

Cotton College State University
Department of Geology
Undergraduate syllabus

FIRST SEMESTER

<u>PAPER: GLY 101C</u> General Geology Geomorphology Geomorphology Practical	L+T+P=3+0+1=4 credits
<u>PAPER: GLY 102C</u> Crystallography Crystallography Practical	L+T+P=3+0+1=4 credits
<u>PAPER: GLY 103C</u> Descriptive Mineralogy Mineral Hand Specimen Practical	L+T+P=3+0+1=4 credits
<u>PAPER: GLY 104E</u> General Geology and Structural Geology Structural Geology Practical	L+T+P=2+0+1=3 credits

SECOND SEMESTER

<u>PAPER: GLY 201C</u> Optical Mineralogy Optical Mineralogy Practical	L+T+P=3+0+1=4 credits
<u>PAPER: GLY 202C</u> Structural Geology and Geotectonics Structural Maps and Problems	L+T+P=3+0+1=4 credits
<u>PAPER: GLY 203C</u> Crystal Chemistry and Geochemistry	L+T+P=3+1+0=4 credits
<u>PAPER: GLY 204E</u> Crystallography, Mineralogy and Optical Mineralogy Crystallography, Mineralogy and Optical Mineralogy Practical	L+T+P=2+0+1=3 credits

THIRD SEMESTER

PAPER: GLY 301C **L+T+P=3+0+1=4 credits**
Igneous Petrology
Igneous Petrology Practical

PAPER: GLY 302C **L+T+P=3+0+1=4 credits**
Metamorphic Petrology
Metamorphic Petrology Practical

PAPER: GLY 303C **L+T+P=3+0+1=4credits**
Sedimentary Petrology
Sedimentary Petrology Practical

PAPER: GLY 304E **L+T+P=2+0+1=3 credits**
Igneous and Metamorphic Petrology
Igneous and Metamorphic Petrology Practical

FOURTH SEMESTER

PAPER: GLY 401C **L+T+P=3+0+1=4 credit**
Remote Sensing
Remote Sensing Practical

PAPER: GLY 402C **L+T+P=3+1+0=4 credits**
Principles of Stratigraphy

PAPER: GLY 403C **L+T+P=2+0+2=4 credits**
Geological Fieldwork
Seminar

PAPER: GLY 404E **L+T+P=2+0+1=3 credits**
Sedimentary Petrology and Principles of Stratigraphy
Sedimentary Petrology Practical

FIFTH SEMESTER

PAPER: GLY 501C **L+T+P=3+1+0=4 credits**
Indian Stratigraphy and Hydrogeology

PAPER: GLY 502C **L+T+P=3+0+1=4 credits**
Palaeontology
Palaeontology Practical

PAPER: GLY 503C **L+T+P=3+0+1=4 credits**
Soil Geology
Environmental Geology
Engineering Geology
Engineering Geology Practical

PAPER: GLY 504E **L+T+P=2+0+1=3 credits**
Indian Stratigraphy and Palaeontology
Palaeontology Practical

SIXTH SEMESTER

PAPER: GLY 601C **L+T+P=3+1+0=4 credits**
Ore Genesis and Prospecting and Mining

PAPER: GLY 602C **L+T+P=3+0+1=4 credits**
Indian Mineral Deposits
Mineral Economics
Fuel Geology
Economic Geology Practical

PAPER: GLY 603C **L+T+P=0+0+4=4 credits**
Geological Fieldwork

PAPER: GLY 604E **L+(T+P)=1+(1+1)=3 credits**
Economic Geology and Indian Mineral Deposits
Economic Geology Practical
Field Work

FIRST SEMESTER

PAPER: GLY 101C **L+T+P=3+0+1=4 credits**
General Geology
Geomorphology
Geomorphology Practical

PAPER: GLY 102C **L+T+P=3+0+1=4 credits**
Crystallography
Crystallography Practical

PAPER: GLY 103C **L+T+P=3+0+1=4 credits**
Descriptive Mineralogy
Mineral Hand Specimen Practical

PAPER: GLY 104E **L+T+P=2+0+1=3 credits**
General Geology and Structural Geology
Structural Geology Practical

PAPER: GLY 101C
Number of Lectures: 48

L+T+P=3+0+1=4 credits

THEORY

General Geology:

Scope of Geology and its relation to the different branches of sciences; Different branches of Geology. The Universe and the Solar System; Earth as a planet; Origin and age of the earth; Physical parameters (size, shape, mass, density, rotation & revolution) of the earth; Major surface features of the earth – continents and ocean basins and their evolution.

Earth's interior; Use of seismic waves in the study of earth's internal structures. Major internal processes of the earth; Volcanism and volcanoes; Types and distribution of volcanoes; Causes of earthquake; Earthquake belts; Prediction of earthquake; Earthquake zones of India and World.

Geomorphology:

Definition and time connotation of geomorphology. Role of climate and tectonics on landscape development; Rock weathering, mass wasting and hill slope evolution; Geomorphic process of rivers, wind, glaciers, sea and their associated landforms.

PRACTICAL

Study of contours: Pattern of contours to indicate various topographical features; Interpretation of topographic maps; Drawing of profile and study of geomorphological features from topographic maps.

Model study of different geomorphic features.

Recommended Books:

1. *Geomorphology – A.L. Bloom; Prentice Hall of India Pvt. Ltd.*
2. *A Textbook of Geomorphology – P. Dayal; Shukla Book Depot, Patna.*
3. *Geomorphology – S. Singh; Prayag Pustak Bhawan, Allahabad*
4. *Physical Geology – R. F. Flint and J. Skinner, John Wiley and Sons, Inc*
5. *Principles of Geomorphology – W. D. Thornbury; John Wiley and Sons, Inc*
6. *Engineering and General Geology – P. Singh (6th edition); S. K. Kataria and Sons*

PAPER: GLY 102C
Number of Lectures=48

L+T+P=3+0+1=4 credits

THEORY

Crystallography:

Evolution of Mineralogy and Crystallography, Definition of mineral and its relation to crystal; Definition of crystalline and amorphous substance; Crystallization and crystal growth.

Crystal morphology; Interfacial angle and its measurement; Symmetry operations and elements; Types of external symmetry shown by the crystals; Point Groups; Symmetry notations of Hermann-Mauguin with relation to different crystal systems and conversion to total symmetry.

Crystallographic axis; Axial ratio; Parameters and indices; Crystal forms and habit; Zone, Zone axis and Zonal equation.

Unit cell; Definition and types of lattices; Significance of the lattice; Bravais (Space) lattices; Skew axis and Glide planes; Space Groups.

Study of 32 Point Groups (Crystal classes) including forms, symmetry elements, stereogram and example of minerals.

Crystal intergrowth; Definition of twinning, Twin elements, Composition surface, Types of Twinning, Twin laws, Various twin laws of different crystal systems, Twinning in feldspar group of minerals.

