

**DEPARTMENT OF
EARTH AND ENVIRONMENTAL SCIENCE
K.S.K.V. Kachchh University
Mundra Road, Bhuj-370 001, Kachchh (Gujarat State)**



**Syllabus
M.Sc. (Geology)
(As per the new structure of CBCS)
(Effective from June 2010)**

**Submitted to
The Board of University Teaching and Research (BUTR)
KSKV Kachchh University
Bhuj-Kachchh**

GENERAL STRUTURE

Semesters	Semester-I	Semester-II	Semester-III	Semester-IV	TOTAL
Course category					
Core courses	4	4	3	1	12 - CORE
Elective courses	0	0	2	4	6 - ELECT
Interdisciplinary courses	1 (3)	1 (3)	0	0	2 - ID
Foundation courses	1 (n)	1 (n)			2 - FC
Course / Credits	28	28	24	24	22 / 104

Extended Course Structure (Semester-I and II)

Semesters Course category	Semester-I <i>(credits of each course/ paper are written in the brackets) (T+Tu&P)</i>	Semester-II <i>(credits of each course/ paper are written in the brackets) (T+Tu&P)</i>
Core courses	<ol style="list-style-type: none"> 1. GEO-101/C Structural geology (4+2) <i>LAB (Petrofabric analysis, map section etc)</i> 2. GEO-102/C Crystallography (3+1) <i>LAB (32 point groups, twin crystals, clinographic proj.)</i> 3. GEO-103/C Standard Stratigraphy and Paleontology (4+2) <i>LAB (micropalaeontology, ichnofacise)</i> 4. GEO-104/C Geotectonics (3+1) 	<ol style="list-style-type: none"> 1. GEO-205/C Sedimentary Petrology and Sedimentology (4+2) <i>LAB (Petrography, Grain size analysis, sieving for sedimentary environment)</i> 2. GEO-206/C Stratigraphy and Boundary Problems of India (4+1) 3. GEO-207/C Economic Geology (4+1) <i>LAB (Ore Microscopy)</i> 4. GEO-208/C Mineralogy and Optics (3+1) <i>LAB (megascopic, microscopic minerals and optics)</i>
Elective courses	NIL	NIL
Interdisciplinary courses	<ol style="list-style-type: none"> 1. GEO-141/I Remote Sensing and GIS (3+1) <i>LAB (RS & GIS)</i> 2. GEO-142/I Disaster Management (3+1) 3. GEO-143/I Nanotechnology (3+1) <i>(Any one can be offered out of three given above)</i> 	<ol style="list-style-type: none"> 1. GEO-244/I Engineering Geology (3+1) <i>LAB (Geotech. practical)</i> 2. GEO-245/I Environmental Geology (3+1) 3. GEO-246/I Research Methodology, Statistics and Computer application (3+1) <i>LAB (Statistical and Computer related practical)</i> <i>(Any one can be offered out of three given above)</i>
Foundational courses	(One out of many suggested by BAOU) (4) (Self study course)	(One out of many suggested by BAOU) (4) (Self study course)
Total Credits	28	28

Extended Course Structure (Semester-III and IV)

Semesters Course category	Semester-III (credits of each course/ paper are written in the brackets) (T+Tu&P)	Semester-IV (credits of each course/ paper are written in the brackets) (T+Tu&P)
Core courses	<ol style="list-style-type: none"> 1. GEO-309/C Igneous Petrology (4+2) <i>LAB (Megascopic and microscopic rocks, Norms calculation)</i> 2. GEO-310/C Metamorphic Petrology (4+2) <i>LAB (Megascopic and microscopic rocks)</i> 3. GEO-311/C Geomorphology (2+1) 	<p style="color: green;">NIL</p> <ol style="list-style-type: none"> 1. GEO-412/C Groundwater Hydrology (4+1) <i>LAB (Resistivity survey and data analysis)</i>
Elective courses	<ol style="list-style-type: none"> 1. GEO-321/E Geochemistry (3+1) <i>LAB (Geochemical analysis of rocks, manual, XRF, AAS, UV Spectrophotometer etc.)</i> 2. GEO-322/E Petroleum and Coal Geology (4+1) <i>LAB (Use of calorimeter for coal and petroleum)</i> 	<ol style="list-style-type: none"> 1. GEO-424/E Neotectonics and Paleoseismology (4+1) <i>LAB (Morphometric exercise, TL, OSL, C¹⁴ lab visit)</i> 2. GEO-424/E Geodesy and Surveying (3+1) <i>LAB (Plane Table, Prismatic, Magnetic and Total station survey, mapping etc.)</i> 3. GEO-425/E Geochemistry <i>Dissertation (10)</i> 4. GEO-426/E Petroleum and Coal Geology <i>Dissertation (10)</i> 5. GEO-427/E Neotectonics and Paleoseismology <i>Dissertation (10)</i> 6. GEO-428/E Geodesy and Surveying <i>Dissertation (10)</i> 7. GEO-429/E Geological mapping, Stratigraphy, Petrology, Paleontology, Structural Geo., etc. of any area <i>Dissertation (10)</i> <i>(Dissertation equal to two course work) (Any one out of 3 to 7)</i>
Interdisciplinary courses	NIL	NIL
Total Credits	24	24

SEMESTER-1**CORE COURSES****GEO-101/C****STRUCTURAL GEOLOGY**

(4 Credits for Theory and 2 Credits for Tutorials and Practicals)

UNIT-1 Concepts of Structural Geology, Dynamic and Kinematic analysis of rocks in two dimensions. Stress and Strain.

