Geology Department
Osmania University
Proposed Choice Based Credit System (CBCS)
M.Sc. Geology
Scheme of Instruction and Examination (2015-2016)

Semester – I

S. No	Code No.	Paper	Paper Title	Hours / Week	Internal Assessment	Semester Exam	Total Marks	Credits
Theory								
1	AGL 101 T	I	Crystallography, Optical Mineralogy & Mineralogy	4	20 Marks	80 Marks	100 Marks	4
2	AGL 102 T	II	Structural Geology & Geotectonics	4	20 Marks	80 Marks	100 Marks	4
3	AGL 103 T	III	Paleontology & Stratigraphy	4	20 Marks	80 Marks	100 Marks	4
4	AGL 104 T	IV	Geomophology & Field Geology	4	20 Marks	80 Marks	100 Marks	4
Practical								
5	AGL 105 P	I	Crystallography, Mineralogy & Optical Mineralogy	6	-	150 Marks	150 Marks	3
6	AGL 106 P	II	Geomorphology & Paleontology	4	-	100 Marks	100 Marks	2
7	AGL 107 P	III	Field Geology & Structural Geology	4	-	100 Marks	100 Marks	2
8	AGL 108 P	IV	Communication Skills	2	-	50 Marks	50 Marks	1
			Total	32	80	720	800	24

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Semester – II

S. No	Code No.	Paper	Paper Title	Hours / Week	Internal Assessment	Semester Exam	Total Marks	Credits
Theory								
1	AGL 201 T	I	Igenous Petrology & Geochemistry	4	20 Marks	80 Marks	100 Marks	4
2	AGL 202 T	II	Metamorphic Petrology & Thermodynamics	4	20 Marks	80 Marks	100 Marks	4
3	AGL 203 T	III	Sedimentology & Petroleum Geology	4	20 Marks	80 Marks	100 Marks	4
4	AGL 204 T	IV	Ore Genesis & Mineral Deposits	4	20 Marks	80 Marks	100 Marks	4
Practical								
5	AGL 205 P	I	Igneous Petrology, Metamorphic Petrology & Geochemistry	6	-	150 Marks	100 Marks	3
6	AGL 206 P	II	Sedimentology & Petroleum Geology	4	-	100 Marks	100 Marks	2
7	AGL 207 P	III	Ore Genesis & Mineral Deposits	4	-	100 Marks	100 Marks	2
8	AGL 208 P		Statistics & Computation Techniques	2		50 Marks	50 Marks	1
				32	80	720	800	24

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Semester – III

S. No	Code No.	Paper	Paper Title	Hours / Week	Internal Assessment	Semester Exam	Total Marks	Credits
Theory								
1	AGL 301 T	I	Mineral Exploration	4	20 Marks	80 Marks	100 Marks	4
2	AGL 302 T	II	Hydrogeology	4	20 Marks	80 Marks	100 Marks	4
3	AGL 303 T	III	Remote Sensing & GIS	4	20 Marks	80 Marks	100 Marks	4
4	AGL 304 T	IV	CB – 1. Disaster Management CB – 2. Watershed Management	4	20 Marks	80 Marks	100 Marks	4
5			Seminar Lecture by Student			25 Marks	25 Marks	2
Practical								
5	AGL 305 P	I	Mineral Exploration (Geological Exploration; Geophysical Exploration & Geochemical Exploration)	6	-	150 Marks	100 Marks	3
6	AGL 306 P	II	Hydrogeology	4	-	100 Marks	100 Marks	2
7	AGL 307 P	III	Remote Sensing & Geographic Information Systems (GIS)	4		100 Marks	100 Marks	2
8	AGL 308 P	IV	Personality Development	2	-	50 Marks		1
			Total	32	*80*	720	800	24

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Semester – IV

S. No	Code No.	Paper	Paper Title	Hours / Week	Internal Assessment	Semester Exam	Total Marks	Credits
Theory								
1	AGL 401 T	I	Environmental Geology	4	20 Marks	80 Marks	100 Marks	4
2	AGL 402 T	II	Mining Geology & Engineering Geology	4	20 Marks	80 Marks	100 Marks	4
3	AGL 403 T	III	Mineral Economics & Fuels	4	20 Marks	80 Marks	100 Marks	4
4	AGL 404 T	IV	CB – 1. Mineral Chemistry CB – 2. Precambrian Geology & Crustal Evolution	4	20 Marks	80 Marks	100 Marks	4
Practical								
5	AGL 405 P	I	Mining, Engineering Geology & Environmental Geology	6	-	150 Marks	150 Marks	3
6	AGL 406 P	II	Precambrian Geology & Fuels	4	-	100 Marks	100 Marks	2
7	AGL 407 P	III	Project Work	4	-	100 Marks	100 Marks	2
8	AGL 408 P	IV	Seminar	2	-	50 Marks	50 Marks	1
			Total	32	80	720	800	24

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Subjects offered in IV Semester, M. Sc. Geology at Department of Geology
University College of Science (UCS), Saifabad, Hyderabad-4

