UNIVERSITY OF KERALA

M.Sc. Degree Course in Geology: Structure and Mark Distribution (2017 Admission onwards)

Paper Code	Title of the paper	Distribution of hours		Marks		
		Lecture	Practical	CA	ESA	Total
GL 211	Physical Geology and Geomorphology	**6**		25	75	**100**
GL 212	Structural Geology and Engineering Geology	**4**		25	75	**100**
GL 213	Crystallography and Mineralogy	**5**		25	75	**100**
GL 224	@**Practical I :** Geomorphology, Structural Geology, Crystallography and Mineralogy		**10**	25	75	**100**
GL221	Environmental Geology	**6**		25	75	**100**
GL 222	Sedimentology and Geochemistry	**4**		25	75	**100**
GL 223	Remote Sensing and Geographic Information System Applications	**5**		25	75	**100**
	Dissertation/Field work or Field Visit*		**2 (Dissertation)**			
GL 225	@**Practical II :** Sedimentology, Remote Sensing and Survey		**6 (Sed. & RS)** **2 (Survey)**	25	75	**100**
GL 231	Stratigraphy and Palaeontology	**7**		25	75	**100**
GL 232	Igneous and Metamorphic Petrology	**4**		25	75	**100**
GL 233	Hydrogeology	**6**		25	75	**100**
GL 244	@**Practical III :** Igneous and Metamorphic Petrology and Hydrogeology		**8**	25	75	**100**
GL 241	Economic Geology	**4**		25	75	**100**
GL 242	Exploration Geology	**5**		25	75	**100**
GL 243	Applied Geology and Geostatistics	**6**		25	75	**100**
	Dissertation/Field work/Group Mapping#		**2 (Dissertation)**			
GL 245	@**Practical IV :** Economic Geology, Exploration Geology and Applied Geology		**8**	25	75	**100**
GL 246	**Dissertation**					**100**
	Comprehensive Viva Voce (Includes 10 marks for Group Mapping)					**100**
	Grand total marks					**1800**

Note: * Dissertation work commences in 2nd Semester with 2 hours per week. Field visit or field work in 2nd Semester refers to a period of maximum 10 days duration (10 x 5 = 50 Hours) and is a compulsory part of the curriculum.

Dissertation work continues in 4th Semester with 2 hours per week and an additional Field work component for a period of maximum 10 days duration (10 x 5 = 50 Hours). Group Mapping includes field training in geological mapping for a period of maximum 10 days duration (10 x 5 = 50 Hours) and is a compulsory part of the curriculum to be carried out prior to the Dissertation Field work.

@ Practical Examinations of 1st and 2nd Semesters will be conducted at the end of second semester and that of 3rd and 4th Semesters will be conducted at the end of 4th Semester and each practical examination will be of 3 hours duration.

University of Kerala

M.Sc. Degree Course in Geology

(Effective from 2017 Admissions)

GL 211: PHYSICAL GEOLOGY AND GEOMORPHOLOGY

UNIT I

Geochronology and age of the Earth – Relative and absolute ages – Principles of isotope dating. Types of decay and half life – Brief idea of U-U-Pb, K-Ar, Rb-Sr and Sm-Nd dating methods and their significance – Fission track dating – Comparative study of different dating methods. Problems of interpretation of dates and limitations of isotope dating.

UNIT II

Gravity, Geomagnetism and Thermal history of the earth – Geodesy – Density distribution, shape and mass of the earth, density vs depth profile – Brief idea of Gravity, gravity anomalies and their interpretation - The earth as Magnet, Earth's magnetic field, changes in magnetic field, origin of geomagnetic field, palaeomagnetism – Basic ideas of Seismotectonics, Plate tectonics and Rheological stratification of the mantle.

UNIT III

Development of geomorphic thoughts – Beginnings – Catastrophism – Gradualism – Geographical cycle – Treppen Concept – Pediplanation cycle – Environmental dynamism and Environmental passivism – Dynamic equilibrium. Cascading process system – The solar energy cascade, denudation, sediment cascade, transported load in rivers, rate of erosion over space and time. Brief idea of the Models of Landscape evolution by Davis, King, Penck Hack and Gilbert.

UNIT IV

Regional denudation – Landforms – igneous activity and landforms, structure and landforms, lithology and landforms. Influence of climate and structure on geomorphic processes and landforms – Concept of morphogenetic regions. Evolution of hill slopes – brief idea. Geomorphic indicators of neotectonic movements: Steam channel morphology changes, drainage modifications, fault reactivation, uplift-subsidence pattern in coastal areas.

Coastal geomorphology – sea level changes. Geomorphic significance of waves and currents. Shore line processes and associated landforms.

Desert geomorphology – processes of erosion and transport – erosional and depositional features – dunes, rock varnish, pediment, inselbergs, wadis. Glacial processes and associated landforms.

UNIT V

Drainage basin – drainage pattern, network characteristics; morphometric analysis of drainage basins – stream hydraulics. Fluvial denudational and erosional land forms. Concept of rejuvenation and interruptions in the evolution of landforms. Soils – Formation, classification, soil profile, Soils of Kerala and India.

UNIT VI

Geomorphic features of the Indian subcontinent – Geomorphology of Kerala – classification, relief features, geological significance, rivers of Kerala. Applied geomorphology: Application of geomorphology in mineral prospecting, Civil Engineering, Hydrogeology and Environmental studies – brief idea of Tectonogeomorphology.

Reference books

Ahmad E. Coastal Geomorphology. Orient Longman, 1972.
Cox A. Plate Tectonics and geomagnetic reversals. Freeman, 1973.
Holmes A. Principles of Physical Geology. Ronald, 1965.
King C. A. M. Beaches and Coasts. Arnold, 1972.
Leopold L., Wolman C. and Miller J. P. Fluvial processes in geomorphology. Freeman, 1963.
Thornbury W. D. Principles of geomorphology. Wiley, 1968.
Turner F. W., Weiss M. P. The Earth. Molt Reinhardt and Winston, 1972.
Eicher L. D. Geologic Time. Prentice Hall, 1968.
Hamilton E. I. Applied Geomorphology. Academic Press, 1965.
Darlrymple B. G. and Lampere M. A. Potassium-Argon dating. Freeman, 1969.
Windley B. F. The evolving continents. John Wiley, 1977.
Lay Thorne, Terry W. C. Modern Global Seismology. Academic Press, 1995.
R.D. Russell, John Arthur Jacobs, J. Tuzo Wilson. Physics and Geology. McGraw-Hill Inc., US, 1974
Sharma H. S. Indian Geomorphology. Concept Publishing Co., New Delhi, 1990.