UNIT-2 Folds: Classification and mechanism, Faults and ductile shear zone – classification, mechanism and identification.

UNIT-3 Cleavage and Lineation, boudinage, Deformation of linear structures by flexural slip folding and shear folding; deformation of planar structures by flexural slip folding and shears folding; superimposed folding.

LABORATORY

Petrofabric analysis: Streographic analysis of planes and lines. Analysis of folds, faults. Interpretation of geological maps. Map sections, structural problems. Computer aid to analysis of structural data.

Texts / References (Suggested Readings)

Ramsay, J.G. Folding and fracturing of rocks, McGraw Hill, 1967.

Ghosh, S.K. Structural Geology – Fundamentals and modern development, Pergamon, 1993

Hobbs, B.E., Means, W.D. and Williams, P.F. An outline of structural geology, John Wiley, 1976.

Davis, Structural Geology, Wiley

M. P. Billings, Structural Geology, CBS

Paor, D. Structural Geology and Personal Computer, Pergamon, 1996.

Rowland, S.M. and Duebendorfer, E.M. Structural Analysis and Synthesis, Pergamon, 1994.

D M Ragan Structural geology - An Introduction to Geometrical Techniques, John Wiley, 1985.

GEO-102/C

CRYSTALLOGRAPHY

(3 Credits for Theory and 1 Credit for Tutorials and Practicals)

UNIT-1 Crystallography: Classical Crystallography, Lattice and properties, Crystal structures, Crystal chemistry. 14 Bravais Lattices.

UNIT- 2 Crystal symmetry, 32 point groups with all forms, 230 space groups, HM symbols and Stereograms.

UNIT-3 Crystal defects, X-Ray Diffraction, SEM, XRF etc. (use of high performance instruments in crystallography)

LABORATORY

Identification of crystal models, their symmetry elements according to 32 point groups, Herman-Maugan classification of crystals. Stereographic projections, twin crystals.

Texts / References (Suggested Readings)

Donald Bloss, Crystallography and Crystal chemistry, Holt Rinehart and Winstar Jr., 1971.

J. D. Dana, Manual of Mineralogy Wiley E Edition

Dana Text Book of mineralogy

GEO-103/C

STANDARD STRATIGRAPHY AND PALEONTOLOGY

(4 Credits for Theory and 2 Credits for Tutorials and Practicals)

UNIT-1 Principles of Paleontology: Structural variations and diversity in fossils, evolution of life, principles of taxonomic classification, species concepts, taxonomic nomenclature, biostratigraphic principles, palaeoenvironmental reconstruction, paleobiogeography.

UNIT-2 Ichnology and micropaleontology: classification and environmental significance of trace fossils, animal sediment relationship. Collection and preparation techniques of microfossils, morphology and classification of foraminifera, study of some common benthic and planktonic foraminifera, applications of micropalaeontology.

UNIT-3 Precambrian, Palaeozoic, Mesozoic and Cenozoic Standard Stratigraphy. Various techniques adopted for Stratigraphical analysis: Lithostratigraphy and Chronostratigraphy, Biostratigraphy, Sequence Stratigraphy, Magnetostratigraphy, Seismostratigraphy.

LABORATORY

Morphological descriptions and illustrations of representative fossils belonging to some foraminiferal genera (micropaleontology): Preparation of stratigraphic range charts and biostratigraphic zonation.

Texts / References (Suggested Readings)

Raup, D.M. and Stanley, S.M. Principles of Paleontology, W.H. Freeman & Co. 1971.

Clarkson, E.N.K. Invertebrate Palaeontology and Evolution, ELBS. 1987.

Haynes, J.R. Foraminifera, John Wiley. 1981.

Shrock and Twenhoefells, Invertebrate Paleontology, CBS publishers

Woods, H. Palaeontology Invertebrate, International Book Bureau, 1966.

Murray, J.W. Atlas of Invertebrate Macrofossils, Longman. 1985.

GEO-104/C

GEOTECTONICS

(3 Credits for Theory and 1 Credit for Tutorials and Practicals)

UNIT-1 Plate Tectonics: Concepts and boundaries, seafloor spreading, case studies of the world, paleomagnetism, normal and reverse magnetism, polar wandering, hot spots, plumes, convection and mechanism.