Semester – III

S. No	Code No.	Paper	Paper Title	Hours / Week	Internal Assessment	Semester Exam	Total Marks	Credits
Theory								
1	AGL(S)401 T	IV	Watershed Development	4	20 Marks	80 Marks	100 Marks	4
Practical								

(S) Saifabad

Semester – IV

S. No	Code No.	Paper	Paper Title	Hours / Week	Internal Assessment	Semester Exam	Total Marks	Credits
Theory								
1	AGL 401 T	I	Chemical Geology	4	20 Marks	80 Marks	100 Marks	4
Practical								
5	AGL(S)401 T	I	Chemical Geology, Mining Geology & Engineering Geology	9	-	150 Marks	150 Marks	3

I Semester

Paper - I (AGL 101 P): Crystallography, Optical Mineralogy & Mineralogy

Unit – I

External symmetry of crystals: Symmetry Elements, methods of projection, derivation of 32 classes, Hermaun Muguin notation. Internal symmetry of crystals: Derivation of 230 space groups, diffraction of crystals by X-rays, Braggs' law.

Unit –II

Principles of optical mineralogy: Optical mineralogy, polarized light, behaviour of isotropic and anisotropic minerals in polarized light, refractive index, double refraction, birefringence, sign of elongation, interference figures, 2V, dispersion in minerals. optic sign, pleochroic scheme and determination of fast and slow vibrations and accessory plates.

Unit – III

Introduction to mineralogy: Definition and classification of minerals. structural and chemical principles of crystals / minerals, chemical bonds, ionic radii, coordination number (CN) and polyhedron. Structure, chemistry, physical and optical characters and paragenesis of mineral groups: Olivine, pyroxene, amphibole, mica and spinel groups.

Unit – IV

Structure, chemistry, physical and optical characters and paragenesis of mineral groups: Feldspar, quartz, feldspathoid, aluminum silicate, epidote and garnet groups. Accessory minerals: Apatite, calcite, corundum, scapolite, sphene and zircon. Earth mineralogy: Average mineralogical composition of crust and mantle, mineral transformations in the mantle with depth.

Practicals

Crystallography and Mineralogy

1. Study of important crystal models corresponding to Normal Class of cubic system.
2. Study of important crystal models corresponding to Normal Class of orthorhombic system.
3. Study of important crystal models corresponding to Normal Class of monoclinic system.
4. Study of important crystal models corresponding to Normal Class of triclinic system.
5. Study of important crystal models corresponding to Normal Class of tetragonal system.
6. Study of important crystal models corresponding to Normal Class of hexagonal system.
7. Stereographic projections on the Wulf's Stereonet.
8. Megascopic study of rock forming minerals : Olivines, pyroxenes, amphiboles and micas.
9. Megascopic study of rock forming minerals : Feldspars, feldspathoids, silica minerals

and alumino silicates.
10. Megascopy of accessory minerals : Apatite, zircon, magnetite, ilmenite, calcite, epidote, sphene etc

Optical Mineralogy

1. Centering and, orthoscopic and conoscopic arrangement of the petrological microscope.
2. Microscopy of rock forming minerals : Olivines, pyroxenes, amphiboles and micas.
3. Microscopy of rock forming minerals : Feldspars, feldspathoids, silica minerals and alumino silicates.
4. Microscopy of accessory minerals : Apatite, zircon, magnetite, ilmenite, calcite, epidote, sphene etc.
5. Determination of relative relief (RI) of minerals by Becke-line test and .
6. Determination of sign of elongation of minerals.
7. Determination of pleochroic scheme of minerals.
8. Determination of optic sign of uniaxial minerals.
9. Determination of optic sign of biaxial minerals.
10. Determination of anorthite content of plagioclase by Michel Levy Method.

Books Recommended

Crystallography, Mineralogy & Optical Mineralogy

1. Deer, W., Howie, R.A. & Zussman, J., 1996; The Rock forming minerals. Longman.
2. Klein, C and Hurbut, Jr., C.S. 1993; Manual of Mineralogy. John Wiley.
3. Putnis Andrew, 1992; Introduction to Mineral Science, Cambridge University Press.
4. Spear, F.S. 1993; Mineralogical Phase Equiligria and Pressure – Temperature – Time paths. Mineralogical society of America Publisher.
5. Phillips, Wm, R. & Griften, D.T 1986. Optical Mineralogy, CBS edition.
6. Hutchison, C.S., 1974 laboratory handbook of Petrographic Techniques. John Wiley.

Paper – II (AGL 102 T) Structural Geology & Geotectonics

Unit – I

Concept of stress and strain: Stress-strain relationships of elastic, plastic and viscous materials, measurement of strain in deformed rocks, behaviour of minerals and rocks under deformation conditions. Folds: classification and causes of folding, diapirs and salt domes.

Unit – II

Shear zones: Recognition of shear zones and faults in field, mechanics of shearing and faulting. Geometry of thrust sheets: Block faulted and rifted regions. Wrench faults and associated structures. Tectonic mélanges, Dome and basin structures, Structural behaviour of igneous rocks. Foliations and Lineations: classification, origin and significance. Petrofabric analysis (microfabrics): Data collection, plotting, symmetry and interpretation, concept of symmetry of fabric of tectonites.