Crystallographic projections of Isometric, Tetragonal, Orthorhombic and Monoclinic systems; Determination of axial ratio.

PRACTICAL

Study of the forms and symmetry elements of crystals belonging to the holohedral (Normal) classes of Isometric, Tetragonal, Hexagonal, Orthorhombic, Monoclinic & Triclinic systems and Hextetrahedral, Diploidal, Gyroidal, Tetragonal-scalenohedral, Hexagonal-Trapezohedral, Hexagonal-scalenohedral & Trigonal-trapezohedral classes with the help of either natural crystals or wooden and glass models; Drawing of crystals in clinographic projections.

Study of twinning with the help of crystal models with reference to composition plane, twin plane and twin axis.

Stereographic projection and determination of axial ratios of crystal models of the holohedral classes of Isometric, Tetragonal, Orthorhombic and Monoclinic systems.

Recommended Books:

1. Manual of Mineralogy (After J.D.Dana) – C.Klein and C.S.Hurlbut, Jr.; *John Wiley and Sons, Inc.*
2. Mineralogy – L.G.Berry and B.Mason (Revised by R.V.Dietrich); *CBS Publishers and Distributors.*
3. A Textbook of Mineralogy – E.S.Dana (Revised by W.E.Ford); *New Age International Publishers.*
4. Fundamentals of Optical, Spectroscopic and X-ray Mineralogy – S.Mitra; *New Age International Publishers.*
5. Laboratory Experiments in X-ray Crystallography – L.V. Azaroff and R.J. Donahue; *McGraw Hill Book Company, Inc.*

PAPER: GLY 103C
Number of Lectures=48

L+T+P=3+0+1=4 credits

THEORY

Descriptive Mineralogy:

Scope of Mineralogy; Definition of mineral; Physical properties of mineral, Relationship of physical properties with atomic structure; Mineral classification; Classification and structure of silicate minerals.

Study of physical & optical properties, atomic structure and chemistry of the following groups of mineral – Olivine, Garnet, Epidote, Pyroxene, Amphibole, Mica, Clay minerals, Silica, Feldspar and Feldspathoid.

Study of the following individual minerals – Sillimanite, Kyanite, Andalusite, Staurolite, Apatite, Chlorite, Zircon, Beryl, Calcite, Tourmaline, Magnetite, Ilmanite, Haematite, Sphene and Rutile.

PRACTICAL

Study of the distinguishing characters and physical properties of the important silicate minerals and carbonate minerals (Calcite & Dolomite) in hand specimen.

Recommended Books:

1. Mineral Science – Cornelis Klein
2. Mineralogy – Dexter Perkins
3. Manual of Mineralogy – C.Klein and C.S. Hurlbut

PAPER: GLY 104E

L+T+P=2+0+1=3 credits

THEORY

General Geology:

Introduction to geology, its subdivisions and relation to other branches of science.
Earth as a planet, Origin and age of the earth.

The three rock types – igneous, sedimentary and metamorphic rocks and their distinguishing characters.

Volcanism and volcanoes; types and world distribution of volcanoes.

Earthquakes: causes of earthquakes, earthquake belts, earthquake zones of India, prediction of earthquakes. Use of seismic waves in the study of earth's internal constitution.

Geological actions of river, wind, glacier and their associated landforms.

Major surface features of the earth: continents and ocean basins.

Introduction to rock weathering.

Structural Geology:

Definition & scope of Structural Geology; Primary and secondary structures.

Concept of non-diastrophic and diastrophic structures; Non-diastrophic structures: stratification, current or cross bedding, graded bedding, ripple marks, unconformities, mud cracks & rain prints, flow layers, primary joints, vesicular & amygdaloidal structures and pillow structure.

Concept of Stress and Strain, Mohr's stress circle; Elasticity, plasticity & brittleness; Diastrophic structures: Planar & linear structures; Strike direction, dip angle, dip direction.

Diastrophic Structure: Basic concepts of Lineation, Foliation, Fold, Fault and Joints: their origin.

PRACTICAL

Study of contour line, pattern of contour line to indicate various topographical features and structure of contours on toposheets.

Maps: Interpretation of topographic maps. Drawing of profile and study of geomorphological features from contoured maps.

Determination of dip and strike from bore hole data. Solution of three point problems.

Completion of outcrops of beds from surface and borehole data.

Interpretation of structures from geological maps with simple structures. Drawing of cross-section.

Recommended Books:

1. An outline of Structural Geology – B.E.Hobbs, W.D.Means and P.F.Williams; *John Wiley and Sons, Inc.*
2. Structural Geology – S.K.Ghosh; *Pergamon Press.*
3. Physical Geology – R.F.Flinton and B.J Skinner, John Wiley and Sons, Inc

SECOND SEMESTER

PAPER: GLY 201C **L+T+P=3+0+1=4 credits**
Optical Mineralogy
Optical Mineralogy Practical

PAPER: GLY 202C **L+T+P=3+0+1=4 credits**
Structural Geology and Geotectonics
Structural Maps and Problems

PAPER: GLY 203C **L+T+P=3+1+0=4 credits**
Crystal Chemistry and Geochemistry

PAPER: GLY 204E **L+T+P=2+0+1=3 credits**
Crystallography, Mineralogy and Optical Mineralogy
Crystallography, Mineralogy and Optical Mineralogy Practical

PAPER: GLY 201C **L+T+P=3+0+1=4 credits**
Number of Lectures=48

THEORY

Optical Mineralogy:

Scope & utility of optical mineralogy; Reflection and refraction of rays; Refractive index; Dispersion of light; Polarization of light (*plane or linear polarization, circular polarization & elliptical*)

polarization); Polarizer; Linear or plane polarization by doubly refracting crystals (*Nicol prism*), by differential absorption (*Polaroid*) and by reflection (*Brewster's Law*); Isotropic and anisotropic media.

Isotropic and Anisotropic (Uniaxial positive & negative and Biaxial positive & negative) minerals; Optic axis; Optical Indicatrix : Isotropic, Uniaxial & Biaxial indicatrices, their configuration and different sections within these indicatrices.

Opaque and non-opaque minerals; Petrological (refraction or transmitted-light) and Ore (reflection-light) microscope and their configuration; Orthoscopic and conoscopic arrangement of Petrological microscope; Accessory plates (*Mica Plate, Gypsum Plate & Quartz Wedge*) & their uses.

Properties of minerals in thin section : Colour; Pleochroism; Determination of pleochroic scheme; Relief; Shape or Form; Cleavage; Fracture; Double refraction; Birefringence; Determination of refractive index of minerals [*Liquid immersion method, Central illumination method (Becke Test) & Oblique illumination method*]; Extinction positions; Extinction angle (*straight or parallel, oblique & symmetrical extinction*); Interference colour & its determination; Determination of vibration direction.

Interference figure; Determination of optic sign; Measurement of optic axial angle.

