, pelitic and carbonate rocks.

UNIT – V

Anatexis and formation of migmatites and origin of granitic magma; petrographic and petrogenetic studies of charnockite, migmatite and amphibolite; metamorphism in relation to magma and orogeny; metamorphism in relation to plate tectonics.

Recommended Books:

Bucher, K. and Frey, M. 1984: *Petrogenesis of Metamorphic Rocks, Springer Verlag*
Kretz, R., 1994: *Metamorphic Crystallization, John Wiley*
Philipotts, A., 1992: *Igneous and Metamorphic Petrology. Prentice Hall*
Turner, F.J., 1980: *Metamorphic Petrology, McGraw Hill, New York*
Wood, B.J.and Fraser, D.G., 1976: *Elementary thermodyamics for Geologist. Oxford University Press*
Yardely, B.W., 1989., *An Introduction to Metamorphic Petrology. Longman New Yourk*

M. Sc. Second Year (Semester IV)
GEOLOGY

M4GEO02-CT12 Core Course – XII No. of Credits : 4
(Mineral Exploration & Mining Geology)

UNIT – I

Guides for locating ore deposits: structural, lithological, stratigraphic and physiographic guides. Surface prospecting methods: pitting and trenching; Sub-surface exploration: drilling, different types of drilling, use of diamond drilling in exploration; core-logging and assaying; sampling: various methods of sampling.

UNIT – II

Ore reserves and resources: definition and outline of United Nations International framework classification of mineral reserves and resources; grades and recovery of ores; methods of ore reserve estimations; surface area and cross sectional area methods; recoverable reserves and anticipated life of the deposits.

UNIT – III

Outline of geophysical and geochemical prospecting; role of remote sensing in mineral exploration; explosives: types, storage and precautions in handling of explosives; blasting: various patterns of blast holes and methods of their charging and blasting.

UNIT – IV

Elements of mining: mining methods; various types of surface and underground mining methods; factors involving in selection of open cast and underground mining methods; salient features of bench-mining, shrinkage stopping, sub-level stopping and sub-level top slicing; coal mining methods: room and pillar method, long wall method.

UNIT – V

Outlines of the rules governing conservation, development and utilization of mineral resources; National mineral policy; prospecting license and mining lease; procedures of granting prospecting license and mining lease. Environmental aspects of Mining activities.

Recommended Books:

Dobrin, M. B., 1976: *Introduction to Geophysical Prospecting. McGraw Hill*
Arogyaswami, R.P.N., 1996: *Courses in Mining Geology. IV Ed. Oxford IBH*
Boyle, R.W., 1982: *Geochemical Prospecting for Thorium and Uranium Deposits. Elsevier*
Clark, G.B., 1967: *Elements of Mining. III Ed. John Wiley*

M. Sc. Second Year (Semester IV)
GEOLOGY

M4GEO03-ET03 Discipline Specific Elective Course – III No. of Credits : 4
(Environmental Geology & Disaster Management)

UNIT – I

Environment : definition and types of environment; Environmental Geology: definition and concepts of environmental geology; pollution and geohazards; environmental problems: global warming, green house effect, depletion of ozone layer, acid rain.

UNIT – II

Air pollution : causes, impact and remedial strategies; Noise pollution : causes, impact and remedial strategies; Water pollution : causes, impact and remedial strategies; groundwater pollution and health issues.

UNIT – III

Environmental impacts of mining activities; concept of eco-friendly mining; laws governing protection of environment and control of pollution; environmental impact assessment (EIA).

UNIT – IV

Disaster, concept and types of disaster, factors, causes and effect of disasters; human behaviour and response during disaster; natural disasters (earthquakes , volcanic activities, floods, droughts land slides).

UNIT – V

Man made disaster, environmental changes, mining, industrial, epidemic, mechanism, distribution and impact of cyclones, hurricanes, tsunamis, lightning etc. management and mitigation of disasters.