Unit – III

Geotectonics: Introduction, tectonic framework of earth's crust, interior of earth. isostasy, convection currents, Wilson Cycle. Continental Drift: Computer fitting, geological and palaeontological evidences in support of continental drift and insitu theories. Sea-floor spreading: Hess's concept and evidences of sea-floor spreading. Vine-mathew's magnetic tape recorder.

Unit – IV

Plate tectonics: Concept of plate and plate movements, plate model of Morgan, nature of convergent, divergent and conservative plate margins, transpression and transtension. Plate tectonics in relation to igneous, sedimentary and metamorphic processes and mineralization. Triple junctions, aulocogens, plume theory, island arcs. Nature and origin of earth's magnetic field.

Practicals

Structural Geology

1. Reconstruction of folds, determination of the depth at the end of the section.
2. Reconstruction of folds, determination of the height at the end of the section.
3. Vertical fault problems
4. Inclined fault problems; standard geological maps.
5. Maps with uniformly dipping beds / unconformable beds.
6. Maps with beds dipping with different dips.
7. Maps with folded formations.
8. Maps with faulted formations.
9. Maps with intrusives / unconformities.
10. Maps of geotechnical importance.

Books Recommended

Structural Geology & Geotectonics

1. An outline of Structural Geology By John Wiley:: Hobbs, Means and Williams, 2. Outline of Structural Geology By Mathuen, London:: E S Hills, 3. Structural Geology of rocks and regions By John Wiley:: H. davis, 4. Foundations of structural geology By Blakie:: R.G.Park, 5. Structural Geology By McGraw Hill:: L.U.De Sitter, 6. Structural Geology By P.H.I.:: M.P.Billings, 7. Fundamentals of modern structural geology By S.K. Ghosh., Elsivier Publication, 8. T.M.H.: Aspects of tectonics of SE Asia: K.S.valdiya Understanding the earth By Artemis Press:: Gass, Smith and Wilson, 9. Physical Geology By P.H.I.:: Judson, Deffeyes & Hargraves, 10. Plate tectonics and crustal evolution By K.C.Condie Pergomon press, 11. Holmes principles of Physical Geology. By D.Duff Chapman& Hall, 12. The evolving continents: By B. F. Windley J.W., 13. Crustal evolution and orogeny By S.P.h.Sychanthavong. Oxford & IBH., 14. The evolving earth By Sawkins and others. Mac Millan, 15. The evolving Earth By L A M Cocks. Cambridge University Press, 16. Plate tectonics and magnetic reversals. Allan Cox . Freeman, 17. Basic problems in Geotectonics. V V Beloussov. Mc Graw Hill, 18. Development in Geotectonics. Series from Vol.1 to 6. Elsevier, 19. Continental deformation By Paul Hancock. Oxford Publication House.

Paper – III (AGL 103 T)
Palaeontology & Stratigraphy

Unit – I

Micro-palaeontology: Origin and evolution of life. Classification and uses of micro fossils. Detailed study of microfossils such as Foraminifera, Radiolaria, Conodonta, Ostracoda, Bacteria, Diatoms, Dinoflagellata and Charophyta. Plant fossils: Gondwana flora and their significance.

Unit – II

Vertibrate palaeontology: General characters, classification, evolution of Fishes including Agnaths, Placoderms, Chondrichythis and Osteichthyes. General characters, age of Amphibians, Reptiles and Mammals. General characters, classification, evolution, age and extinction of Dinosaurs. General characters, classification and evolution of Horse, Elephant and Man.

Unit - III

Principles of stratigraphy: Nomenclature and the modern stratigraphic code. Litho-, bio- and chrono-stratigraphic units and their inter-relationships. Geological time scale. Magneto-stratigraphy. Dating of rocks. Modern methods of stratigraphic correlation. Precambrian stratigraphy: Achaean stratigraphy -tectonic frame-work, geological history and evolution of Dharwar, and their equivalents; Easterghats mobile belt; Proterozoic stratigraphy -tectonic framework, geological history and evolution of Cuddapahs and their equivalents.

Unit -IV

Palaeozoic stratigraphy: Palaeozoic formations of India with special reference to type localities, history of sedimentation, fossil content. Mesozoic stratigraphy: Mesozoic formations of India with special reference to type localities, history of sedimentation, fossil content. Palaeogeography and Gondwana system. Cenozoic stratigraphy: Cenozoic formations of India, Rise of the Himalayas and evolution of Siwalik basin. Deccan volcanics. Stratigraphic boundaries: Stratigraphic boundary problems in Indian geology.

Practicals

Palaeontology

1. Morphology, classification, geological age and stratigraphic position of important fossils of Potozoa and corals.
2. Morphology, classification, geological age and stratigraphic position of important fossils of Gastopoda.
3. Morphology, classification, geological age and stratigraphic position of important fossils of Cephalopoda.
4. Morphology, classification, geological age and stratigraphic position of important fossils of Lamellaebranchia.
5. Morphology, classification, geological age and stratigraphic position of important fossils of Brachiopoda.