UNIT-2 The Earth's Crust, Mantle and Core: Crustal types, Seismic crustal structure, heat flow, crustal gravity and crustal magnetism, mantle plumes, convection in the mantle, core: Introduction.

UNIT-3 Tectonic Settings: Ocean ridges, Ophiolites, Cratons and passive margins, Continental rifts, Arc systems, Orogens.

LABORATORY

NIL

Texts / References (Suggested Readings)

Kent C. Condie, Plate Tectonics and Crustal Evolution, 4th Edition.

Kearey P and F.J. Vine, Global Tectonics. *Blackwell scientific Publications*

INTERDISCIPLINARY COURSES

GEO-141/I

REMOTE SENSING AND GIS

(3 Credits for Theory and 1 Credit for Tutorials and Practicals)

UNIT –1 Remote Sensing and Photogeology: Fundamental concepts of remote sensing; electromagnetic energy and its interactions in the atmosphere and with terrain features; elements of photographic systems, aerial photography and geological applications, Fundamentals of photogrammetry, satellite remote sensing, multi-spectral scanners, thermal scanners, microwave remote sensing, fundamentals of image interpretation and geological applications

UNIT – 2 Introduction to GIS: Introduction to digital image processing and Geographic Information System, spatial data models and data structures, visualization and query of spatial data, overlay analysis, geological applications of GIS.

UNIT – 3 GPS: introduction, principle and working application of GPS.

LABORATORY

Laboratory exercise for remote sensing and Photogeology: Topographical map, areal photo and satellite imagery interpretation for geological and geomorphological applications, Basic photogrammetry exercises like parallax measurements for height determination, Introduction to digital image processing and GIS application packages. Tutorials for GIS softwares (Arc GIS, IRDAS, GeoMedia etc)

Texts / References (Suggested Readings)

- Sabnis, F.F.** Remote sensing - Principles and Interpretation, W.H. Freeman and Co., 1978.
- Lillesand, T.M. and Kiefer, R.W.** Remote sensing and Image Interpretation, John Wiley, 1987.
- S. A. Druary,** Image Interpretation in Geology,
- Pandey, S.N.** Principles and Applications of Photogeology, Wiley Eastern, 1987.
- Bonham Carter, G.F.** GIS for Geoscientists- Modelling with GIS, Elsevier, 1994.
- Lattman, L.H. and Ray, R.G.** Aerial photographs in field geology, McGraw Hill, 1965.

GEO-142/I

ENVIRONMENTAL GEOLOGY

(3 Credits for Theory and 1 Credit for Tutorials and Practicals)

UNIT-1 Environmental Geology: Geologic and Natural Hazards and hostile environment: Volcanism, earthquakes, land slide and mass movements, floods, water logging, pollution.

UNIT-2 Mineral and Water resource exploration and environmental impact, waste disposal, Geology and urbanization, mineral resources and future of mankind.

UNIT-3 Environmental Problems related to Geology: Indian Perspective.

LABORATORY

Laboratory exercises on mapping of seismic zones of India, Active and Passive Volcanoes in world and mapping of Earthquake zones in world.

Texts / References (Suggested Readings)

Bell, F.G. Fundamentals of Engineering Geology, Butterworths, 1983.

Krynine, D.P. Judd, W.P. Principles of Engineering Geology, McGraw Hill, 1957.

Ronald W. Tank, Environmental Geology

Keller, Environmental Geology

Blyth and de Freitas, A Geology for Engineers

K. S. Valdiya, Environmental Geology: Indian Context

SEMESTER-2**CORE COURSES****GEO-205/C****SEDIMENTARY PETROLOGY AND SEDIMENTOLOGY***(4 Credits for Theory and 2 Credits for Tutorials and Practicals)*

UNIT-1 Rocks to sediments; Kinds of sedimentary particles; Hydraulics, sediment transportation and structures; Texture - shape, size, fabric and surface textures, methods of textural analysis, textural parameters and their significance

UNIT-2 Gravels, Conglomerates & Breccias; Sands & Sandstones; Shales, Argillites & Siltstones; Limestones & Dolomites; Non-Clastic Sediments; Diagenesis & Lithification; Provenance.

UNIT-3 Physical and chemical parameters of depositional environments; Classification of environments; Structures and vertical sequences formed in alluvial, deltaic, coastal, deep sea, aeolian & carbonate environments, Sedimentary basin analysis

LABORATORY

Megascopeic and microscopic identification of sedimentary rocks, Grain size analysis, sieving for sedimentary environment.