GL 212 : STRUCTURAL GEOLOGY AND ENGINEERING GEOLOGY

UNIT I

Fundamental concepts of rock deformation. Stress – hydrostatic, lithostatic and deviatoric stress. Stress ellipsoid. Dilation and distortion. Strain – homogenous, inhomogenous, rotational and

irrotational strain. Strain ellipsoid. Simple and pure shear. Types of homogenous strain. Stress-Strain diagrams and their use in studying the stages of deformation and factors affecting deformation. Progressive deformation and finite strain. Measurement of strain in two dimensions.

UNIT II

Brittle and shear failure – Faults and fractures. Mohr circle, fault geometry and nomenclature. Features of fault planes and fragmental rocks produced by faulting. Lineaments and Deep fractures. Joints, Analysis of fractures. Shear zone. Ductile and Brittle-Ductile shear zones. Stress and strain ellipsoids and their application in the study of fractures.

UNIT III

Geometric and genetic classification of cylindrical folds. Canoe fold and inverted canoe fold. Minor folds and their use in determining the major fold structure. Pumpelly's rule. Mechanics of folding. Superposed folding, simple fold interference patterns. Fold classification of Donath and Parker, and Ramsay.

UNIT IV

Tectonites – classification, tectonic fabric. Foliation – axial plane foliation and its origin, fracture cleavages, crenulation cleavage. Transposed foliation. Use of axial plane foliation and fracture cleavages and the determination of major structures. – Lineation – types, classification and origin.

Geologic bodies and scale and structural co ordinates. Introduction to Structural Analysis and Fundamentals of geometric analysis. Application of stereographic and equal area projections in the representation of structures. Geometric analysis of folds and lineations. Concept of petrofabrics, use of universal stage in fabric studies, fabric symmetry.

UNIT V

Engineering Geology – Role of geology in Civil Engineering – Engineering properties of rocks and soil – Geotechnical investigation for Civil Engineering projects – Rock mechanics – strength and deformation properties of rocks and soils – Rock as building material – Dimension and decorative stones. Aggregates. Building stones of Kerala.

UNIT VI

Dams: Classification, foundation, abutment and reservoir problem. Geological aspects of dam investigations – Tunnels: Classification, Geological factors in tunneling – Landslides: Types, causes and prevention – Stability of slopes – Aseismic design of buildings. Influence of geological conditions on foundations and design of buildings. Geological considerations in investigations for construction of highways, bridges and shoreline structures.

Reference books

Billings, M. P. Structural Geology Prentice Hall, 1974
Marshak S. and Gautam Mitra. Basic methods of Structural Geology. Prentice Hall Inc. 1988.
Ragan M. D. Structural Geology, Wiley 1969.
Philips F. C. Stereographic projection in Structural Geology. Arnold 1960.
Lisle R. J. and Leyshon P. R. Stereographic Projection Techniques for Geologists and Civil Engineers. Cambridge University Press. 1994.
Turner F.J. and Weiss L.E. Structural Analysis of Metamorphic Tectonites. Mc Graw Hill, 1963.
Hobbs B.E., Means W.B. and William P. F. An Outline of Structural Geology. John Wiley 1976.
Krynine and Judd. Principles of Engineering Geology and Geotechniques. Mc Graw Hill 1957
Bell F. G. Engineering Geology. Elsevier 2007.
Waltham T. Foundations of Engineering Geology. Spon Press. 1994.

GL 213 : CRYSTALLOGRAPHY AND MINERALOGY

UNIT I

Crystallography – Crystalline state – Repetition Theory, Translation periodicity of crystals. Basic rotational symmetries and possibility of simultaneous rotational symmetries in different directions of crystals. Space lattices. Derivation of 32 crystal classes. Crystal projection – Stereographic projection. Herman-Maugin notation. Representation of symmetry of normal classes of crystal systems and their significance.

UNIT II

Refractive index and birefringence. Interference colours, optical accessories – Berek compensator, Biquartz wedge and Bertrand ocular. Wave surface and indicatrices. Dichroism and Pleochroism. Pleochroism scheme. Conoscopic study and interference figures. Optic orientation, extinction angle, optic axial angle, optic sign and optic anomalies.

UNIT III

Mineralogy – Occurrence of minerals – Isomorphism, polymorphism and polytypism. Bonding in minerals. Solid solution and exsolution. AAS, XRF, ICP, Electron probe micro analysis, scanning and transmission electron microscopy. XRD – powder & single crystal techniques.

UNIT IV

Gemmology: Physical characters (including electrical, thermal and magnetic characters); optical properties. Classification of gemstones. Common precious and semi-precious stones; their properties, mode of occurrence and distribution in India.

Application of UV, X rays and Infra red rays in gem identification. Synthetic gems – characteristics. Uses of gemstones.

UNIT V

Mineralogical expression of radioactivity – metamictisation, fracturing, discoloration, pleochroic haloes and fission tracks. Structure and classification of silicates. – Distinctive chemical and optical characters of the minerals of the following groups – Olivine, garnet, aluminosilicates, epidote, pyroxene, amphibole, mica, feldspar and feldspathoid; tourmaline, beryl, spinel.

UNIT VI

Clay mineralogy characterization, classification and structure of clay minerals, clay mineral identification by XRD and DTA. Genesis of clays. Different methods of clay mineral separation.

Reference books

Philips F. C. Introduction to Crystallography. Nelson T, 1963.
Burger M. J. Elements of Crystallography, Wiley, 1963.
Dana E. S. Textbook of Crystallography, Revised by Ford W E, Wiley, 1962.
Berry L. G. and Mason B. Mineralogy, Freeman, 1959.
Wahlstrom E. E. Optical Crystallography, Wiley, 1962.
Winchell A. N. Elements of optical mineralogy, Pt I, Wiley, 1951.
Perkins D. Mineralogy. Pearson Education, 2002.
Wenk H. R. and Bulakh. Minerals, Their constitution and origin. Cambridge University Press, 2004.

Perkins D. and Henke K. R. Minerals in thin section. Pearson Education Inc., 2004.
Nesse W. D. Introduction to Optical Mineralogy. Oxford University Press, 2004.
Nesse W. D. Introduction to Mineralogy. Oxford University Press, 2008.
Kerr, Paul F. Optical Mineralogy. McGraw-Hill, New York, London. 1977

GL 221: ENVIRONMENTAL GEOLOGY

UNIT I

Environmental Geology – fundamental concepts – its scope, objectives and aims – dimensions of environmental stress-scope of environmental geosciences. Ecological perspective of environment – Concepts of ecosystem – Earth's major ecosystem, terrestrial and acquatic. Role of geologist in environmental studies. Status of environmental consciousness in India – EPA. Man and Environment. Geological factors of Environmental Health. Need for environmental protection, balancing economic development. Climate change, carbon sequestration and carbon budgeting.