6. Morphology,classification, geological age and stratigraphic position of important fossils of chinodermanta.
7. Morphology, classification, geological age and stratigraphic position of important fossils of Arthropoda.
8. Morphology, classification, geological age and stratigraphic position of important plant fossils.
9. Morphology, classification, geological age and stratigraphic position of important microfossils
10. Morphology, classification, geological age and stratigraphic position of important vertibrate fossils.

Books Recommended

Palaeontology & Stratigraphy

1. Outline of palaeontology - H.H.Swinnerton
2. Principles of invertebrate palaeontology-Shrock and Twenhofell.
3. Introduction to evolution-Paul Ames Moody
4. Evolution of the invertebrate-Jean chaline
5. Palaeobotany - Arnold
6. Elements of Micropalaeontology by G. Bignot
7. Microfossils by M.D. Brasier
8. Palaeobiology of Plant protests by Helen Tappen
9. Palaeontology – Evolution and Animal distribution by P.C. Jain & M.S. Anantharaman
10. A text book of Stratigraphy and Micropalaeontology and Palaeobotany by S.K. Tiwari
11. Sedimentation and stratigraphy - Krumbein and Sloss L.L.
12. Principles of stratigraphy - Dunbars & Rodgers
13. Principles and practices in Stratigraphy - Marvin Weller
14. Geology of India & Burma- M.S.Krishnan, 15. Geology of India- D.N. Wadia, 16. Fundamentals of Historical geology & stratigraphy of India- Ravindra Kumar.

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Paper – IV (AGL 104 T) Geomorphology & Field Geology

Unit – I

Geomorphology: Definition and fundamental concepts of geomorphology, Geomorphic processes: Exogenic processes -gradation, degradation and aggradation; Endogenetic process -diastrophism, and volcanism. Extraterrestrial process -fall of meteorites. Weathering: physical weathering, chemical weathering and differential weathering, formation of soil, soil profile and mass wasting and its types. Fluvial cycle: Streams and valleys, drainage patterns and their significance, stream deposition, Peneplain concept, topography on domal, folded and faulted structures. Groundwater cycle: Origin of limestone caverns. Landforms of karst regions and karst topography.

Unit – II

Glacial cycle: Features resulting from glaciers, development of landforms, effects of glaciation beyond ice caps and interglacial deposits. Arid cycle: Origin of deserts and its landforms, topographic effects of wind erosion. Volcanism: Landforms resulting from eruption and deposition of volcanism. Geomorphology of coasts: Topographic features resulting from marine deposition. Topography of ocean floors: Landforms related to shelves, slopes and deep sea. Applied geomorphology: Application of geomorphology to various fields of earth sciences.

Unit – III

Field Geology: Introduction, Toposheets: Definition, Scale –definition, small scale and large scale, reading various components of a toposheet. Geological map -definition, various components of a geological map including scale, legend, structures etc. Field work and sampling: Field work, geological items to be carried to the field, Use of clinometer compass, Brunton compass, strike and dip measurements; Sampling and oriented sample and its significance, and sampling for isotopic and geochronological studies and its significance; Geological mapping procedures: Geological mapping of igneous terrains, geological mapping of sedimentary terrains, geological mapping of metamorphic terrains.

Unit – IV

Geographic positioning system (GPS): Introduction, definition and scope of GPS, advantages and uses of GPS in different fields. Surveying: Principles and methods surveying, chain survey, prismatic survey, plane table survey and theodolite survey. Dumpy's level and Abny's level. Methods of representation of survey-data.

Practicals

Geomorphology

1. Intra-conversion of scales of toposheets.
2. Study of contour-variations and elevations on toposheets.
3. Identification and classification of various types of fluivial, aeolin, glacial and volcanic landforms on toposheets, geological maps, aerial photos and Lansat imageries.
4. Identification, demarcation and classification of folds and faults from the toposheet.
5. Identification, demarcation and classification of lineaments from toposheet.

6. Identification, classification and preparation of drainage basin map on toposheet.
7. Morphometry analylsis of the drainage basin on toposheet.
8. Identification and interpretation of gully patterns on toposheet.
9. Preparation of landuse- and landcover-maps from toposheet.
10. Identification and classification of geomorphological units on toposheet, aerial photos, Landsat imageries.

Field Geology

1. Reading of toposheets, geological maps and mine plans.
2. Representation factor of scale, representation of scale on the maps.
3. Chain survey of an object taking offsets.
4. Prismatic compass survey of an object by taking forward and backward bearing
5. Plane-table survey -radiation method
6. Plane-table survey -intersection method
7. Plane-table survey -traversing method
8. Profiling using Abny's level and Levelling using Dumpy's level
9. Theodolite survey -countouring and height measurements.
10. Operation of GPS.