Distinguishing Optical Characters of Some Important Non-opaque minerals: Garnet group (*Garnet*); Olivine group (*Olivine*); Aluminosilicate group (*Sillimanite, Kyanite, Andalusite*); *Serpentine*; *Staurolite*; Pyroxene group (*Enstatite, Hypersthene, Augite, Diopside*); Amphibole group (*Actinolite, Hornblende*); Mica group (*Biotite, Muscovite*); Feldspar group [*Orthoclase, Microcline, Plagioclase (Albite to Anorthite)*]; Feldspathoid group (*Nephelene, Leucite*) and Silica group (*Quartz*); Carbonate minerals (*Calcite, Dolomite*).

PRACTICAL

Study & Identification of the following minerals in thin section under Petrological Microscope :

Minerals with high to moderate relief: Garnet group (***Garnet***); Olivine group (***Olivine***); Aluminosilicate group (***Sillimanite, Kyanite, Andalusite***); ***Serpentine***; ***Staurolite***; Pyroxene group (***Enstatite, Hypersthene, Augite, Diopside***); Amphibole group (***Actinolite, Hornblende***); Mica group (***Biotite, Muscovite***).

Minerals with low relief: Feldspar group (***Orthoclase, Microcline, Plagioclase***); Feldspathoid group (***Nephelene, Leucite***) and Silica group (***Quartz***).

Minerals with variable relief : Carbonate minerals (***Calcite, Dolomite***).

Comparison of the refractive index of mineral in thin section with the help of central illumination method (Becke Test) [*isotropic & uniaxial minerals*].

Determination of vibration direction, pleochroic scheme and optical orientation of minerals under Petrological Microscope with the help of accessory plates.

Determination of the composition of plagioclase by Michael-Levy method.

Study under Petrological Microscope of uniaxial and biaxial interference figures and their recognition. Determination of optic sign from centered & offcentered uniaxial interference figures and centered acute bisectrix & centered optic axis biaxial interference figures by the use of accessory plates.

Recommended Books:

1. Optical Mineralogy : Principles and Practice – Colin D. Gribble and Allan J. Hall, George Allen and Unwin, 1985.
2. Optical Mineralogy – P.F.Kerr; McGraw-Hill Book Company, INC.

3. Fundamentals of Optical, Spectroscopic and X-ray Mineralogy – S.Mitra; *New Age International Publishers*.
4. Optical Mineralogy : The Nonopaque Minerals – W.R.Phillips and D.T.Griffen; *CBS Publishers and Distributors*.
5. Optical Crystallography – E.E.Wahlstrom; *John Wiley and Sons, Inc.*
6. An Introduction to the Rock-Forming Minerals – W.A.Deer, R.A.Howie and J.Zussman; *ELBS Publishers with Longman*.

PAPER: GLY 202C

L+T+P=3+0+1=4 credits

Number of Lectures=48

THEORY

Structural Geology:

Definition & scope of Structural Geology; Primary, secondary & penecontemporaneous structures; Concept of non-diastrophic and diastrophic structures; Non-diastrophic structures in sedimentary rocks : stratification, current or cross bedding, graded bedding, ripple marks, unconformities, offlap, overlap, mud cracks & rain prints; Determination of top and bottom or direction of younging of layered rocks; Non-diastrophic structures in igneous rocks : flow banding, flow layers, flow lines, schlieren, primary joints, vesicular & amygdaloidal structures, pillow structure, sheet structure, platy structure & perlitic structure.

Physics of deformation: Stress : Force, Traction & Stress; Normal stress & Shear stress; Stress at a point and Stress ellipsoid; Hydrostatic or Confining stress & Deviatoric or Directed stress; Stress acting on a plane; Mohr's stress circle.

Strain : Translation, rotation & deformation; Strain & Strain ellipsoid; Measurement of strain; Homogeneous & Inhomogeneous or Heterogeneous deformation or strain; Special types of homogeneous strain - axially symmetric extension, axially symmetric shortening and plane strain (pure shear & simple shear); Relationship between stress & strain.

Behaviour of rocks under stress : Elasticity, plasticity & brittleness; Stages of deformation; Factors of deformation – confining pressure or depth, temperature & time.

Diastrophic structures: Planar & linear structures; Strike direction, dip angle, dip direction, plunge, bearing and use of the clinometer & Brunton compass.

Foliation : Compositional foliation, Disjunctive foliation, Crenulation foliation, Continuous foliation, Axial planar foliation, Transected foliation. Relationship of foliation to other structures.

Lineation : Classification of structural lineations; Discrete lineation, Constructed lineation, Fold-hinge lineation, Boudins, Structured lineations, slickensides, Mullions, Irregular mullions; Mineral lineation, Quartz rods.

Fold: Definition; Structural elements of single layer folded & multi layer folded surface; nomenclature of fold based on sense of curvature, on direction of younging relative to sense of fold closure, on the symmetry of folds, on interlimb angle (after *Fleuty, 1964*), on the dip of the axial plane versus plunge of the fold axis (after *Fleuty, 1964*), on the nature of the hinge line, on the shape of the hinge, on the number of hinges, on the geometrical relations among neighbouring structures; Geometrical classification of fold based on orthogonal thickness (t_w), axial trace thickness (T_w) and dip isogons (after *Ramsay, 1967*); Preliminary idea on the fold superposition & fold interference structure; Causes & mechanics of folding.

Fractures & Joints: Types of fractures : *Extension, Shear & Extensional shear*; Classification of joints; Relationship of fractures to other structures.

Faults: Different structural elements of faults; Classification & Types of faults : *high-angle fault, low-angle fault, dip-slip fault, strike-slip fault, oblique-slip fault, normal & reverse (thrust) fault, dip fault, strike fault, diagonal fault, bedding fault, radial fault, parallel fault, en-echelon fault, peripheral fault*; **Normal fault** – *definition, detachment fault, imbricate fault, synthetic fault, antithetic fault, horst & graben structure*; **Reverse (Thrust) fault** – *definition, overthrust, underthrust, nappe (thrust nappe & fold nappe), klippe, window or fenster, ramp-flat geometry, Imbricate structure or schuppen structure, duplex structure*; **Strike-slip fault** – *definition, transcurrent fault, wrench or tear or lateral fault, strike slip duplex, normal or negative flower structure or tulip structure & reverse or positive flower structure or palm-tree structure*.

Causes & mechanics of faulting, Anderson's genetic classification of faults.

Geotectonics:

Classical concept of Geosynclines. Concept of Isostasy, Continental drift hypothesis, Geomagnetism, Palaeomagnetism & Polar wandering curve.

Plate Tectonics – Nature & types of plate boundaries – convergent (subduction & collision), divergent and conservative (Transform fault); Triple point junctions. Hot spots & Mantle plumes. Brief outline of the structural features & tectonics of North East India.

PRACTICAL

Exercise on Geological Contoured Maps:

Determination of dip and strike from bore hole data. Solution of three point problems.

Completion of outcrops of beds from surface and borehole data.

Interpretation of structures from geological maps with simple structures. Drawing of cross-section.