UNIT II

Resource – description and classification of resources. Resources of the land, their uses and management. Resources of the Ocean floor. Mineral Resources – Conservation and management. Sustainable development in non renewable resources.

UNIT III

Natural hazards – Earthquakes and seismic hazards, seismic hazard assessment – earthquake prediction. Neotectonics.

Disaster management – zoning and risk assessment, hazard zonation maps. Landslides – identification of landslide – landslide prone areas. Flood hazard management – zoning and risk assessment-hazard zonation maps. Coastal erosion – causes and mitigation measures.

UNIT IV

Changing concepts of wastes and their disposal. Management practices for solid, liquid, gaseous and radioactive wastes. Sanitary landfills. Pollution and energy. Problems of pollution of geospheres and climatic changes. Air pollution, sources of pollution, pollution due to dust and waste disposal. Problems of urbanization. Medical Geology – Geologic factors on human health

– Fluorosis, Cancer, Silicosis, Radon Hazards. Heavy metal poisoning and related health hazards. Trace elements in human biology.

UNIT V

Development and technology- human factors. Environmental geologic mapping. Environmental change-natural and manmade. Prediction of environmental changes and areas of human concern and impact indicators.

Environmental Impact Assessment (EIA) – Elements of EIA – impacts, primary, secondary, prediction, assessment, base-line data generation, physical, biological, cultural, socio-economic aspects. Scales of interest in EIA and EIA models – steady state and time dependent models. Impacts of mining – EIA and environmental management plan for mining projects. Environmental impacts of industrialization.

UNIT VI

EIA of dams, buildings, highways and tunnels. Environmental impacts of river, coastal and deep sea mining and filling of mangroves. Water logging problems due to construction of canals, reservoirs and dams. Soil quality degradation.

Reference books

Flawan P. T. Environmental Geology. John Wiley & Sons, 1970.
Coates D. R. Environmental Geology. John Wiley & Sons, 1981.
Coates D. R. (Ed). Environmental Geomorphology and Environmental Geoscience. Wiley International, 1973.
Strahler A. N. Strahler A. H. Environmental Science. 1973.
Simmons I. G. The Ecology of Natural Resources. Edward Arnold Ltd., 1981.
Barlin L. G. Earthquakes and Urban Environment. Vol.2 and 3. CRC Press Inc., 1980.
Lillesand T. M and Kiefer R. W. Remote Sensing and Image interpretation. John Wiley & Sons, 1979.
Estors J. E. and Senger L. W. Remote Sensing. Hamilton Publishing Company, 1974.
Seigal B. S. and Gillespie A. R. Remote Sensing in Geology. John Wiley & sons, 1980.
Kerr J. M. and others. Natural Resource Economics. Oxford and IBH Publ. Co. Pvt. Ltd, 1997.
Hanley N. and others. Environmental Economics. Mac Millan Ind. Ltd., 1997.
Frampton S. and others. Natural Hazards. Holder and Stoughton, 1996.
Skinner C. H. & Berger R. A. Geology and Health. Oxford University Pres, 2000.
Selnius (Ed). Essentials of Medical Geology. Elsevier, 2005.

GL 222: SEDIMENTOLOGY AND GEOCHEMISTRY

UNIT I

Provenance and diagenesis of sediments. Sedimentary textures: Framework, matrix and cement of terrigenous sediments. Frequency distribution of grain size. Size, shape and fabric of sediments. Sediment movement by fluid flow: Fundamentals of fluid flow. Flow in pipes and channels, competence and capacity. Turbulence, suspended load and bed load.

UNIT II

Sedimentary structures: Stratification, flow regimes, ripples and dunes, anti dunes, large bed forms, sand waves, ridges and bars. Structures formed by scour. Wave, tide, wind and their deposits. Mass flows and Turbidity currents. Penecontemporaneous deformation, Biogenic sedimentary structures.

UNIT III

Mineral stability, mineralogical maturity, provenance. Importance of Heavy minerals in provenance studies – Sedimentary facies and environments – Sedimentary Basin analysis – purpose and scope. Concept of Facies models. Sedimentary basins – classification and definition.

Clastic and non clastic rocks – introduction Sedimentary petrology – sandstones – classification, role of detrital clay, terminology, chemical composition. Conglomerate: composition, texture and classification; Shale: mineral composition, texture, structure and classification. Composition of natural waters. Diagenesis and origin of chemical cements.

UNIT IV

Limestone – Mineralogy, carbonate sand, carbonate mud, carbonate framework, organic matter. Limestone forming environments – carbonate platform, tidal flat, fresh water carbonate deposits. Limestone diagenesis – microspar, silicification. Classification of limestones. Deep-sea carbonate sediments, their diagenesis. Dolomite – Primary and secondary. Dolomitisation. Detrital dolomite and dedolomitisation. Evaporites. Plate Tectonics and sedimentation. Quaternary sediments.

UNIT V

Geochemistry –. Cosmic abundance of elements. Geochemical classification of elements. Distribution and behavior of elements in the crust, mantle and core of the earth. Geochemical cycle.

REE – and introduction with special reference to its distribution in meteorites and rocks. mantle. Geochemistry of Cu, Al, Fe and Mn.

Chemical Equilibrium: Le Chatelier's principle – concept of stability. Acids and bases. pH values. Ionisation constants of acids, bases and hydroxides. Estimation of ionic concentration. Buffers. Geochemistry of natural waters – river, sea, brines.

Introduction to Isotope geochemistry. Isotopes – stable and unstable isotopes. Principles of isotope dating. Application of carbon, oxygen and sulphur isotopes.

UNIT VI

Change of Enthalpy – Entropy-Definition of free energy, its limitations. Free energies of formation. Gibbs free energy. Chemical potential, fugacity and activity. Oxidation-Reduction reactions. Redox potential – limits of pH and Eh in nature. Eh-pH diagrams.

Reference books

Blatt H., Middleton G. and Murray R. Origin of Sedimentary rocks. Prentice Hall, 1972.

Carver R. E. (Ed). Procedures in Sedimentary Petrology, Interscience, 1971.

Folk R. L. Petrology of Sedimentary Rocks. Hempill's University Station, Texas, 1968.

Pettijohn F. J. Sedimentary Rocks. Harper and Row, 1957.