Texts / References (Suggested Readings)

- Blatt, H., Middleton, G.V. and Murray, R.C.** (1980): Origin of Sedimentary Rocks, Prentice-Hall Inc.
- Collins, J.D., and Thompson, D.B.** (1982): Sedimentary Structures, George Allen and Unwin, London.
- Lindholm, R.C.** (1987) A Practical Approach to Sedimentology, Allen and Unwin, London.
- Miall, A.D.** (2000): Principles of Basin Analysis, Springer-Verlag.
- Pettijohn, F.J.** (1975): Sedimentary Rocks (3rd Ed.), Harper and Row Publ., New Delhi.
- Reading, H.G.** (1997): Sedimentary Environments and facies, Blackwell Scientific Publication.
- Reineck, H.E. and Singh, I.B.** (1973): Depositional Sedimentary Environments, Springer-Verlag.
- Selley, R. C.** (2000) Applied Sedimentology, Academic Press.
- Tucker, M.E.** (1981): Sedimentary Petrology: An Introduction, Wiley and Sons, New York.
- Tucker, M.E.** (1990): Carbonate Sedimentology, Blackwell Scientific Publication.

GEO-206/C

STRATIGRAPHY AND BOUNDARY PROBLEMS OF INDIA

(4 Credits for Theory and 1 Credit for Tutorials and Practicals)

- UNIT-1** Tectonic Framework of India: Tectonic divisions, Cratons (Dharwar and Aravalli), Mobile belts (Eastern Ghat, Satpura and Precambrian of Himalaya)
- UNIT-2** Proterozoic Sedimentary basins: Paleoproterozoic (Bijawar, Gwalior, Papaghni Sub-basin) and Mesoproterozoic Basins (Vindhyan, Chattisgarh, Parinatha-Godavari, Cuddapah)
- UNIT-3** Boundary problems of India:
Precambrian/ Cambrian boundary in India, Archaean – Proterozoic boundary of India, Cretaceous/ Tertiary Boundary in India, Paleogene/ Neogene boundary in India, Neogene/ Quaternary boundary in India.

LABORATORY

Semester- end Field Training

Texts / References (Suggested Readings)

- M. Ramakrishnana and R. Vaidyanathan:** Geology of India, (GSI), Bangalore
Stratigraphic boundary problems of India: Memoirs 16, GSI-Bangalore, 1990
M.S. Krishnan, Geology of India and Burma CBS Publisher

GEO-207/C

ECONOMIC GEOLOGY

(4 Credits for Theory and 1 Credit for Tutorials and Practicals)

UNIT - 1 Ore Genesis: Mineral deposits as products of geochemical cycles in relation to igneous, sedimentary, metamorphic and weathering processes. Resources and reserves and their classification, Strategic, critical and essential minerals, National Mineral Policy.

UNIT - 2 Exploration: Gathering and presenting geological data, obtaining and evaluating existing data, Geological guides to mineral search, Designing a reconnaissance project, Principles and techniques of geophysical exploration, Gravity, Magnetic, Seismic, Electrical, Radiometric prospecting.

UNIT - 3 Ore Dressing and Mining Geology: Ore dressing and mineral beneficiation: Concepts of ore dressing, Application of ore microscopy to beneficiation techniques. Processes and mineral beneficiation. Gravity concentration, magnetic separation, heavy media separation. Electrostatic and high Tension separation, Froth floatation. Typical flow sheets of mineral ore dressing. Terminology in mining, types of mining, mine planning and environmental issues related to mining.

LABORATORY

Ore Microscopy

Texts / References (Suggested Readings)

Arogyaswamy, R.N.P(1980). Course in mining Geology, *Oxford & IBH Pub. Co*

Williams Peter J. Exploration and mining geology. *John Wiley & Sons, New York*

Chatterjee, K.K. (1993) An Introduction to Mineral Economics. *Wiley Eastern Ltd.*

Krishnaswamy, S. (1979) India's Mineral Resources; *Oxford and IBH Co.*

Asoke Mookherjee (1999) Ore genesis: a holistic approach, Allied Publishers

GEO-208/C

MINERALOGY AND OPTICS

(3 Credits for Theory and 1 Credit for Tutorials and Practicals)

UNIT-1 Mineralogy: Atomic structures and mineral/ crystal chemistry and diagnostic properties of rock forming minerals including clay minerals techniques of mineral identification. All silicates, sulphates, carbonates, native minerals, sulphides, oxides etc.

UNIT-2 Optics: Properties of light, polarization, interference of light waves, measurement of RI, determination of pleochroic scheme, measurement of birefringence, optic orientation in different crystallographic systems.

UNIT-3 Determination of optic sign of uniaxial and biaxial minerals, determination of optic axial angle, principle of U-stage techniques.

LABORATORY

Megascopic and microscopic study of rock forming minerals, Study of minerals under transmitted light, determination of R.I., colour, pleochroism, fast and slow ray vibration directions, birefringence, extinction angle, sign of minerals, Uni- Bi- axial or isotropic character and 2V. Megascopic and microscopic study of rock forming minerals. X-ray diffraction methods of identification of minerals.