Recommended Books:

Bryant, E., 1985: *Natural Hazards, Cambridge University Press*
Bell, F. G., 1999: *Geological Hazards. Routledge, London*
Keller, E. A., 1978: *Environmental Geology, bell and Howell, USA*
Patwardhan, A. M., 1999: *The Dynamic Earth System. Prentice Hall*
Smith, K. 1992: *Environmental Hazards. Routledge, London*
Subramaniam, V., 2001: *Text Book in Environmental Science, Narosa International.*
Valdiya, K.S., 1987: *Environmental Geology – Indian Context. Tata McGraw Hill*

M. Sc. Second Year (Semester IV)
GEOLOGY

M4GEO04-ET04 Discipline Specific Elective Course – IV (Geochemistry) No. of Credits : 4

UNIT – I

Introduction to atomic structures, periodic table and properties of elements including trace and REE. Basic principles of crystal chemistry, radius ratio, co-ordination number and co-ordination polyhedron; Silicate structures; Isomorphism, polymorphism, solid solution and exsolution.

UNIT – II

Earth in relation to solar system and universe; Introduction to meteorites and planets; Cosmic abundance of elements; Structure and composition of earth and distribution of elements; Geochemical classification of elements.

UNIT – III

Partition coefficient and elemental variation during crystal-liquid fractionation; Geochemistry of atmosphere, hydrosphere and biosphere; Geochemical cycle.

UNIT – IV

Fundamentals of isotope geochemistry; Radiogenic and stable isotopes and their geological applications.

UNIT – V

Introduction to thermodynamics; Gibbs energy and equilibrium; Gx and Tx diagrams; Fundamentals of mole fraction and activity co-efficient; Ideal and non-ideal solutions.

Recommended Books:

Faure, G., *1986: Principal of Isotope Geology. John Wiley*
Govett, G.J.S.(Ed), *11983: Handbook of Exploration Geochemistry Elsevier.*
Henderson, P., *1987: Inorganic Geochemistry, Pergamon Press.*
Hoefs, J., 1980: *Stable Isotope Geochemistry. Springer Verlag*
Krauskopf, K.B., *1967: Introduction to Geochemistry. McGraw hill*
Marshal, C.P. and Fairbridge, R.W., *1999: Encyclopaedia of Geochemistry. Kluwer Academic*
Mason, B. and Moore, C.B., *1991: Introduction to Geochemistry, Wiley Eastern*
Nordstrorm, D.K. and Munoz, J.L., *1986: Geochemical Thermodyamics, Blackwell*

M. Sc. Second Year (Semester IV)
GEOLOGY

M4GEO05-CP06 Core Course PRACTICAL – VI No. of Credits : 4
(Metamorphic Petrology & Photo-geology Remote Sensing)

Metamorphic Petrology:

1. Identification and description of important metamorphic rocks in hand specimen.
2. Petrographic studies of important metamorphic rocks.
3. Graphic construction of ACF, AKF and AFM diagrams.

Mineral Exploration & Mining Geology :

1. Survey by prismatic compass and theodolite.
2. Leveling
3. Use of GPS
4. Bore hole plotting, core logging and correlation.
5. Ore reserves estimation.

Viva-Voce
Field work
Record

M. Sc. Second Year (Semester III)
GEOLOGY

M4GEO06-EP02 Elective PRACTICAL– II No. of Credits : 4
(Environmental Geology & Disaster Management & Geochemistry)

Environmental Geology & Disaster Management:

1. Analysis of different parameters of air, water and noise.
2. Interpretation of air, water and noise data.
3. Preparation of iso-concentration maps of water quality parameters.
4. Seismic maps of World, India and Rajasthan.
5. Exercises on slope failure and landslides.

Geochemistry :

1. Presentation of analytical data and graphical representation in various diagrams.
2. Calculation of important mineral formula from chemical analysis.

Viva-Voce
Record

Compulsory Field Training Program : Geological Field Training Mining & Exploration aspects. – 10 days duration

Note: **Field Training is Compulsory, Student not taking part in the field training shall not be allowed to appear in the examination**

M. Sc. Second Year (Semester IV)
GEOLOGY

M4GEO07-SE02 Skill Course Elective - Survey & Leveling No. of Credits : 2

Introduction to Surveying: Objective of surveying and its importance.

Classification, principles of surveying

Linear measurements: Distance Measurement Chains, tapes, electronic distance measurement,

Plane Table Surveying Methods

Theodolite : Definition and terms, temporary adjustments, measurement from theodolite

Leveling instruments: Definition, different type of leveling instruments

Contouring : General, Contour Interval, Characteristics, Methods of contouring

Global Positioning System (GPS) : Theory, principles and applications.