Krumbein W. C. and Pettijohn E. J. Manual of Sedimentary Petrology. Appleton Century Co., 1938

Stelley R. C. Ancient Sedimentary Environments, Cornell University Press, 1972.

Pettijohn F. J, Potter P. E., Siever R. Sand and Sandstone. Springer-Verlag, 1972.

Nichols G. Sedimentology and Stratigraphy. Wiley-Blackwell, 2009.

Krauskopf E. B. Introduction to Geochemistry, 1967.

Mason B. Principles of Geochemistry. Wiley, 1966.

Brownlow A. N. Geochemistry, Prentice Hall, 1975.

Rankama K. Progress in Isotope Geology, Interscience, 1963.

Walther J. V. Essentials of Geochemistry. Jones and Barlett Publishers, 2005.

GL 223: REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM APPLICATIONS

UNIT I

Concept of remote sensing – Electromagnetic radiation – characteristics, remote sensing regions and bands; radiation principles and energy resources, energy interaction with the atmosphere. Acquisition and interpretation of remote sensing data Aerial photography – types of aerial photographs, their geometry and photo characters, stereoscopy, stereoscopic parallax, relief displacement; principles of photogrammetry. Aerial photo and imagery pattern and interpretation – principles, elements and procedures. Digital image processing – characteristics of remote sensing data, pre-processing, enhancements, classification.

UNIT II

Aerial thermography – Thermal radiometers and scanners. Thermal IR remote sensing – Collection and interpretation of thermographic data. Multispectral scanning and recognition of spectral patterns. Microwave sensing, SLAR system, terrain characteristics influencing the Radar return. Interpretation of SLAR Data.

UNIT III

Application of aerial photographs in photogrammetry, land use, forestry, agriculture, geology and environmental studies. Remote sensing applications in interpreting structure and tectonics, lithological mapping, in geomorphologic, fluvial, coastal, structural, stratigraphic, mineral resources, groundwater studies, natural hazards and disaster mitigation and environmental monitoring. Status of remote sensing studies in India – Bhaskara and IRS systems.

UNIT IV

Geographical Information System – Introduction, definition, components of a GIS – GIS softwares – Raster and Vector data – Spatial data – Introduction – Maps and GIS – thematic characters of spatial data – Different sources of spatial data. Spatial data modeling – Entity – definition – spatial data models – spatial data structures.

UNIT V

Attribute data management – Database data models – creating a database – GIS database applications. Data input and editing – Integrated database – Brief idea of Digital Terrain Modeling and Integration of Remote Sensing data and GIS.

UNIT VI

Data Analysis – Measurements in GIS – Queries – Reclassification – Buffering – Brief idea of Data integration, map overlay, spatial interpolation, analysis of surfaces, network analysis – Applications of GIS in geology, urban planning, hydrology, forestry and agriculture – The future of GIS – Current Issues and trends.

Reference books

Lillesand T. M. and Keifer R. W. Remote sensing and Image interpretation. John Wiley and Sons, 1979.

Estors J. E. and Senger L. W. Remote Sensing. Hamilton Publishing Company, 1974.

Seigal B. S. and Gillespie A. R. Remote sensing in Geology, John Wiley & Sons, 1980.

Gupta R. P. Remote Sensing Geology. Springer, 2003.

Chandra A. M and Ghosh S. K. Remote Sensing and Geographical Information Systems. Narosa Publishing House, 2007.

Reddy A. M. Text book of Remote Sensing and Geographical Information Systems. BS Publications, 2006.

Rees W. G. Physical principles of Remote Sensing. Cambridge University Press, 2001.

Bernhardsen T. Geographic Information Systems – An introduction. Wiley India, 2002.

Lo C. P. and Yeung A. K. W. Concepts and Techniques of Geographic Information Systems. Prentice Hall 2002.
Heywood I., Cornelius. S. and Carver S. An Introduction to Geographical Information Systems, Longman Limited
Bonham, G. F and Carter. Geographic Information system for Geoscientists- Modelling with GIS, Elsevier.
Sabbins F. F. Remote Sensing – Principles and Applications. Freeman, 1985.
Panda, B. C. Remote Sensing – Principles and Applications. Viva Books Private Limited, New Delhi, 2005.
George Joseph. Fundamentals of Remote Sensing. Universities Press, Hyderabad. 2003
Pandey, S. N. Principles and Applications of Photogeology. New Age International (P) Limited Publishers, New Delhi, 2001.

GL 231: STRATIGRAPHY AND PALAEONTOLOGY

UNIT I

Stratigraphy: Evolution of Stratigraphic principles. Contributions of Steno, Lehmann, Werner, Hutton, Darwin, Smith and Holmes. Evolution of Geological Time Scale. Code of Stratigraphic Nomenclature. Stratigraphic procedures (surface and sub-surface). A brief study of the stratotypes. Global Boundary Stratotype Sections & Points (GSSP) and major occurrences of the following systems: Cambrian, Carboniferous, Cretaceous, Tertiary and Quaternary.

UNIT II

Application of stratigraphy in palaeoenvironmental reconstructions. Major climatic events of the Phanerozoic eon. Boundary problems in Stratigraphy with special reference to Vindhyans, Saline series and Deccan traps. Chronostratigraphy – an introduction – Concepts and Elements of Magnetostratigraphy, Event stratigraphy, Sequence stratigraphy, Cyclostratigraphy, Allostratigraphy, Pedostratigraphy and Chemostratigraphy. Basic ideas of Quaternary Stratigraphy.

UNIT III

Models of crustal evolution Craton-mobile belt concept. Granulite and Greenstone terrains – origin, rock associations, structure, metamorphism and models of evolution. Evolution of high grade mobile belts. Precambrian shield of India –special reference to the Karnataka craton.

UNIT IV

Palaeontology – nature of fossil record. Distribution of main groups in time. Importance of fossils in palaeoclimatic and palaeogeographic studies, origin and early evolution of life. Patterns

of evolution. Invertebrates – trends in the evolution of the following: Brachiopods, Pelecypoda, Nautiloidea, Ammonoidea, Trilobita, Graptozoa and Echinoidia.

UNIT V

Vertebrate Palaeontology – General characteristics and evolution of Pisces, amphibians, reptiles, birds and mammals (horse, elephant and man – basic morphologic features). Siwalik vertebrate fauna. Mass extinction events. Plant fossils: Gondwana flora and their significance.