Structural Problems:

Use of Stereographic net (Wulf's net or Schmidt's net) in:

- (i) Plotting of planes
- (ii) Plotting of poles to the planes
- (iii) Plotting of lines (plotting of plunge, bearing and pitch)
- (iv) Determination of plunge & bearing of the line of intersection between two planes
- (v) Determination of angle between two planes
- (vi) Determination of apparent dip/dips in different directions in a plane
- (vii) Determination of strike & true dip of a plane from apparent dip/dips

Determination of the thickness of inclined beds by geometric construction to the scale.

Recommended Books:

1. An outline of Structural Geology – B.E.Hobbs, W.D.Means and P.F.Williams; *John Wiley and Sons, Inc.*
2. Structural Geology – S.K.Ghosh; *Pergamon Press.*
3. Structural Geology – R.J.Twiss and E.M.Moores; *W.H.Freeman and Company.*
4. Structural Geology of Rocks and Regions – G.H.Davis (2nd Edition); *John Wiley and Sons, Inc.*
5. Structural Geology – Haakon Fossen, Cambridge University Press, 2010.
6. Aspects of Tectonics – K.S.Valdiya; *Tata McGraw-Hill Publishing Company Ltd.*
7. Plate Tectonics and Crustal Evolution – K.C.Condie; *Pergamon Press.*
8. Global Tectonics – P.Keary and F.J.Vine; *Blackwell Scientific Publications.*
9. The Evolving Continents – B.F.Windley; *John Wiley and Sons, Inc*

PAPER: GLY 203C
Number of Lectures=48

L+T+P=3+1+0=4 credits

THEORY

Geochemistry:

Cosmic abundance of elements; Composition of meteorites & lunar rocks; Geochemical classification of elements; Composition of crust, mantle and core of the earth.

Concept of partition coefficient, camouflage, capture and admittance. Sedimentation as a geochemical process. Preliminary idea on major and trace (including rare earth) elements.

Crystal Chemistry:

Chemical bonds, elementary concepts of isomorphism, atomic substitution, polymorphism, solid solution, defect lattice, geological thermometry, packing and density, co-ordination number.

Recommended Books:

1. Study of Halite (NaCl), Fluorite and Diamond structures. Manual of Mineralogy (After J.D.Dana) – C.Klein and C.S.Hurlbut, Jr.; *John Wiley and Sons, Inc.*
2. Principles of Geochemistry – B.Mason and C.B.Moore; *New Age International Publishers.*
3. Introduction to Geochemistry – K.B.Krauskopf; *McGraw-Hill Book Company.*
4. Geochemistry of Solid – W.F.Fyfe; *McGraw-Hill Book Company.*
5. Inorganic Geochemistry – Paul Henderson, Oxford (Pergamon Press), 1982.

PAPER: GLY 204E
Number of Lectures=32

L+T+P=2+0+1=3 credits

THEORY

Crystallography:

Crystalline and amorphous substance, Morphological features of crystal, Interfacial angle and its measurement, External symmetry of crystal, Hermann Mauguin Notation, Crystallographic axis, Axial ratio, Parameter and Indices, Crystal forms and habit, Unit cell, Bravais lattice, Definition of twinning, twin elements, compositional surface and type of twinning.

Study of the normal classes of Isometric, Tetragonal, Hexagonal, Orthorhombic, Monoclinic and Triclinic system.

Mineralogy:

Scope of Mineralogy; Definition of mineral; Physical properties of mineral; Relationship of physical properties with atomic structure; Mineral classification.

Study of physical & optical properties, atomic structure and chemistry of the following groups of minerals – Olivine, Pyroxene, Amphibole, Mica, Silica and Feldspar.

Study of the following individual minerals – Sillimanite, Kyanite, Andalusite, Zircon, Beryl, Calcite, Tourmaline, Magnetite, Hematite and Rutile.

Optical Mineralogy:

Scope & utility of optical mineralogy; Nature of light; Reflection and refraction of rays; Refractive index: its determination; Polarization of light; Wave front and wave surface; Double refraction by *Nicol prism*, pleochroism.

Cleavage, Extinction, Interference colour, Accessory plates (*Mica Plate, Gypsum Plate & Quartz Wedge*) & their uses.

PRACTICAL

Study of the models of the crystal forms of the normal classes of Isometric, Tetragonal, Hexagonal, Orthorhombic and Monoclinic system. Study of the twin models.

Study of the distinguishing physical properties of important minerals in hand specimen.

Study & Identification of the following minerals in thin section under Petrological Microscope:

Minerals with high to moderate relief : Garnet group (*Garnet*); Olivine group (*Olivine*); Aluminosilicate group (*Sillimanite, Kyanite, Andalusite*); *Serpentine; Staurolite*; Pyroxene group (*Enstatite, Hypersthene, Augite, Diopside*); Amphibole group (*Actinolite, Hornblende*); Mica group (*Biotite, Muscovite*).

Minerals with low relief : Feldspar group (*Orthoclase, Microcline, Plagioclase*); Feldspathoid group (*Nephelene, Leucite*) and Silica group (*Quartz*).

Minerals with variable relief : Carbonate minerals (*Calcite, Dolomite*).

Recommended Books:

Manual of Mineralogy (After J.D.Dana) – C.Klein and C.S.Hurlbut, Jr.; *John Wiley and Sons, Inc.*

THIRD SEMESTER

PAPER: GLY 301C

Igneous Petrology

Igneous Petrology Practical

L+T+P=3+0+1=4 credits

PAPER: GLY 302C

Metamorphic Petrology

Metamorphic Petrology Practical

L+T+P=3+0+1=4 credits

PAPER: GLY 303C

Sedimentary Petrology

L+T+P=3+0+1=4credits

Sedimentary Petrology Practical

PAPER: GLY 304E

L+T+P=2+0+1=3 credits

Igneous and Metamorphic Petrology

Igneous and Metamorphic Petrology Practical

PAPER: GLY 301C

L+T+P=3+0+1=4 credits

Number of Lectures=48

THEORY

Igneous Petrology:

Definition; Mode of occurrence; Textures & structures; Classification of igneous rocks on textural, mineralogical (*IUGS classification*), chemical & quasi-chemical (*C.I.P.W. classification*) criteria.

Magma : Composition, origin & types; Nature of primary magma; Crystallization of magma; Reaction principle; Magmatic differentiation; Assimilation; Role of volatiles constituents in magmatic differentiation.

Thermodynamics of magmatic crystallization – Concepts of system, phase and component; Mineralogical Phase rule; Phase equilibria in igneous rocks : one, two & three component systems; Experimental observation of the following two component (binary) & three component (ternary) systems and their petrographical significance – (i) Diopside ($\text{CaMgSi}_2\text{O}_6$) – Anorthite ($\text{CaAl}_2\text{Si}_2\text{O}_8$) system [*Congruent melting*], (ii) Forsterite (Mg_2SiO_4) – Silica (SiO_2) system [*Incongruent melting*], (iii) Albite ($\text{NaAlSi}_3\text{O}_8$) – Anorthite ($\text{CaAl}_2\text{Si}_2\text{O}_8$) system [*Solid solution*] & (iv) Potash feldspar (KAlSi_3O_8)– Albite ($\text{NaAlSi}_3\text{O}_8$)– Silica (SiO_2) system.