Texts / References (Suggested Readings)

Deer, W.A. , Howie, R.A., and Zussman, J. An Introduction to rock forming minerals, Longman, 1962

Winchell, A.N. Elements of Optical Mineralogy, John Wiley, 1962.

Berry, L.G. and Mason, B. Mineralogy, Freeman, 1957.

Donald Bloss, Crystallography and Crystal chemistry, Holt Rinehart and Winstar Jr., 1971.

Deer, W.A. , Howie, R.A., and Zussman, J. An Introduction to rock forming minerals, Longman, 1962

J. D. Dana Manual of Mineralogy Wiely E Edition

Dana, Text Book of mineralogy

Winchell, A.N. Elements of Optical Mineralogy, John Wiley, 1962.

Berry, L.G. and Mason, B. Mineralogy, Freeman, 1957.

INTERDISCIPLINARY COURSES**GEO-244/I****DISASTER MANAGEMENT**

(3 Credits for Theory and 1 Credit for Tutorials and Practicals)

UNIT-1: Introduction, Theoretical Concepts and Case study: Coastal development and Disaster, Rising disaster and their reversal, The politics of disaster, The role of coordination in Disaster Management. Different approach to disaster recovery, Debris disposal and Recycling from disaster.

UNIT-2: Human, Personal and International issues: Disaster Management and population with special needs, Disaster Psychology: A Dual perspective, Managing the spontaneous volunteer, First responder and workforce protection, Disaster rehabilitation: towards a new perspective

UNIT-3: Planning, Prevention and Preparedness: The role of training in disaster management, Disaster management and intergovernmental relations, Issues in hospital preparedness, Strategic planning for emergency manager

LABORATORY

Field Training with the State / District Level Disaster Management Authority,

Training to use various rescue equipments, instruments, First Aid etc.

Texts / References (Suggested Readings)

Harsh Gupta (2003), Disaster Management, Universities Press.

Thomas D. Schneid and Larry Collins (2001), Disaster management and preparedness: *Occupational safety and health guide series*, CRC Press.

GEO-245/I

ENGINEERING GEOLOGY

(3 Credits for Theory and 1 Credit for Tutorials and Practicals)

UNIT-1 Engineering Geology: Strength of Geological material, ground and laboratory investigations, Concepts of stress, strain, Mohr circle and failure theories. Engineering properties of rocks, and soils and their classifications. Weathering. Discontinuities in rock masses.

UNIT-2 Rock slope stability, landslides and stability of structures, Reservoirs and dams.

UNIT-3 Tunnels, excavations, ground treatment and support, map reading, foundations and structures in earthquake prone regions.

LABORATORY

Geotechnical analysis of rocks, soils and materials, Material testing etc.

Texts / References (Suggested Readings)

Krynine D P & Judd W R(1998) Principles of engineering geology & geotechniques; *Mc Graw Hill, NY*

Bell F G (1980) Engineering geology and geotechniques; *Butterworths, London.*

Bell F G (1983) Fundamentals of engineering geology; *Butterworths, London.*

Zaruba, Q. and Mencl, V.(1976) Engineering geology; *Scientific publishing Amsterdam.*

GEO-246/I

RESEARCH METHODOLOGY, STATISTICS AND COMPUTER APPLICATION

(3 Credits for Theory and 1 Credit for Tutorials and Practicals)

UNIT- 1: Introduction to Research and Scientific Writing: Characteristics and Types of Scientific Research, Organizing Scientific Research: Experimental Design, Research Methodology, Sampling designs. Research proposals, Paper, Reviews, thesis, conference reports, book reviews, project reports, reference writing and scientific abbreviations. Preparation and delivery of Scientific Presentations

UNIT- 2: Introduction to Biometry and Parametric Tests: Statistics, Definition and scope, Sampling and sample designs, presentation of data (tabular, graphical and diagrammatic presentation), Measures of central tendency, dispersion and standard error; Probability distributions: binomial, poisson and normal distribution, Statistical significance (Hypothesis testing, types of error, level of significance), Student's t distribution, Analysis of variance, χ^2 test and goodness of fit, Regression and Correlation Analysis

UNIT- 3: Computer Applications: History, development and types of computers; Computer hardware, software and peripheral devices; Basic working on DOS, Windows and Linux, General awareness and use of popular software and packages, Microsoft office, Internet-Browsing

LABORATORY

Statistics and Computer related practical

Texts / References (Suggested Readings)

C R Kothari (2008) Research Methodology : Methods And Techniques, New Age International.

Wayne Goddard, Stuart Melville (2004): Research Methodology: An Introduction, Juta and Company Ltd.

Allan G. Bluman (2005): Elementary statistics: a step by step approach, McGraw Hill Publ.

Preben Blæsild, Jørgen Granfeldt (2003): Statistics with applications in biology and geology, CRC Press.