UNIT VI

Micropalaeontology: importance and types of microfossils, collection and preparation of microfossils for study. Foraminifers, Ostracods, Conodonts – their general morphology and palaeoecology. Calcareous nano fossils – morphology and biogeography – significance of nano fossils. Application of micro fossils in petroleum exploration.

Reference books

Arkell W. J. Jurassic Geology of the World. Oliver & Loyd, 1960.
Ager D. V. Principles of palaeoecology, Mc Graw Hill, 1963.
Brookfield M. E. Principles of Stratigraphy. Blackwell Publishing, 2004.
Dunbar C. O. & Rogers J. Principles of Stratigraphy. Wiley, 1960
Gignoux M. Stratigraphic Geology. Freeman, 1960.
Eicher L. D. Geologic Time. Prentice Hall, 1968.
Flint R. F. Glacial & Pleistocene Geology. Wiley, 1961.
Gupta V. J. Precambrian Stratigraphy of India. Hindustan Publishing House, 1977.
Gupta V. J. Palaeozoic Stratigraphy of India. Hindustan Publishing House, 1977.
Gupta V. J. Mesozoic Stratigraphy of India. Hindustan Publishing House, 1977.
Gupta V. J. Cenozoic Stratigraphy of India. Hindustan Publishing House, 1977.
Kay & Golbert. Stratigraphy & Life history. Wiley, 1965.
Krishnan M.S. Geology of India and Burma. Higginbothams, 1968.
Weller J. M. Stratigraphic principles & Practice. Harper & Row, 1959.
Krumbein N. C. & Sloss L. D. Stratigraphy and sedimentation. Freeman, 1963.
Easton W. H. Invertebrate Palaeontology. Harper and Brother, 1960.
Cushman A. J. Foraminifera. Harvard University Press, 1959.
Colebert H. E. Evolution of the Vertebrates. John Wiley & Sons, 1961.
Moore R.C., Lalicker C.G., Fisher A.G. Invertebrate fossils. Mc Graw Hill, 1952.
Glaessnar M. F. Principles of Micro Palaeontology. Mc Graw Hill, 1953.
Woods H. Invertebrate Palaeontology. Cambridge University Press, 1961.
Benton,M. J. Vertebrate Palaeontology, 2nd edition, Blackwell Science, 2000.

GL 232: IGNEOUS AND METAMORPHIC PETROLOGY

UNIT I

Thermodynamics in the study of silicate systems.Reaction principles in petrogenesis – continuous and discontinuous reaction series. Heterogenous equilibrium and phase rule. Application of phase rule in the study of silicate systems – binary and ternary. Study of the following systems. Diopside-Anorthite, Albite-Anorthite, Forsterite-Silica,

Forsterite-Anorthite-Silica and Othoclase-Anorthite-Albite Simple basalt systems of Barth.

UNIT II

Magma – Physical properties – temperature, density, viscosity and melting behavior. Plume magmatism and Hot spots. Magmatic evolution and differentiation – Chemical composition Evolutionary mechanisms – crystal settling in magma, magma convections, igneous cumulates, liquid immiscibility, diffusion processes, magmatic assimilations, mixing of magmas, assimilation of fractional crystallization (AFC), trace element trends in magmatic evolution. Variation diagrams – significance and interpretation.

UNIT III

Classifications of igneous rocks – mode, norm, CIPW, Schand and IUGS, igneous rock names. Igneous rock textures and their genetic significance. Tectonic association of igneous bodies. Large layered igneous complexes, continental alkaline rocks, ultra alkaline and silica poor alkaline rocks. Intrusive rocks of Kerala.

UNIT IV

Concept of metamorphism – Beginning of metamorphism – High temperature and high pressure limit of metamorphism. Types of metamorphism. Factors of metamorphism: P, T, fluid phase (CO_2, H_2O and O_2). Application of phase rule in metamorphic mineral paragenesis. Equilibrium thermodynamics in metamorphic petrology – Gibb's free energy, enthalpy, entropy, Clasius – Clapeyron equation, buffering, Schreinemaker's rule and bundle. Chemographic diagrams – principles of ACF, A'KF and Thompson's AFM diagrams.

UNIT V

Classification of metamorphic rocks. Concepts in metamorphism – Grubenmann's depth zone concept, metamorphic zone concept – isograd and reaction isograd, metamorphic facies concept and facies series, Winkler's grade concept, Miyashiro's paired metamorphic belts and baric types of metamorphism, P-T-t paths – isobaric cooling (IBC) and isothermal decompression (ITD) paths. Prograde and retrograde metamorphism; Thermobarometry. Regional metamorphism of carbonate, pelitic and mafic rocks. Thermal metamorphism of carbonate rocks. Extraterrestrial Metamorphism (Impact and shock metamorphism).

UNIT VI

Structure and texture of metamorphic rocks – mega and microscopic – textures of contact, regional and cataclastic metamorphism - foliation, lineation, porphyroblast and clast, snowball garnet. Becke's Crystalloblastic series. Retrograde metamorphism. Metasomatism and metasomatic zonation, metamorphic differentiation, migmatites and anatexis, charnockite and incipient charnockite, khondalite, gondite.

Reference books

Carmichael, I. S. E., Turner F. J. Verhoogen J. Igneous Petrology. Mc Graw Hill, 1971.

Tyrell G. W. Principles of Petrology. Metheun, 1963.

Barth T. F. W. Theoritical Petrology. Wiley, 1962.

Bowen N. D. Evolution of Igneous Rocks. Dover Publications, 1956.

Wahlstrom E. Theortical Igneous Petrology. Wiley, 1961.

Ehlers E. G. The interpretation of Geological Phase Diagrams. Freeman, 1972.

Myron G. Best 2003 Igneous and metamorphic petrology Edition2, Wiley-Blackwell, 2003

Kornprobst J. 2002 Metamorphic rocks and their geodynamic significance: a petrological handbook, Springer

Blatt, J., Tracy J. R. and Owens B.E. 2006 Petrology: Igneous, Sedimentary, and Metamorphic. Edition3, W. H. Freeman

Shelley D. Igneous and metamorphic rocks under the microscope: classification, textures, microstructures, and mineral preferred - orientations Springer, 1993.

Fry N. The field description of metamorphic rocks. Geological Society of London handbook series. Open University Press, 1984

Vernon R. H. and Clarke G. L. 2008 Principles of metamorphic petrology Cambridge University Press.

Winter J. Principles of Igneous and Metamorphic Petrology 2nd Edition 2009

Vernon R. H. A practical guide to rock microstructure Cambridge University Press, 2004 Books

Bucher K and Frey M. 1994 Petrogenesis of metamorphic rocks Edition6, Illustrated Publisher Springer-Verlag.