Books Recommended

Geomorphology & Field Geology

1. Principles of Geomorphology by Thornbury, W.D..
2. Photogeology by Miller and Miller
3. Geomorphology by Arthur Bloome
4. Principles of Physical geology by Arthur Holms
5. Analysis of landforms by Twidale, C.R
6. Geomorphology by Lobeck by Lobeck, A.K.
7. Field Geology by Lahee
8. Field Geology by Compton

II Semester

Paper – I (AGL 201 T) Igneous Petrology & Geochemistry

Unit – I

Igneous Petrology: Origin of magmas: Normal state of mantle, onset of partial melting of mantle, processes of partial melting in mantle, mantle-magmas in relation to degree and depth-level of partial melting. Phase equilibrium in igneous systems: Binary systems including Fo-Si and An-Ab, ternary systems including Di-Ab-An and Fo-Di-An. Bowen's reaction principle: Reaction series and its application to petrogenesis. Magmatic evolution and differentiation: Fractional crystallization, gravitational differentiation, gas-streaming, liquid immiscibility and assimilation. Structures and textures: Definition, description, rock examples and genetic implications of common structures and textures of igneous rocks. Classification of igneous rocks: Mode, CIPW norm, IUGS and Irvine-Baragar classifications; Magmatism and tectonics: Inter-relationship between tectonic settings and igneous rock suites.

Unit – II

Igneous rock suites: Form, structure, texture, modal mineralogy, petrogenesis and distribution of the following igneous rocks: Ultramafic rocks: Dunite-peridotite-pyroxenite suite; kimberlites, lamprophyres, lamproites, komatiites; Basic rocks: Gabbro-norite-anorthosite-troctolite suite, Dolerites; Basalts and related rocks; Intermediate rocks: Diorite-monzonite-syenite suite; Andesites and related rocks; Acidic rocks: Granite-syenite-granodiorite-tonalite suite; Rhyolites and related rocks; Alkaline rocks: Shonkinite, ijolite, urtite, melteigite, malignite, alkali gabbros, alkali basalt, alkali granite, alkali syenite, nepheline syenite and phonolite; Carbonatites; Ophiolite suite.

Unit – III

Geochemistry: Introduction: Definition, scope and objectives. Elements: origin, abundance of elements in the solar system and earth, and its constituents; average mineralogical, petrological and, major and trace elemental composition of crust. Meteorites: Classification, mineralogy, chemical composition, origin and age of meteorites. Primary geochemical differentiation of earth: Original molten system, phases involved, chemical reactions and chemical affinity of elements. Goldschmidt's geochemical classification of elements: Definition, theoretical basis and significance of the classification, siderophiles, chalcophiles, lithophiles and atmophiles with examples. Periodic table: Definition and examples of transition elements, platinum group of elements, rare-earth elements, compatible elements, incompatible elements, high-field strength elements (HFSE), large ion lithophile elements (LILE). Magmatism as geochemical process: Major elemental distribution in igneous rocks: Geochemical trends of Mg, Fe, Mn, Ca, Al, Na, K and Si, Ti and P and, variation of Si/Al, (Na+K)/Al and Ca/Na ratios during differentiation by fractional crystallization of a basaltic magma. Goldschmidt's rules governing distribution of major elements. Trace element distribution in igneous rocks: Goldschmidt's rules

governing distribution of trace elements during magmatic crystallization including camouflage, capture and admittance with examples of these substitutions.

Unit – IV

Sedimentation as a geochemical process: Chemical breakdown and products of sedimentation, soil geochemistry, major and trace element composition of sandstone, shale and limestone, positive and negative colloids, Eh-pH relations during sedimentation; Metamorphism as a geochemical process: Chemical composition of metamorphic rocks; Isotope geochemistry: Definition, stable isotopes and radiogenic isotopes. Stable isotopes: Variations in abundance of O, S, C and H in minerals, rocks and water with respect to international standards, significance of stable isotope study. Radiogenic isotopes: Geochronology, radioactivity decay schemes and growth of daughter isotopes. Radiometric dating: Brief outline of U-Th-Pb, K-Ar, Sm-Nd and Rb-Sr methods of dating. Atmospheric geochemistry: Zonal structure of atmosphere, variable and non-variable chemical constituents of atmosphere.

Practicals

Igneous Petrology

1. Megascopy of ultramafic, basic, intermediate and acidic igneous rocks.
2. Microscopy of ultramafic, basic, intermediate and acidic igneous rocks.
3. Modal classification of ultramafic, and basic igneous rocks following the IUGS nomenclature.
4. Modal classification of intermediate and acidic igneous rocks following the IUGS nomenclature.
5. Chemical classification of igneous rocks in the (Na_2O+K_2O) vs SiO2 diagram.
6. Calculation of the CIPW norm of gabbro
7. Calculation of the CIPW norm of diorite.
8. Calculation of the CIPW norm of granite
9. Calculation of the CIPW norm of syenite
10. Calculation of the CIPW norm nepheline syenite.