Rock association (Consanguinity); Petrographic Province and Variation diagrams. Descriptive petrography & origin of the following rock families:

- Granite – Rhyolite family
- Syenite – Trachyte family
- Gabbro – Basalt family
- Ultrabasic & Ultramafic rocks

Brief petrographic discussion and origin of the following rock types : Lamprophyres; Anorthosite; Carbonatites;.

PRACTICAL

Identification of the following rocks in hand specimens:

Various types of *granite, granodiorite, syenite, aplite, gabbro, diorite, anorthosite, pegmatite, rhyolite, trachyte, andesite, dolerite, basalt, lamprophyres, serpentinite.*

Textures and structures of igneous rocks in hand specimens.

Micro-textures and structures of igneous rocks.

Study & identification of following rocks in thin sections under microscope :

Granite, Granodiorite, Monzonite, Aplite, Syenite, Nepheline syenite, Gabbro, Norite, Dolerite, Anorthosite, Rhyolite, Trachyte, Basalt, Peridotite, Pyroxenite, Picrite, Dunite, Lamprophyre.

Recognition of the following Indian stratigraphic rocks in hand specimens:
Charnockite, Basic Charnockite, Leptynite, Myllem Granite.

Recommended Books:

1. Petrology – E.G.Ehlers and H.Blatt; *CBS Publishers and Distributors.*
2. Igneous Rocks – A.K.Gupta; *Allied Publishers Ltd.*
3. Igneous Petrology – A.Hall; *ELBS/Longman.*
4. Petrology of Igneous and Metamorphic Rocks – D.W.Hyndman (2nd Edition); *McGraw-Hill Book Company.*
5. Igneous and Metamorphic Petrology – M.G.Best; *CBS Publishers and Distributors*
6. Principles of Igneous and Metamorphic Petrology – A.R.Philpotts; *Prentice-Hall of India Pvt. Ltd.*
7. Petrography – H.Williams; F.J.Turner and C.M.Gilbert; *CBS Publishers and Distributors.*
8. The Study of Rocks in Thin Section – W.W.Moorhouse; *CBS Publishers and Distributors.*

PAPER: GLY 302C

L+T+P=3+0+1=4 credits

Number of Lectures=48

THEORY

Metamorphic Petrology:

Metamorphism & Metasomatism (*Isochemical & Allochemical Metamorphism*); Factors or Agents or Variables of Metamorphism; Types of Metamorphism; Depth Zones of Metamorphism; Facies & Facies Series of Metamorphism; Grades & Isogrades of Metamorphism; Textures & Structures of Metamorphic rocks.

Concept of chemical equilibrium in metamorphism; Phase rule; Application of the phase rule to natural rocks; Metamorphic Phase diagrams (*Compositional Phase diagrams & P-T diagrams*); Metamorphic reactions & its types; Prograde or Progressive & Retrograde or Retrogressive Metamorphism; Influence of fluids on metamorphic phase equilibria; Determination of Pressure-Temperature conditions of metamorphism (geothermobarometry): a preliminary idea.

Characteristic mineral assemblages and mineral reactions of pelitic, basic and calcareous (Pure, Impure & Calc-silicate) rocks belonging to different facies of regional dynamo-thermal metamorphism, and impure calcareous sedimentary rocks belonging to different facies of contact metamorphism (*Indian examples should be cited wherever applicable*); Descriptive Petrography of Quartzite, Granulite, Eclogite and Hornfels; Migmatites – their types & origin; Anatexis (or Palingenesis) & formation of granite.

PRACTICAL

Identification of metamorphic rocks in hand specimen:

Slate, phyllite, various types of schists, gneiss, amphibolite, hornblende schist, granulite, Calc-silicate rocks, marble, quartzite, hornfels, augen gneiss, mylonite, migmatite, eclogite

Textures and structures of metamorphic rocks in hand specimen.

Micro-textures and structures of metamorphic rocks in thin sections.

Study & identification of following rocks in thin sections under microscope:

Chlorite schist, Biotite schist, Garnetiferous schist, Sillimanite schist, Amphibolite / Hornblenschist, Quartzite, Granulite.

Recognition of the following Indian stratigraphic rocks in hand specimens:

Gondite, Khondalite, Kodurite, Khasi Greenstone.

Recommended Books:

1. Metamorphic Petrology – B.W.D.Yardley; *ELBS/Longman*
2. Petrology of Igneous and Metamorphic Rocks – D.W.Hyndman (2nd Edition); *McGraw-Hill Book Company*
3. Igneous and Metamorphic Petrology – M.G.Best; *CBS Publishers and Distributors*
4. An introduction to igneous and metamorphic petrology - John, D Winter, Prentice Hall, 2001.

PAPER: GLY 303C

L+T+P=3+0+1=4 credits

Number of Lectures=48

THEORY

Sedimentary Petrology:

Introduction; Scope; Abundance of common sediments; Processes of formation of sedimentary rocks – weathering, transportation, deposition, diagenesis, compaction, cementation and recrystallisation; Mineralogical composition of sedimentary rocks; Provenance; Sedimentary cycle; Physico-chemical factors of sedimentation.

Textures of sedimentary rocks – concepts of size, grade scale, sphericity & roundness; Statistical analyses of grain size and their implications.

Description of Sedimentary structures – *lamination, ripple marks, current bedding, sand lineation, stylolites, geode, nodules & concretions.*

Classification of sedimentary rocks; Classification of sandstone.

Petrographic description of the following rocks: Sandstone (*orthoquartzite, arkose, graywacke*), , shale, , limestone, dolomite, conglomerate & breccia.

Concepts on sedimentary environments and sedimentary facies.

Concept and Classification of Sedimentary Basins.

PRACTICAL

Mechanical analysis of loose sediments using at least four standard sieves. Representing the data by frequency curves and preparation of cumulative curves, Determination of mean & median diameter.

Study of sphericity & roundness of sediment grains by visual method using Power's scale.

Identification and study of the following rocks in hand specimens:

Conglomerate, Breccia, Sandstone (Orthoquartzite, Arkose, Graywacke), Grit, Shale, Oilshale, Limestone, Fossiliferous limestone, Ferruginous rocks.

Study and identification of following sedimentary structures:

Lamination, Ripple marks, Current bedding, Sand lineation, Stylolites, Geode, Nodules & Concretions.

Identification & study of heavy minerals and quartz types in thin sections.

Study of limestone in thin section and identification of the rock on the basis of allochems and orthochems.