Barker A. J. 1998 Introduction to metamorphic textures and microstructures Edition 2, Routledge.

GL 233: HYDROGEOLOGY

UNIT I

Introduction – definition and classification of subsurface water. Elements of surface hydrology: formation of precipitation, measurement and depth of precipitation over an area. Evaporation and transpiration – factors affecting evaporation and transpiration

Measurement of evaporation Consumptive use – infiltration, run off. Types of water – meteoric, juvenile, connate, magmatic and sea water. Hydrological cycle and its components – Groundwater in the hydrologic cycle. Origin of ground water.

UNIT II

Water bearing properties of rocks – interstices and porosity, permeability, specific yield and specific retention. Aquifers, aquicludes, aquitard and aquifuge. Vertical distribution of subsurface water; zone of saturation and zone of aeration. Types of aquifers – unconfined, confined, semi-confined and semi-unconfined. Geological material as aquifers – unconsolidated materials and consolidates rocks. Water table and piezometric surface; their fluctuations.

Radioisotopes in hydrogeological studies.

UNIT III

Groundwater Hydraulics: Movement of groundwater – Darcy's law; Range of validity; its experimental verification. Hydraulic conductivity of geologic materials. Determination of hydraulic conductivity – formula, laboratory methods and field tests. Flow nets; Flow in relation to groundwater contours. Aquifer parameters – transmissivity, storativity, drainage factor. Pumping tests – objectives, layout of the tests, measurements and interpretation. Methods of analyzing pumping test data. Theim's equilibrium method. Theis method, Theis recovery method, Jacob and Cooper-Jacob methods.

UNIT IV

Groundwater Exploration: Use of aerial photographs and Landsat imageries in groundwater exploration. Hydrogeomorphic and lineament mapping.

Prospecting for groundwater – geological aspects. Surface geophysical methods – geo-electrical – electrical resistivity and seismic refraction methods. Drilling for groundwater – cable tool, hydraulic rotary, reverse rotary and down the hole hammer drilling.

Water Well Construction – Water well design criteria and specifications. Well production tests – well loss, specific capacity. Maintenance of production wells.

UNIT V

Quality of groundwater – methods of collection and analysis of water samples as related to groundwater investigations. Physical, chemical and bacterial measures of water quality. Problems of groundwater contamination by As and F – Remedial measures for their treatment. The general occurrence of various constituents in groundwater. Graphical representation of groundwater quality data – Collin's diagram. Quality of groundwater for domestic, irrigational and agricultural uses.

UNIT VI

Groundwater recharge – natural and artificial recharge. Groundwater management. Rainwater harvesting and managed aquifer recharge. Groundwater conditions and problems in urban areas. Over-exploitation of groundwater and groundwater mining. Coastal aquifers, sea water intrusion and remedial measures. Groundwater provinces of India. Groundwater conditions in Kerala. Consumptive and Conjunctive use of surface and groundwater –Groundwater legislation – brief idea.

Reference Books

1. Todd D. K. Groundwater hydrology Wiley 1980
2. Walton W. C. Groundwater resource evaluation McGraw Hill 1970
3. Bouwer H. Groundwater hydrology 1978
4. Lindsley R.K., Kohler M.A. and Paulhus J. L.H. Applied Hydrology. Tata McGraw Hill 1975
5. Davis, Stanley N. and Deweist, Roger J. M. Hydrogeology. John Wiley & Sons, 1966
6. Fetter C.W. Hydrogeology. Prentice Hall, 2001.
7. Raghunath H.M. Hydrology. Wiley Eastern Limited, 1998.
8. Raghunath H. M. Groundwater. 2nd Edition, Wiley Eastern Limited, Calcutta, 1987.
9. Sharma, H. D. and A. S. Chawla. Manual on Groundwater and Tube wells. Technical Report No. 18., CBIP, New Delhi, 1977.

GL 241: ECONOMIC GEOLOGY

UNIT I

Nature and morphology of principal types of ore deposits. Textures and structures of ore and gangue minerals. Fluid inclusions. Ore forming solutions and their migration. Wall rock alteration. Major theories of ore genesis. Paragenetic sequences, zoning. Magmatic processes of mineralization.

Dating of ore deposits. Controls of ore localization.

UNIT II

Classification of ore deposits. Environments of ore formation – genetic relationship between rocks and ore deposits. Diamond in kimberlite, ores in pegmatite. Cr, Pt, Ti, Cu and Ni deposits associated with basic and ultrabasic rocks.

UNIT III

Greisen deposits, skarn deposits, disseminated sulphide, oxide and sulphate deposits of sedimentary and volcanic environments. Salient characteristics of hydrothermal, stratiform, stratabound, sedimentary, residual and supergene ore deposits with examples. Metamorphism of ore deposits.

UNIT IV

Metallogenic epochs and provinces; metallogeny and mineral belts. Plate tectonic controls in mineralization. Ore mineralization through geologic time. Principles and applications of ore microscopy. Ore textures and their genetic significance.

UNIT V

Atomic minerals – geochemistry of U and Th deposits; genetic classification of U and Th deposits. Geology and genesis of U deposits of Jaduguda. Pb-Zn deposits of Rajasthan, Cu deposits of Singhbhum and Malanjkhand, East Coast Bauxite, Iron ore deposits of Bailadila and Kudremukh. Strategic, critical and essential minerals of India. National Mineral Policy of India.

UNIT VI

Coal – physical and chemical properties of coal; coal petrography: - macroscopic and microscopic components of coal and their mode of origin. Coal deposits of Raniganj and Jharia. Lignite deposits of Neyveli and Palana. Tertiary coal fields of Assam. Coal Bed Methane. Industrial uses of coal.

Petroleum – source rocks; process of transformation of organic matter to petroleum; migration and accumulation of petroleum. Some of the important petroliferous basins of India such as Assam shelf, Bombay offshore, Cambay basin, Cauvery basin, Krishna-Godavari basin, Andaman-Nicobar and Lakshwadeep basins.