Geochemistry

1. Mineral formula recalculation of olivine.
2. Mineral formula recalculation of pyroxene.
3. Mineral formula recalculation of amphibole.
4. Mineral formula recalculation of mica.
5. Mineral formula calculation of feldspars.
6. Mineral formula calculation of feldspathoid.
7. Whole-rock chemical analysis for major and trace elements following standard procedures.
8. Preparation and interpretation of binary variation diagrams for whole rock major and trace element compositions of igneous rock suites using Harker's and Nockold's indices.
9. Preparation and interpretation of ternary variation diagrams for whole rock major element compositions of igneous rock suites using AFM and Ca-Na-K diagrams.

10. Preparation and interpretation of REE patterns for basic, intermediate and acidic igneous rocks.

Books Recommended,

Igneous Petrology & Geochemistry

1. Igneous petrology – Middlemost, 2. Igneous Petrology – Antony Hall, 3. Igneous and Metamorphic Petrology- Best, 4. Introduction to Petrology- P.J.Wyllie, Prentice Hall, 5. Petrology – V. Hyndman Ed II, 6. The evolution of Igneous Rocks – N.L.Bowen, Princeton University Press, 7. Granite Petrology and Granite Problem – Marino V.Elsevier, 8. Natural Histroy of Igneous rocks – Herker A.Mc.Millan, 9. Basalts VolI andII Poldervaart and Hess, H,H,, 10. Ultramafic rocks – Wylliie, P.J.Heffer, 11. Petrography, An introduction to the study of rocks in thin sections - Howell, William and Turner, W.H.Freeman, 12. Principles of Geochemistry by B. Mason and C. B. Moore, 13. Principles of isotope geology –Gunter Faure, John Wiley, 14. Petrology, The Study of Igneous, Sedimentary and Metamorphic Rocks by Loren A. Raymond, WCB Publ., 1995, 15. Petrology by Walter T. Huang, McGraw-Hill Publ., 1962, 16. Igneous rocks by Alok K. Gupta, Allied Publ., 1998, 17. Igneous petrogenesis -a global tectonic approach (1989) M. Wilson Unwin Hyman Ltd., 18. Igneous Rocks and Processes: A Practical Guide by Robin Gill. Wiley-Blackwell Publ., 2010.

Paper – II (AGL 202 T)
Metamorphic Petrology & Thermodynamics

Unit – I

Metamorphic Petrology: Definition, scope, historical background, factors and kinds of metamorphism and metamorphic processes; Classification: Classification of metamorphic rocks and nomenclature; Structures and textures: Definition, description and physical conditions of formation of various structures of metamorphic rocks; Concepts of metamorphism: Zones, grades, and facies of metamorphism. Phase relations: ACF, AFM and AKF phase diagrams for metamorphic mineral assemblages.

Unit – II

Contact metamorphism: Definition, physical conditions, distribution, sub-facies and characteristic mineral assemblages of sandinite facies and hornfels facies; Regional metamorphism: Definition, physical conditions, distribution, sub-facies and characteristic mineral assemblages of zeolite facies, greenschist facies, blueschist facies, amphibolite facies, granulite facies, and eclogite facies. Inter-relationship between metamorphism and tectonism.

Unit – III

Thermodynamics: Introduction: Definition, scope, and objectives of thermodynamics, inter-relationship between petrogenetic processes and thermodynamics; Role of thermodynamics in geochemistry; Phase rule: Gibb's phase rule and study of phase relations in Al_2SiO_5 system; Goldschmidt's mineralogical phase rule, 'pressure-temperature-depth relations' among various metamorphic facies and ultrametamorphism; Paired metamorphic belts: Definition, characteristics and distribution, case study of Sanbagawa-Ryoke paired metamorphic belt, Japan; Pressure vs metamorphic minerals: Metapelitic and metabasic minerals and mineral assemblages characteristic of various baric types of metamorphism.

Unit – IV

Chemical processes: Reversible and irreversible processes; Internal energy: Definition and expression of internal energy of a system, First law of thermodynamics; Entropy: Definition and expression of entropy of a system, Second law of thermodynamics, Enthalpy: Definition and expression of enthalpy of a system; Free energy: Gibb's free energy and Helmotz free energy of a system; Chemical potential: Fugacity and activity of a solute, activity coefficient; P-T diagrams: Petrogenetic grids, univariant reaction curves for important metamorphic reactions, geothermobarometry, pressure(P)-temperature(T)-time(t) paths.

Practicals

Metamorphic Petrology

1. Megascopy of metamorphic rocks: slates, phyllites, schists and gneisses.
2. Megascopy of metamorphic rocks: amphibolites, charnockites, khondalites, eclogites.
3. Megascopy of metamorphic rocks: marbles and quartzites.
4. Microscopy of metamorphic rocks: slates, phyllites, schists and gneisses.

5. Microscopy of metamorphic rocks: amphibolites, charnockites, khondalites and eclogites.
6. Microscopy of metamorphic rocks: marbles and quartzites.
7. Construction and interpretation of ACF diagrams.
8. Construction and interpretation of AFM diagrams.
9. Construction and interpretation of AKF diagrams.
10. Calculation, plotting and interpretation of Niggli values for metamorphic rocks.