T. V. Loudon (1979), Computer methods in geology, Academic Press.

SEMESTER-3**CORE COURSES****GEO-309 / C****IGNEOUS PETROLOGY**

(4 Credits for Theory and 2 Credits for Tutorials and Practicals)

UNIT-1 Evolution and formation of magma and magmatic systems; Crystallisation paths of binary and ternary systems. Magmatic differentiation, assimilation and partial melting, various rock suits, chemical and mineralogical classification (general).

UNIT-2 Petrography, Structures and textures of the Calc-Alkaline volcanic and plutonic rocks. Plutons, etc. with major case studies.

UNIT-3 Petrography, Structures and textures of the Alkaline and sub-alkaline volcanic and plutonic rocks, Mafic and ultramafic rock bodies, ophiolites, Kimberlites etc. with major case studies.

LABORATORY

Megascopeic and microscopic studies of igneous rock, Norms calculation and rock classification

Texts / References (Suggested Readings)

Myron G. Best Igneous and Metamorphic Petrology, CBS Publishers

Winter Igneous and Metamorphic petrology by

Anthony Hall Igneous Petrology by

Carmichael, I.S.E., J. Igneous Petrology, McGraw Hill 1974.

Cox, K.G. Bell, J.D. and Pankhurst, R.J. Interpretation of Igneous Rocks. George Ullen & Unwin 1979.

Wilson, M. Igneous Petrogenesis. Unwin Hyman 1990.

GEO-310/C

METAMORPHIC PETROLOGY

(4 Credits for Theory and 2 Credits for Tutorials and Practicals)

UNIT-1 Nature of Metamorphism: Introduction, Agents, types of metamorphism, types of protolith, Classification of metamorphic rocks, Famous case studies of the world.

UNIT-2 Structures and Textures of metamorphic rocks: process of deformation, recrystallization, Textures of dynamic, regional, contact, non-foliated rocks, Origin of fabrics in metamorphic system.

UNIT-3 Metamorphic facies, metamorphism of mafic and ultramafic rocks, Field relation of metamorphic bodies and metamorphic facies, Metamorphism of pelitic sediments: Diagenesis and low grade metamorphism of pelites, medium grade, AFM diagrams, partial melting of pelites, High P/T metamorphism of pelites, migmatites,

LABORATORY

Megascope and microscopic studies of metamorphic rocks

Texts / References (Suggested Readings)

Yardly, B. W. An Introduction to Metamorphic petrology, Longman

Myron G. Best, Igneous and Metamorphic Petrology, CBS Publishers

Winter, Igneous and Metamorphic petrology

Philopotts, A.R. Principles of Igneous and Metamorphic Petrology, Prentice Hall, 1994.

Bhaskar Rao, B. Metamorphic Petrology, IBH & Oxford, 1986.

GEO-311/C

GEOMORPHOLOGY

(2 Credits for Theory and 1 Credit for Tutorials and Practicals)

UNIT-1 Principles of Geomorphology: Processes, pedogenesis and morphogenetic regions.

Concept of cycle of erosion; fluvial, aeolian, Coastal, Karst and glacial landscapes, methods of analysis of landforms, slopes and drainage.

UNIT-2 Applications of Geomorphology: Morphometric analysis (Landscape fractal

dimension, river ordering, sinuosity, Mountain front sinuosity, rates of uplift).

LABORATORY

Preparation and interpretation of Geomorphic map

Texts / References (Suggested Readings)

Thornbury, W.D. Principles of Geomorphology, Wiley Eastern, 1993.

Holmes, A. Physical Geology, Nelson, 1965.

Way, D.S. Terrain Analysis. N3/4-ITC Delft, The Netherlands, Mc Graw Hill, 1973.

ELECTIVE COURSES**GEO-321/E****GEOCHEMISTRY**

(3 Credits for Theory and 1 Credit for Tutorials and Practicals)

UNIT-1 Basic concepts of geochemistry: Elements, their classification and distribution in different rocks, stability of nuclides, cosmic abundance, abundance in meteorites and rocks. Formation of minerals from magmatic fluids,

UNIT-2 Geochemistry of Lithosphere and atmosphere, Radioactive decay, nuclear devices and techniques. Isotopic geochronometers, Geochemistry of igneous and metamorphic rocks: Geochemistry and distribution of U and Th in rocks, minerals and sediments.

UNIT-3 Application and Instrumentation in Geochemistry: Use of X-Ray Fluorescence Spectroscopy, Use of Atomic Absorption Spectrometer, Use of XRD, use of UV-Vis-Spectrophotometer, etc.

LABORATORY

Calculations of atomic weight of elements with reference to isotopes; Calculation and plotting of binding energy and neutron/proton ratios of various isotopes; problems related to radioactive decay of nuclides; determination of K-Ar ages; Ages, initial ratios and plotting of isochrones using Rb-Sr and Sm-Nd isotope data.