Reference books

Bateman A. M. Economic mineral deposits. Wiley, 1962.
Lawrence R. Introduction to ore forming processes. Blackwell, 2005.
Leverson A. I. Geology of petroleum. Mc Graw Hill, 1958.
Brown J. C. and Dey A. K. India's mineral wealth. Oxford, 1936
Mason B. Principles of Geochemistry. Wiley, 1966.
Cameroon E. N. Ore microscopy. Wiley, 1961.
Edwards A. B. Textures of ore minerals. Aust. Inst. Min. & Met, 1960.
Krauskopf K. B. Introduction to Geochemistry.
Stanton R. K. Ore petrology. Mc Graw Hill, 1972.
Sullivan C. J. Ore and granitization. Econ. Geol., Vol.43, pp 470-489, 1948.
Park C. G and Mc Diamird R. A. Ore deposits. Freeman, 1964.
Jensen and Bateman A. M. Economic Mineral Deposits, III Edn, John Wiley, 1990.
Sawking F. J. Sulphide ore deposits in relation to plate tectonics. Journ. Geol. Vol.80, No.40, pp 377-397, 1972.
Mukherjee A. Metamorphic and metamorphosed sulphide deposits. Econ. Geol., Vol. 65, No.70, 1970.
Evans A. M. An introduction to ore geology. Blackwell Scientific Publ., 1980.
Tissot B. P. and Welta D. H. Petroleum formation and occurrence. Springer Verlag, 1978.
Van Krozalon D. Coal. Elsevier, 1964,
Hobson G. D. and Tiratsoo E.N. Introduction to petroleum geology. Scientific Press Ltd., 1981.
Mukherjee A. Ore genesis – A holistic approach. Prentice Hall, 1998.
Aswathnarayana U. Principles of nuclear geology. Oxford Uty Press, 1985.
Singh M. P. (Ed) Coal and Organic petrology. Hindustan Publ. Corpn, 1998.
Selley R. C. Elements of petroleum geology. Academic Press.

GL 242: EXPLORATION GEOLOGY

UNIT I

Stages of exploration – Reconnaissance survey; criteria for exploration method (guides to ores). Collection and processing of exploration data. Field work in sedimentary, igneous and metamorphic terrains. Maps of different scales used in exploration, Trenching and pitting – selection of trench sites, logging and sampling of trenches and pits. Drilling – design of a drilling programme, drilling methods – vertical and inclined drill holes. Types of drilling, logging of bore holes, borehole deviations. Preparation of sections and level plans, mineral maps of the

area, fence diagrams. Subsurface mapping – floor and roof contouring. Sampling –Purpose of sampling. Sample types, methods of sampling; Sample preparation and errors in sampling.

UNIT II

Geophysical prospecting: Gravity survey – principles. Bouguer anomaly, latitude, elevation and terrain corrections, survey methods, interpretation of gravity curves of bodies of different shapes. Magnetic survey – principles and earth's magnetic fields, survey methods, interpretation and applications. Seismic surveys – methods of generation, propagation and sensing of seismic waves, wave types, travel time graphs from different media and interfaces. Seismic velocities in geological materials. Seismic survey source, recorders, reflection and refraction surveys and interpretation of profiles.

UNIT III

Electrical surveys: electrical properties of rocks, theory of current flow in different media. Resistivity survey, application and interpretation of data. Self potential survey, application and interpretation of data. Induced polarization, application and interpretation of profiles. Radiometric survey – theory, survey, methods and interpretation of data.

Borehole logging – electrical, radiometric, sonic and thermal logging of the boreholes.

Drilling mud – its role and effects on logging.

UNIT IV

Geochemical exploration: basic principles, geochemical anomalies, geochemical relief, indicators and path finders, geochemical environment, dispersion and mobility, trace element studies. Survey procedures: Rock sampling, Soil sampling, Stream sediment sampling, Water sampling, Vegetation sampling and Vapour sampling. Field and laboratory procedures: analysis and interpretation of data. Sampling errors, its causes and prevention. Biogeochemical exploration: Accumulation of mineral elements by plants, relation of biogeochemical anomalies with ore deposits, methods of biogeochemical prospecting for ore deposits – Geobotanical indicators.

UNIT V

Exploration programme – Objectives, economic factors and gestation period in Reconnaissance and Detailed exploration. Regional exploration programme. Reserve estimation Ore body modeling. Grade, tonnage, cut off grade and reserve classification. UNFC – Sampling and ore reserve calculation, plan methods and cross-section methods.

UNIT VI

Methods of prospecting and estimation of coal and lignite reserves. Prospecting for oil and gas. Exploration for Coal Bed Methane (CBM). Exploration for polymetallic nodules.

Reference Books

1. Peters W. C. Exploration and mining geology. Wiley.
2. Rose A. W. Hawkes H. E. and Webb J. S. Geochemistry in mineral exploration Academic Press.
3. Arogyaswamy R. N. P. Courses in Mining Geology. Oxford and IBH, New Delhi.
4. Low J. W. Geological field methods. Mc Graw Hill.
5. Lahee F. H. Field Geology. Mc Graw.
6. Compton R. R. Manual of Field Geology. Wiley.
7. Malyuga D. P. Biochemical methods of prospecting. Consultants Bureau N York.
8. Dobrin M. B. Introduction to geophysical prospecting. Pergamon Press.
9. Ginzburg D. H. Principles of geochemical prospecting. Pergamon
10. Ginzburg D. H. and Kind R. F. Applied geophysics for geologists and engineers. Pergamon.
11. Bagchi T. C. Elements of prospecting and exploration. Kalyan Publishers.
12. Sinha R. K. and Sharma N. L. Mineral economics. Oxford and IBH.
13. Reedman J. H. Techniques in Mineral exploration. Allied Scientific.
14. Umathy R. M. Textbook of Mining Geology.
15. Chandra D., Singh R. M. and Singh M. P. Textbook of coal (Indian context) Tara Book Agency, Varanasi, 2000.
16. Boyle R. W. Geochemical prospecting for thorium and uranium deposits. Elsevier.
17. Banerjee P. K. and Ghosh S. Elements of prospecting for non – fuel mineral deposits 1997.
18. Moon, Charles J., (ed.), Whatley, Michael, K. G. (ed.) and Evans, Anthony M., (ed.). Introduction to Mineral Exploration. 2nd Edn. Blackwell, New Delhi, 2012.
19. Roger W. Marjoribanks. Geological Methods in Mineral Exploration and Mining. Chapman & Hall, 1997.

GL 243: APPLIED GEOLOGY AND GEOSTATISTICS

UNIT I

Mining methods – Criterion for selecting mining method. Alluvial mining. Mining of beach placers of Kerala. Opencast mining – different methods. Underground mining – parts of the mine – Coal mining methods: Open cast and Underground.

Sea bed mining. Exploitation/Recovery/Mining/Extraction of petroleum. Mining legislation in India. Plans to be prepared and maintained in a mine – EMP, Mining Plan, Mine Closure Plan, Surface Plan, etc. Underground gasification of coal and lignite.