Books Recommended

Metamorphic Petrology & Thermodynamics

1. Elementary Thermodynamics for Geologists by B. J .Wood and D .G. Fraser.
2. Principles of Igneous and Metamorphic Petrology by A. R. Philpotts.
3. Igneous and Metamorphic Petrology by G. M. Best.
4. An Introduction to Metamorphic Petrology by V. W. Yardly

Paper – III (AGL 203 T)
Sedimentology & Petroleum Geology

Unit – I

Sedimentology: Sedimentary environments: Definition and classification, non-marine environments including fluvial, glacial, eolin and lacustrine environments, transitional environments including deltaic, beach and tidal flats, marine environments including shelf (clastic and non-clastic) and deep sea sedimentary environment.

Unit – II

Evolution of sedimentary basins: Sedimentary basins, geosynclinal concept, plate tectonics, pre-flysch, flysch, molasses and turbidites; Tectonic setting of sedimentary basins: Sedimentary basins in various tectonic environments including divergent-, convergent-, transform fault-, hybrid- and intraplate-tectonic settings.

Unit – III

Petroleum Geology: Definition, nature and origin of petroleum hydrocarbons; Constitution: Composition of petroleum and natural gas; Origin: Genesis of hydrocarbons, conversion of organic matter to petroleum, variety of petroleum hydrocarbons and gas hydrates; Reservoir rocks: Migration and accumulation of oil; Oil traps: Different types of traps including structural traps, stratigraphic traps and combination traps, salt domes.

Unit – IV

Exploration and exploitation of petroleum: Surface indications, direct detection of hydrocarbons including geological, geophysical (elecrical and seismic), geochemical and remote sensing methods. Distribution: Geographic and sratigraphic distribution of oil and gas, global distribution, petroliferous basins in India.

Practicals

Sedimentology

1. Megascopy of clastic sedimentary rocks (conglomerates, breccias, sandstones and shales) and non-clastic sedimentary rocks (limestones, fossiliferous limestones including stromatolitic limestones and dolomites).
2. Microscopy of clastic and non-clastic rocks as given above.
3. Grain size analysis by sieving method.
4. Heavy mineral (zircon, rutile and tourmaline, ZRT) analysis using bromoform.
5. Estimation of sphericity and roundness of grains.
6. Identification of sedimentary structures and interpretation of depositional environments..

7. Construction and interpretation of rose diagrams using palaeocurrent data.
8. Classification of sedimentary rocks by plotting the modal and whole rock chemical compositions in relevant triangular diagrams.
9. Study and interpretation of lithofacies maps.
10. Classification of stromatolites (algal bioherms) using Logan et al (1964) scheme.

Books Recommended

Sedimentology & Petroleum Geology

1. Sedimentary Rocks By Pettijohn, F. J., Harper & Row, N. Y.
2. Origin of Sedimentary Rocks By Blott, H., Middleton and Murray, R.
3. Procedures in Sedimentary Petrology By Carver, R.C.
4. Sedimentology Process and Product By Leader, M. R.
5. Sand and Sandstones By Pettijohn, F.J., & Potter, P.E.
6. Palaeocurrents and Basin analysis By Potter, P.E., & Petijohn, F.J.
7. Depositional Sedimentary Environments By Rieneck, H.E., Singh, I.B.
8. An Introduction to Sedimentology By Shelly, R.C.
9. Practical Manual of Sedimentary Petrology By Babu, S.K., & Sinha, D.K.
10. Petrology of Sedimentary Rocks By Folk, R.L.
11. Practical Manual of Sedimentology By Lindholm, R.
12. Sedimentary Structures: CBS Publications
13. Petroleum Geology (Paperback - 2003) by Jon Gluyas and Richard Swarbrick. Publisher: Blackwell Publishers. flipcart.com
14. Elements of Petroleum Geology. (Paperback - 1998) by Richard C. Selley. Publisher: Academic Press. flipcart.com
15. Petroleum Geology (Paperback - 2003) by Jon Gluyas and Richard Swarbrick. Publisher: Blackwell Publishers. flipcart.com
16. Geostatistics And Petroleum Geology. (Hardcover - 1998) by Michael Edward Hohn and M. E. Hohn. Publisher: Kluwer Academic Publishers.
17. Elements of Petroleum Geology By Selley, R.C. 100/998 Academic Press.
18. Petroleum Geology By North, F.K.

19. Petroleum Geology By Chapman, R.C, 20. Petroleum Geology By Leverson, A.I., 21. Sedimentation and stratigraphy By Krumbein and Sloss, 22. Petroleum Formation and Occurrence By Tissot, B.A & Welte, D.A 1984. Springer Verlag.

Paper – IV (AGL 204 T) Ore Genesis and Mineral Deposits

Unit – I

Ore genesis: Introduction: Modern concept of ore genesis, *Ore mineral groups:* Detailed study of all principal ore mineral groups, plate tectonics and ore deposits; *Metallogeny:* Metallogeny through geological time. *Ore textures:* Advanced study of ore textures. scientific application of ore textures and ore genesis; *Paragenesis:* Paragenetic sequences and zoning in metallic ore deposits. *Ore microscopy:* Application of ore microscopy in mineral technology, *P-T estimation:* Application of geothermobarometry, *Fluid inclusion study:* Principles, assumptions, limitations and applications of fluid inclusions in ores: *Isotopic ore genesis:* Role and application of stable isotopes in ore genesis.