Recommended Books:

1. Petrology of Sedimentary Rocks by Sam Boggs, Jr., Cambridge University Press, 2009, 600pp.
2. Sedimentary Petrology – F.J.Pettijohn; *CBS Publishers and Distributors.*
3. Introduction to Sedimentology – S.M.Sengupta; *Oxford and IBH Publishing Company Pvt. Ltd.*
4. A Practical Approach to Sedimentology – R.C.Lindholm; *CBS Publishers and Distributors.*
5. Petrography – H.Williams; F.J.Turner and C.M.Gilbert; *CBS Publishers and Distributors.*
6. Sedimentary Petrology – H. Blatt; W. H. Freeman & Co.
7. Depositional Sedimentary Environments – H. E. Reineck & I. B. Singh

PAPER: GLY 304E

L+T+P=2+0+1=3 credits

Number of Lectures=32

THEORY

Igneous Petrology:

Igneous rocks, Mode of occurrence of igneous rocks, Textures and structures, Classification of igneous rocks on textural, mineralogical (IUGS classification), Chemical and quasi-chemical (C.I.P.W) criteria.

Magma: composition, origin and types, Crystallisation of magma, Bowen's reaction series, Magmatic differentiation and assimilation.

Mineralogical Phase Rule, phase equilibria in igneous rocks: one, two and three component systems.

Congruent and incongruent melting, Diopside ($\text{CaMgSi}_2\text{O}_6$) - Anorthite($\text{CaAl}_2\text{Si}_2\text{O}_8$) System (Incongruent melting, Forsterite (Mg_2SiO_4) - Silica(SiO_2) system (Incongruent melting).

Variation Diagram.

Brief petrographic discussion of the following rock types - Granite, Dolerite, Syenite, Anorthosite, Pegmatite.

Metamorphic Petrology:

Metamorphic Geology, Definition of metamorphism and metasomatism, Factors or agents of metamorphism, Types of metamorphism. Prograde (Barrovian zones) and retrograde metamorphism.

Basic concepts of depth zones, grades and facies classification of metamorphic rocks. Textures and structures of metamorphic rocks.

Nomenclature of metamorphic rocks: Foliated and lineated rocks – slate, phyllite, schist, and gneiss.

Non-foliated and non-lineated rocks – Hornfels. Specific types – marble, quartzite, greenschist, amphibolites, serpentine, blueschist, eclogite, calc-silicate rock, skarn, granulite, migmatite.

PRACTICAL

Identification of the following metamorphic rock hand specimens:

Granite, Rhyolite, Gabbro, Basalt, Dolerite, Pegmatite.

Slate, phyllite, schists, gneiss, quartzite, marble, amphibolite, granulite, augen gneiss, migmatite.

Recommended Books:

1. Igneous and Metamorphic Petrology – M.G.Best; *CBS Publishers and Distributors*
2. An introduction to igneous and metamorphic petrology - John, D Winter, Prentice Hall, 2001.
3. Sedimentary Rocks by F.J.Pettijohn; *CBS Publishers and Distributors*.

FOURTH SEMESTER

PAPER: GLY 401C

Remote Sensing

Remote Sensing Practical

L+T+P=3+0+1=4 credit

PAPER: GLY 402C

Principles of Stratigraphy

L+T+P=3+1+0=4 credits

PAPER: GLY 403C

Geological Fieldwork

Seminar

L+T+P=2+0+2=4 credits

PAPER: GLY 404E

Sedimentary Petrology and Principles of Stratigraphy

Sedimentary Petrology Practical

L+T+P=2+0+1=3 credits

Paper: GLY 401C

Number of Lectures=48

L+T+P=3+0+1=4 credits

THEORY

Remote Sensing and Introduction to GIS:

Principles of Remote Sensing - Introduction to Remote Sensing; Nature of Electro-magnetic Energy; Electro Magnetic Spectrum; Interaction of Electro-magnetic Radiation with atmosphere and earth

surface features; Atmospheric windows; Energy sources for Remote Sensing; Types of Sensor & Platform; Spectral Response Curves; Advantages & limitations of Remote Sensing.

Aerial Photography – Working Principal and Terminologies of Aerial Photography, Scale and Resolution of the Aerial Photograph, Types of Aerial Photography, Acquisition of Aerial Photograph, Principles of Stereoscopy, Merits and Demerits of Photographic System

Concept of Digital Image, Sensor Resolution, Multi-spectral Images, False Colour Composit

Orbital Parameters of Remote Sensing Satellites, Geostationary and near polar orbit; LANDSAT and IRS Programme.

Elements of Image Interpretation; Geotechnical Elements; Application of Remote Sensing in Geomorphological, Structural, Lineament and Lithological Mapping; and Environmental Studies.

Introduction to GIS – Elements of GIS, Geospatial database; Spatial data structure; Capabilities of GIS

PRACTICAL

Stereo vision test, Use of Pocket Stereoscope, Visual interpretation of satellite image and aerial photograph for interpretation of lineament, lithology and structure.

Recommended Books:

1. Principles and Applications of Photogeology – S.N.Pandey; *New Age International Publishers*.
2. Remote Sensing Geology – R.P. Gupta; *Springer-Verlag*.
3. Remote Sensing and Image Interpretation – T.M. Lillesand and R.W. Kiefer; *John Wiley and Sons, Inc.*
4. Interpretation of Airphotos and Remotely Sensed Images – R.H. Arnold; *Prentice-Hall, Inc.*
5. An Introduction to Geographical Information Systems – I. Heywood, S. Cornelius and S. Carver; *Longman Group*.

PAPER: GLY 402C

L+T+P=3+1+0=4 credits

Number of Lectures=48

THEORY

Principles of Stratigraphy:

A brief survey of classical geological reconnaissance; Warner and Neptunism; Hutton and Uniformitarianism; Smith and Paleontological Correlation; Lyell's Principles.

The Geological Time Scale and preliminary idea of crustal and biological evolution of earth through the geologic time; Earth during different geologic time periods. Geochronology; Absolute geological time; Methods of measurement of geological time – rate of sedimentation, salinity, radio-activity.

Stratigraphic classification & nomenclature – concepts of Time-Rock (Chronostratigraphic), Rock (Lithostratigraphic) & Biostratigraphic units.

Principles of stratigraphic correlation.

Preliminary concepts of sequence stratigraphy.

Paleoclimate, paleogeography, eustatic changes.

Recommended Books:

1. Stratigraphic Principles and Practices – J.M.Weller; *Universal BookStall, Delhi.*
2. Principles of Stratigraphy – C.O.Dunbar and J.Rodgers; *John Wiley and Sons, Inc.*
3. Stratigraphy and Sedimentation – W.C.Krumbein and L.L.Sloss; *W.H.Freema*

PAPER: GLY 403C

L+T+P=2+0+2=4 credits

Geological Field Work:

- (a) Duration of the Fieldwork is to be minimum of 3 days.
- (b) An area with good rock exposures in the vicinity of the Institution (Local) is to be selected for this field trip.
- (c) Students are to be trained how to take readings like strike direction, amount & direction of dip; plunge & bearing; front bearing & back bearing with the help of Clinometer and Brunton Compass.
- (d) A short & concise Field report is to be submitted before the Fourth Semester Examination.
- (e) **Field Work is compulsory** and students who do not attend the field work are to be declared 'Fail' in Paper – GLY 403C.