UNIT II

Fundamentals of ore dressing - crushing, grinding, sizing, jigging, tabling, floatation. Spiralling, Magnetic and electrostatic separation. Beneficiation of ores by bio-leaching method.

UNIT III

Scales of measurement: nominal, ordinal, interval and ratio; Averages: mean, median, mode, GM and HM; Measures of dispersion: Range, Mean deviation, Variance, Standard deviation, and quartile deviation, coefficient of variation (Only the Concepts & numerical problems in the field of geology).

Elements of probability: random experiments, sample space, event, disjoint events, definitions of probability, independence of events. Addition theorem, multiplication theorem, Bayes' theorem (statements and simple problems).

UNIT IV

Concept of Random variables, probability distributions; standard probability distributions: Binomial, Poisson, and normal (examples and applications in Geology).

Importance of sampling in data collection; sampling techniques: simple random sampling, systematic sampling, stratified sampling, cluster sampling (methods, situations and examples); Parameter and statistic; sampling distributions: normal, t, chi square and F (definitions, relation and applications).

UNIT V

Introduction to statistical inference: estimation, testing of hypothesis (basic principles, importance of statistical inference in decision making with suitable examples in Geology); t-test of mean, t-test for equality of means, Chi square test of independence, analysis of variance: one-way and two-way (numerical problems); Non-parametric tests (name of the tests and their applications only).

UNIT VI

Geological measurements of sequences of data: correlation and simple linear regression (concepts, least squares method, simple problems in geology);

Moving averages and Kriging, trend analysis, multiple regression, principle component analysis, discriminant analysis, cluster analysis, factor analysis (Only the Concepts and applications in Geology).

Reference Books

1. Davis J. C. Statistics and data analysis in Geology. Wiley.
2. Harbadigh J. M. and Merriam U. F. Computer applications in stratigraphic analysis. Wiley 1968.
3. Miller R. L. and Khan T. S. Statistical analysis in geological analysis. Wiley 1962.
4. Moroney K. J. Facts from figures. Penguin 1952.
5. Krumbein M. B. and Gray Hill H. A. Introduction to statistical methods.
6. Gaudin A. M. Principles of mineral dressing. Mc Graw Hill.
7. Taggart A. P. Handbook of mineral dressing. Wiley.
8. Paul P., Mishra G. C. and Panda D. K. Modern mining equipments beyond 2000AD as applicable to the limestone mining industry. National Council for Cement and Building Materials, New Delhi.
9. Bhaskarathondaiman K. Blasting technology. India Cements Tirunelveli.
10. Biran K. K. and Ramaswamy P. Surface miner – ecofriendly equipment for open cast mines. Mining engineers journal, V. 1(11), 2000.
11. Surana I. S. Mining without drilling and blasting Mining Engineers Journal v 2(9), 2000.

GL 224: Practical I

GEOMORPHOLOGY, STRUCTURAL GEOLOGY, CRYSTALLOGRAPHY AND MINERALOGY

GEOMORPHOLOGY

Interpretation of topographic maps and identification of salient geomorphic features. Morphometric studies.

STRUCTURAL GEOLOGY

Interpretation of geologic maps. Trigonometric, graphic and stereographic solution to problems in structural geology.

Geometric analysis of planar and linear structures.

CRYSTALLOGRAPHY

Stereographic projections – normal class isometric, tetragonal, hexagonal, trigonal, orthorhombic and monoclinic systems.

Calculation of the crystal elements, equation of normals, axial ratios, interfacial angles, indices of faces, Weiss zone law, rule of three faces in a zone, derivation of Millerian sign for a cozonal quartette.

MINERALOGY : OPTICAL MINERALOGY

Determination of the following optical characters of minerals by classical methods:

Relative refringence, order of interference colour, sign of elongation, birefringence, scheme of pleochroism and pleochroic formula, optic orientation, extinction angle, anorthite content.

MINERALOGY : MINERAL CHEMISTRY

Mineralogical calculations: garnet, olivine, pyroxene, feldspar and feldspathoid.

GL 225: Practical II

SEDIMENTOLOGY, REMOTE SENSING AND SURVEY

SEDIMENTOLOGY

Textural analysis of sediments – Sieve analysis, settling analysis, thin section size analysis, measurement and calculation of shape parameters, plotting and interpretation of such data. Heavy mineral separation.

Study of thin sections and hand specimens of limestone, sandstone, shale, conglomerate, breccia and arkose. Study of grain mounts of magnetite, ilmenite, monazite, garnet, quartz and chromite.

REMOTE SENSING

Mapping and identification of drainage features. Identification of land use patterns, geomorphological features, environmental features, lineaments, litho contacts and other geological structures in aerial photographs. General study of satellite imagery.

SURVEY

Methods of Survey including: 1) Plane Table Method, 2) Intersection Method and 3) Radiation Method.

GL 244: Practical III

IGNEOUS AND METAMORPHIC PETROLOGY AND HYDROGEOLOGY

IGNEOUS AND METAMORPHIC PETROLOGY

Megascopic and microscopic study of igneous and metamorphic rocks. Textures and microstructures and their genetic significance. Determination of modal composition, calculation of CIPW norms. Niggli values. Variation diagrams of Harker, Larsen, Niggli and Nockold and Allen. Spider diagrams. Calculation of differentiation index, Peacock's alkali-lime index, Mg number, A/CNK values, use of triangular diagrams in the classification of igneous rocks.

Graphical representation of metamorphic mineral paragenesis – ACF, AKF and AFM diagrams. Construction of phase diagrams from experimental data in the following systems. Diopside-Anorthite, Anorthite-Albite, Forsterite-Silica. Computations of the course of crystallisation of magmas of various compositions in the above systems consequent on fractional crystallisation and assimilation.

HYDROGEOLOGY

Solution of problems based on Darcy's law. Preparation and interpretation of water table contour maps. Computation of aquifer parameters from pumping data. Collection of well inventory data.

Graphical representation of hydrochemical data. Hill-Piper Trilinear diagram and U.S. Salinity diagram.

GL 245: Practical IV

ECONOMIC GEOLOGY, EXPLORATION GEOLOGY AND APPLIED GEOLOGY

ECONOMIC GEOLOGY

Collection and display of data on production, consumption and export of important minerals, coal and petroleum in India. Megascopic identification of ore minerals.

EXPLORATION GEOLOGY

Averaging assays, estimation of ore reserves, cut off grade, core logging and interpretations from litholog plotting.

APPLIED GEOLOGY

Flow chart for ore dressing/beneficiation plant. Calculation of stripping/ore: overburden ratio. Calculation of grade of blended ores.