Texts / References (Suggested Readings)

Mason, B. Principles of Geochemistry, Wiley Eastern, 1982

Krauskopf, K.B. Introduction to Geochemistry, Mc Graw Hill, 1994

Faure, G. Inorganic Geochemistry, Prentice Hall, 1991.

Aswathnarayana, U. Principles of Nuclear Geology, Oxford Press, 1985.

Faul, H. (Ed.), Nuclear Geology, Wiley 1954.

GEO-322/E

PETROLEUM AND COAL GEOLOGY

(4 Credits for Theory and 1 Credit for Tutorials and Practicals)

UNIT-1 Petroleum – Composition, Origin, Occurrence, Migration and Accumulation of Hydrocarbons; Petroleum traps; Reservoir rocks, conditions & mechanisms.

UNIT-2 Petroleum exploration - Geological, geophysical and geochemical methods of petroleum exploration; Drilling rigs, Drill holes, Different methods of drilling, Coring; Casing and Cementation and Drilling fluids; Functions of Petroleum Geologist; Formation evaluation: - (a) Geo-Logging and (b) well logs (Electric, Radioactive and Acoustic); Well Completion and Stimulation.

UNIT- 3 Sedimentary Basin; An outline of the oil belts of the world; Case studies of important Onshore and Offshore petroliferous basins of India

UNIT- 4 Origin of peat, lignite, bitumen and anthracite; Classification, Ranks and Grading of coal; Coal Bed Methane (CBM) – An unconventional petroleum system; Coal petrology and Coal measures of India; Coal exploration techniques.

LABORATORY

Study of geological maps and sections of important coal and oilfields of India and World.

Texts / References (Suggested Readings)

- Bhagwan Sahay.** (1994) Petroleum exploration and exploitation practices. Allied Pub
- Deshpande B. G.** The world of petroleum.
- Levorson A. I.,** Geology of Petroleum. CBS Pub.
- North F. K.** (1985) Petroleum Geology.
- Selley R. C.** (1985) Elements of Petroleum Geology. Academic Press. London
- Chandra, D., Singh, R.M. Singh, M.P.** (2000): Textbook of Coal (Indian context), Tara Book Agency, Varanasi.
- Scott, A.C.** (1987): Coal and Coal-bearing strata: Recent Advances, Blackwell Scientific Publications.
- Singh, M.P.** (1998): Coal and organic Petrology, Hindustan Publishing Corporation, New Delhi.
- Stach;, E., Mackowsky, M-Th., Taylor, G.H., Chandra, D., Teichumullelr, M. and Teichmuller R.** (1982): Stach Texbook of Coal petrology, Gebruder Borntraeger, Stuttgart.
- Thomas, Larry** (2002): Coal Geology, John Wiley and Sons Ltd., England.
- Van Krevelen, D. W.** (1993): Coal :Typology-Physics-Chemistry-Constitution), Elsevier Science, Netherlands.

SEMESTER-4**CORE COURSES****GEO-412/C****GROUNDWATER HYDROLOGY**

(4 Credits for Theory and 1 Credit for Tutorials and Practicals)

UNIT-1 Groundwater Hydrology: Elements of surface hydrology: Precipitation, Evaporation, Transpiration, Evapotranspiration, Infiltration, Runoff, Elementary theory of groundwater flow; Darcy's law and its range of validity. Steady and unsteady flows. Well hydraulics: Determination of aquifer characteristics from pumping tests. Groundwater development: Water well drilling, design and construction.

UNIT-2 Hydrogeology: Groundwater levels and fluctuations: Various causes of water level fluctuations. Fresh and salt water relationship in coastal areas; Ghyben-Herzberg principle and its modification, prevention and control of sea water intrusion, Hydrogeological categorisation. Groundwater provinces of India. Basin wise groundwater development: Groundwater inventory. Basic ideas of groundwater management, artificial recharge and water logging. Quality and geochemistry of groundwater: Methods of plotting of chemical data of water samples. Groundwater facies.

LABORATORY

Preparation and interpretation of water table contour maps

Texts/Reference

Davies, S.N. and De Wiest, R.J.M. (1966) Hydrology, John Wiley, N.Y.

Fetter, C.W. (1990) Applied Hydrology, Prentice Hall

Todd, D.K. (1980) Groundwater Hydrology. John Wiley & Sons, N.Y.

GEO-423/E**NEOTECTONICS AND PALEOSEISMOLOGY***(4 Credits for Theory and 1 Credit for Tutorials and Practicals)*

UNIT-1 Introduction to Neotectonics, active tectonics, landforms and tectonic geomorphology, Geomorphic markers/ indices.

UNIT-2 Quaternary chronology, active tectonics and rivers, study of alluvial rivers (tectonics and fluvial sedimentation, identification of active and neotectonic structures).

UNIT-3 Paleoseismology: Scope of paleoseismology, Prehistoric earthquakes and dating,, recurrence and dating, introduction and field techniques; use in seismic hazard assessment, mapping paleoseismic landforms, prehistoric stratigraphy.