Seminar:

- (a) Each student must take part individually in seminar which includes the presentation and discussion on the seminar topic with minimum duration of 30 minutes.
- (b) The tentative list of topics for Seminar shall be notified at the beginning of the semester. The students are advised to discuss with the concerned teacher and get it approved by the HOD.
- (c) The students shall be required to submit the rough draft of the seminar outputs within two weeks of the notification. The concerned teacher shall make suggestions for modification in the rough draft.
- (d) The final draft shall be submitted by the student within a week thereafter.
- (e) **Seminar is compulsory** and students who do not attend the seminar are to be declared 'Fail' in Paper – GLY 403C even if they secure requisite pass marks in that paper.

PAPER: GLY 404E

L+T+P=2+0+1=3 credits

Number of Lectures=32

THEORY

Sedimentary Petrology:

Introduction; Abundance of common sediments; Processes of formation of sedimentary rocks; Mineralogical composition of sedimentary rocks.

Textures of sedimentary rocks.

Sedimentary structures: *lamination, ripple marks, current bedding, graded bedding, mud*

cracks, rain drop imprints.

Classification of sedimentary rocks; Petrographic description of sandstone and limestone.

Concept of sedimentary environment.

Principles of Stratigraphy:

A brief survey of classical geological reconnaissance; Warner and Neptunism; Hutton and Uniformitarianism; Smith and Paleontological Correlation; Lyell's Principles.

Standard Geological time scale; Stratigraphic classification & nomenclature – concepts of Time-Rock (Chronostratigraphic), Rock (Lithostratigraphic) & Biostratigraphic units.

Principles of stratigraphic correlation.

PRACTICAL

Identification and study of the following rocks in hand specimens:

Conglomerate, Breccia, Grit, Sandstone, Shale, Limestone.

Recommended Books:

1. Sedimentary Rocks – F.J.Pettijohn; *CBS Publishers and Distributors.*
2. Stratigraphic Principles and Practices – J.M.Weller; *Universal BookStall, Delhi.*
3. Principles of Stratigraphy – C.O.Dunbar and J.Rodgers; *John Wiley and Sons, Inc.*

FIFTH SEMESTER

<u>PAPER: GLY 501C</u> Indian Stratigraphy and Hydrogeology	L+T+P=3+1+0=4 credits
<u>PAPER: GLY 502C</u> Palaeontology Palaeontology Practical	L+T+P=3+0+1=4 credits
<u>PAPER: GLY 503C</u> Soil Geology Environmental Geology Engineering Geology Engineering Geology Practical	L+T+P=3+0+1=4 credits
<u>PAPER: GLY 504E</u> Indian Stratigraphy and Palaeontology Palaeontology Practical	L+T+P=2+0+1=3 credits

PAPER: GLY 501C
Number of Lectures=48

L+T+P=3+1+0=4 credits

THEORY

Indian Stratigraphy:

A brief outline of the geology of India – Precambrian to Recent. A brief study of the Precambrian stratigraphy of India of the following areas with respect to lithology, tectonics and igneous activity : (a) Dharwar Province (Karnataka); (b) Singhbhum-Orissa Province (Jharkhand & Orissa); (c) Assam-Meghalaya plateau (Shillong plateau); (d) Aravalli-Bundelkhand Province (Rajasthan); (e) Eastern Ghats Province; (f) Central Indian Province (Madhya Pradesh & Chattishgarh); (g) Cuddapah Super Group of Cuddapah basin; (h) Vindhyan Super Group of Sone Valley.

A brief study of the problems of correlation of the Precambrian rocks occurrences in India.

Introduction to Palaeozoic and Mesozoic Eras and study of the following areas with emphasis on the points mentioned (a to g) :

- (a) Palaeozoic of the Salt Range and Spiti – *Stratigraphic succession, lithology, palaeontology and age.*
- (b) Gondwana of Peninsular and Extra-peninsular India – *Classification, lithology, palaeontology, palaeogeography, igneous activity, structure and economic importance.*
- (c) Mesozoic of the Salt Range and Triassic of Spiti – *Palaeontology and lithology.*
- (d) Jurassic of Cutch – *Palaeontology and lithology.*
- (e) Cretaceous of South India and NE India – *Palaeogeography, palaeontology and lithology, and their relationship.*
- (f) Deccan Traps – *Distribution, lithology and age.*
- (g) Tertiary & Quaternary of NE India – *Lithology, palaeontology, structure and economic importance.*

Hydrogeology:

Ground water distribution; Ground water source; Occurrence & origin; Factors affecting ground water supply; Porosity; Permeability; Hydrological properties of water bearing materials; Types of openings in rocks; Primary & secondary openings.

Water table – Definition & location; Free & confined water; Aquifers; Water table in consolidated and unconsolidated rock formations; Selection of sites for sinking wells. Ground water provinces of India.

Recommended Books:

1. Geology of India and Burma – M.S.Krishnan; *CBS Publishers and Distributors.*
2. Fundamentals of Historical Geology and Stratigraphy of India – R.Kumar; *New Age International Publishers.*
3. Precambrian Geology of India – S.M.Naqvi and J.J.W.Rogers; *Oxford University Press.*
4. Indian Precambrian – B.S.Paliwal (Ed.); *Scientific Publications (India), Jodhpur.*
5. Groundwater Hydrology – D.K.Todd (2nd Edition); *John Wiley and Sons, Inc.*
6. Evolution and Development of Groundwater – G.Mahajan; *Ashish Publishing House.*

PAPER: GLY 502C
Number of Lectures=48

L+T+P=3+0+1=4 credits

THEORY

Palaeontology:

Principles of Palaeontology: Scope of palaeontology; Different branches of palaeontology; Definition & Types of fossils; Mode of preservation of fossils. Application of fossils in – chronostratigraphy, palaeogeography, palaeoecology, biostratigraphy, evolutionary and economic studies. Introduction to microfossils and palynofossils and their applications. Theory of organic evolution interpreted from fossil record.

Descriptive Palaeontology: Broad divisions of invertebrates into different phyla and their major characteristics. A study of the morphological characters, evolutionary trends and brief stratigraphic distribution of the following phyla/classes – Foraminifera, Brachiopoda, Mollusca, Arthropoda (Trilobita), Echinodermata (Echinoidea), Graptoloidea, Anthozoa.

A general idea of the plant fossils of India with special reference to Gondwana Flora and their palaeogeographic significance. Vertebrate fossils and their importance in palaeontology & stratigraphy; A short discussion on the evolutionary trend of **Equidae** and **Proboscidea**.