Unit – II

Ore associations: Petrological ore associations with Indian examples, orthomagmatic ores of mafic-ultramafic association, diamonds in kimberlites, REE in carbonatites, chromite in chromitites and basic rocks, PGE in ultramafic and basic rocks; Cyprus type Cu-Zn, ore of silicic igneous rocks -Kiruna type Fe-P and Kuroko type Zn-Pb-Cu.

Unit – III

Ores of sedimentatary affiliation: Chemical and clastic sedimentation, stratiform and stratabound ore deposits (Mn, Fe, non-ferrous ores), placer concentrations; *Ores of metamorphic affiliation:* Ores related to weathering and weathered surfaces, laterite, bauxite and manganese nodules.

Unit – IV

Ore deposits: Study of geology, nature of occurrence and the genesis of the following ore deposits with special reference to India: 1. Iron ore formations and deposits, 2. Chromite deposits. 3. Manganese deposits. 4. Copper deposits. 5. Lead and Zinc deposits. 6. Bauxite deposits. 7. Magnesite deposits. 8. Barite deposits. 9. Mica deposits. 10. Asbestos deposits. 11. Dimension and decorative stones; *Mineral based Industries:* Iron and steel; *Refractories:* Ceramic, electrical and insulators, glass.

Practicals

Ore Genesis

1. Demonstration and study of ore microscope with respect to the nature of reflected light and magnifications by objectives,
2. Ore sample preparation for ore petrography: polishing, mounding and cleaning with xylene,
3. Identification, classification of textures and paragenesis of pyrite ores under ore microscope,
4. Identification, classification of textures and paragenesis of Pb ores under ore microscope,
5. Identification, classification of textures and paragenesis of sphalerite and bornite ores under ore microscope,
6. Identification, classification of textures and paragenesis of arsenopyrite and chalcocite ores under ore microscope,
7. Identification, classification of textures and paragenesis of pyrrhotite ores under ore microscope,
8. Identification, classification of textures and paragenesis of Fe ores under ore microscope,
9. Identification, classification of textures and paragenesis of Mn ores under ore microscope,
10. Identification, classification of textures and paragenesis of Cr ores under ore microscope.

Mineral Deposits

1. Megascopic description with diagnostic physical properties, identification, classification of the Fe ore minerals,

2. Megascopic description with diagnostic physical properties, identification, classification of the Mn ore minerals3. Megascopic description with diagnostic physical properties, identification, classification of the Cr ore minerals,
4. Megascopic description with diagnostic physical properties, identification, classification of the Al ore minerals,
5. Megascopic description with diagnostic physical properties, identification, classification of the Cu ore minerals,
6. Megascopic description with diagnostic physical properties, identification, classification of the Pb ore minerals,
7. Megascopic description with diagnostic physical properties, identification, classification of the Zn ore minerals,
8. Megascopic description with diagnostic physical properties, identification, classification of the micas and asbestos,
9. Megascopic description with diagnostic physical properties, identification, classification of casseterite, pitchblende, molybdenite, orpiment, realgar and cinnabar,
10. Megascopic description with diagnostic physical properties, identification, classification of gemstones, apatite, gypsum, fluorite, graphite, limestone, dolomite and aluminosilicates.

Books Recommended, Ore Genesis and Mineral Deposits

1. An introduction to the ore geology. By Anthony M Evans 1987 ELBS Books, Willey Scientific Publication, New York,
2. Economic Mineral Deposits. By Bateman Alan M. and Jenson 1981, John Willey & sons,
3. Ore Deposits. By Park C.G. McDiarmid 1972,
4. The geology of ore deposits. By John M. Golbert & Charles Park: W.H. Freeman & Co New York,
5. Geology of Mineral Deposits. By Smirnov, V.I 1972 ,
6. Ore Petrology. By L. Stanton. 1972,
7. Atlas of ore minerals. By Picot:
8. Ore minerals and their intergrowths. By Ramdhor, P. Permagaon Press,
9. Plate tectonics and crustal evolution. By R.C. Kondie 1983,
10. Ore Petrography and Mineralogy. By Craig.J.M. & Vaughjan, D.J. 1981 John Wiley,
11. Metal deposits in relation to plate tectonics By Sawkins, F.J. 1984 Springer Verlag,
12. Economic Geology and Geotectonics. By Toriling, D.H. 1981. Blackwell Sci. Publ.,
13. Geochemistry of Hydrothermal ore deposits By Barnes, H.L. 1979, John Wiley,
14. Time and strata Bound Ore Deposits. By Klemm, D.D. and Schneider, H.J. 1977 , Springer Verlag,
15. Ore genesis – a Holistic approach. By Mookherjee, A. 2000 Allied publisher,
16. Ore deposits and related to structural features. By W.H. New House.