UNIT-4 Paleoseismology of extensional and compressional tectonic environments: geomorphic evidences of paleoearthquakes, stratigraphic evidences, dating of paleoearthquakes, Paleoseismology of subduction zone, Late Quaternary sea level, coseismic event horizon, coseismic uplift.

LABORATORY*Morphometric exercise, TL, OSL, C¹⁴ Laboratory visit***Texts/ Reference****James P. McCalpin (2009)**, Paleoseismology, Academic Press**Schumm, S. A. (1977)**, The Fluvial System Wiley New York**Bull W. D. (1991)** Geomorphic Responses to Climatic Change, Oxford Uni. Press
New York**Keller E. A. (1986)** Active Tectonics National Academic Press, New York**Bull and Mc Fadden**, Tectonic Geomorphology

GEO-424/E

GEODESY AND SURVEYING

(3 Credits for Theory and 1 Credit for Tutorials and Practicals)

UNIT-1 Geodesy: History, principles and techniques in Geodesy, Gravity Principles of gravity, gravity of the earth, isostasy, instrumentation, gravity survey, gravity reductions, data processing and interpretation with case studies. Geomagnetism and Magnetic Prospecting Magnetism of the earth, rock magnetism

UNIT-2 Geodesy: Applications of GPS and GPS survey

UNIT-3 Surveying: principles and techniques

UNIT-4 Use of Total Station (digital theodolite) and Geological and geomorphic mapping, chain and plane table survey

LABORATORY

Plane Table, Prismatic, Magnetic and Total station survey, GPS mapping

Texts/References

Fowler, C.M.R. Solid Earth An Introduction to Global Geophysics, Cambridge University Press, 1990.

Telford, W.M. Geldart, L.P. and Sheriff, R.E., Applied Geophysics, Cambridge University Press, 1990.

Robinson, E.S. and Coruh, C. Basic Exploration Geophysics, John Wiley & Sons, 1988.

T. P. Kanetkar, Principles of Surveying

Hosmer, G.L. Geodesy, Wiley, 1946.

Clark, D. Plane and Geodetic Surveying (v. I & II), Asia Publishing House, 1962.

Bomford, B.G. Geodesy, Oxford, 1971.

Hosmer, G.L. Practical Astronomy, Wiley, 1958.

GEO-425/E

GEOCHEMISTRY DISSERTATION

(10 Credits for Entire Project/ Dissertation, Preparation of report, Internal Evaluation through Presentation, Laboratory work etc.)

GEO-426/E

PETROLEUM AND COAL GEOLOGY DISSERTATION

(10 Credits for Entire Project/ Dissertation, Preparation of report, Internal Evaluation through Presentation, Laboratory work etc.)

GEO-427/E

NEOTECTONICS AND PALEOSEISMOLOGY DISSERTATION

(10 Credits for Entire Project/ Dissertation, Preparation of report, Internal Evaluation through Presentation, Laboratory work etc.)

GEO-428/E

GEODESY AND SURVEYING DISSERTATION

(10 Credits for Entire Project/ Dissertation, Preparation of report, Internal Evaluation through Presentation, Laboratory work etc.)

GEO-429/E

GEOLOGICAL MAPPING, STRATIGRAPHY, PETROLOGY, PALEONTOLOGY, STRUCTURAL GEO., ETC. OF ANY AREA DISSERTATION

(10 Credits for Entire Project/ Dissertation, Preparation of report, Internal Evaluation through Presentation, Laboratory work etc.)

(Dissertation equal to two course work) (Any one out of 3 to7)

MASTERS' THESIS

(Dissertation/ Project work/ Industrial Training Report Environmental Issue/Survey Project Report)

The purpose of this exercise is to become familiar with research methods, computer application, literacy and the presentation skills. Moreover, to think about how to approach, communicate and assess geology and geological problems from various viewpoints. All viewpoints must be addressed in your outline and project. The student has the freedom to select any research problem related to geology; they can also work for their masters' thesis in the department or research institutes or industry with prior communication and approval from both the side.

1. Select any geological problem/ Research Problem in consultation with the faculty for proper guidance.
2. Learn what resources are available and how to access them
3. Collect references, secondary information on the topic and prepare bibliography
4. Set the methodology, approve it from faculty/supervisor and proceed for field and experimental work.
5. Collect findings Record Results (statistics/data tables)
6. Interpret and explain results (using charts)
7. Conclusion and preparation of detailed report/thesis
8. Use outline and related research for presentation of your work.

The outline must include the following:

- For guidelines and format/ consult faculty.
- Literature Review section should include citations and/or references from previous studies of the topic
- References must be taken from a book, journal, newspaper and Internet.
- Make certain that your cited sources are in APA Citation Style.

A 15-minute formal oral presentation during the final examination.