PRACTICAL

Identification of the following genera of fossils by their diagnostic morphological characters. Their stratigraphic ranges to be studied :

- (i) Nummulites, Alveolina, Discocyclina
- (ii) Orthis, Productus, Spirifer, Terebratula, Pentamerus, Rhynchonella, Syringothyris
- (iii) Arca, Cardita, Exogyra, Glycemeris, Pecten, Ostrea, Trigonia, Gryphea, Lima, Inoceramus.
- (iv) Bellerophon, Conus, Cypraea, Cererium, Fusus, Murex, Physa (Bulinus), Turritella, Voluta
- (v) Baculites, Belemnites, Ceratites, Hamites, Nautilus, Perisphinctes, Stephenoceras
- (vi) Calymene, Phacops
- (vii) Cidaris, Hemiaster, Micraster, Echinolampus, Clypeaster, Stygmatoptygus
- (viii) Monograptus, Diplograptus
- (ix) Calceola, Zaphrentis, Favosites, Isastrea
- (x) Glossopteris, Gangamopteris, Ptillophyllum, Vertebraria

Interpretation and determination of stratigraphic range from the fossil assemblages from **Cretaceous of Tiruchchirappalli** and **Jurassic of Kutch**.

Recommended Books:

1. Principles of Invertebrate Paleontology – R.R.Shrock and W.H.Townshofel; *CBS Publishers and Distributors*.
2. Invertebrate Fossils – R.Moore; C.G.Lalicker and A.G.Fishwr; *McGraw-Hill Book Company*.
3. Principles of Paleontology – Raup and Stanley; *CBS Publishers and Distributors*.
4. A Textbook of Palaeontology – A.K.Sen; *Modern Book Agency Pvt. Ltd*.
5. Vertebrate Palaeontology – A.S.Romer; *Oxford University Press*.
6. Vertebrate Palaeontology, 3rd Edition – Michale J. Benton, Blackwell Publishing, 2005.

7. Microfossils and their Applications – P.K.Kathal; *CBS Publishers and Distributors*.

PAPER: GLY 503C
Number of Lectures=48

L+T+P=3+0+1=4 credits

THEORY

Soil Geology:

Definition of soil; Processes of soil formation; Physical properties of soil; Soil profile and classification of soil; Soil types of India; Paleosol.

Environmental Geology:

Definition and scope of Environmental Geology; Natural environmental hazards; Impact of earthquake, landslide, flood and mining on environment.

Engineering Geology:

Role of geologists in engineering projects; Engineering geology with respect to suitability of dam sites, construction of tunnels, highways and bridges; A study of landslides, their causes and protection; engineering properties of soil.

PRACTICAL

Determination of Liquid limit, Plastic limit, Plasticity index, Coefficient of shear and angle of internal friction from supplied data.

Recommended Books:

1. Basic Concept of Soil Science – A.K.Kolay; *New Age International Publishers*.
2. Fundamentals of Soil Science – H.O. Foth; *John Wiley and Sons, Inc*.
3. Studies on Soils of India – S.V. Govinda Rajan and H.G. Gopala Rao; *Vikas Publishing House Pvt. Ltd*.
4. Environmental Geology (Indian Context) – K.S.Valdiya; *Tata McGraw-Hill Publishing Company Ltd*.
5. Environmental Geology – B.W.Murck, B.J.Skinner and S.C.Porter; *John Wiley and Sons, Inc*.
6. Environmental Geology, 9th Edition, by Carla W. Montgomery, McGraw Hill, 2011.
7. Engineering and General Geology – P. Singh; (6th Edition); *S.K.Kataria and Sons*.
8. A Geology for Engineers – F.G.H.Blyth and M.H.deFreitas; *ELBS/Longman*.
9. Text Book of Engineering Geology – N.C. Kesanulu; *Macmillan India Ltd*.
10. Geology for Engineers – D.S. Arora; *CBS Publishers and Distributors*.

PAPER: GLY 504E
Number of Lectures=32

L+T+P=2+0+1=3 credits

THEORY

Indian Stratigraphy:

A brief study of the Precambrian stratigraphy of India with emphasis on the following areas:

a) Assam-Meghalaya Plateau (Shillong Plateau), b) Dharwar Province, c) Central Indian Province, d) Singhbhum-Orissa Province and e) Aravalli-Bundelkhand Province, d) Cuddapah Supergroup of Cuddapah basin and Vindhyan Supergroup of Sone valley.

Introduction to Palaeozoic and Mesozoic Eras and study of the following areas:

a) Palaeozoic of Salt range and Spiti b) Gondwana of India ,c) Mesozoic of Salt range and Triassic of Spiti, d) Jurassic of Kutch,e) Cretaceous of South and North East India, f) Deccan Traps, g)Tertiary and Quaternary of North East India and h) Siwaliks

Palaeontology:

Definition and Types of fossils; Mode of preservation of fossils. Application of fossils (in brief) in biostratigraphy, palaeogeography, palaeoenvironment, evolutionary and economic studies.

Broad divisions of invertebrates into different phyla and their major characteristics.

A study of the morphological characters and brief geological distribution of the following phyla/classes- Foraminifera, Brachiopoda, Lamellibranchia, Gastropoda, Cephalopoda, Trilobita and Echinoidea.

A general idea of the plant fossils of India with special reference to Gondwana Flora and their palaeogeographic significance.

PRACTICAL

Identification of the following genera of fossils by their diagnostic morphological characters and their geological age.

- (i) Nummulites, Alveolina, Discocyclina
- (ii) Orthis, Productus, Spirifer, Terebratula, Rhynchonella
- (iii) Arca, Cardita, Glycemeris, Pecten, Ostrea, Trigonina, Gryphea
- (iv) Conus, Cypraea, Ceratium, Fusus, Natica, Physa Turritella, Voluta
- (v) Belemnites, Ceratites,, Acanthoceras, Nautilus, Perisphinctes, Stephenoceras
- (vi) Calymene, Phacops
- (vii) Cidaris, Hemiaster, Micraster, Echinolampus, Clypeaster, Stygmatoptygus
- (viii) Glossopteris, Gangamopteris, Ptillophyllum, Vertebraria

Interpretation and determination of stratigraphic range from the fossil assemblages from **Cretaceous of Tiruchchirapalli (Trichinopoly)** and **Jurassic of Cutch (Kutch)**.

Recommended Books:

- 1 .Principles of Invertebrate Paleontology – R.R.Shrock and W.H.Townshofel; *CBS Publishers and Distributors*.
2. Geology of India and Burma – M.S.Krishnan; *CBS Publishers and Distributors*.
3. Fundamentals of Historical Geology and Stratigraphy of India – R.Kumar; *New Age International Publishers*.

SIXTH SEMESTER

PAPER: GLY 601C **L+T+P=3+1+0=4 credits**
Ore Genesis and Prospecting and Mining

PAPER: GLY 602C **L+T+P=3+0+1=4 credits**
Indian Mineral Deposits
Mineral Economics
Fuel Geology
Economic Geology Practical

PAPER: GLY 603C **L+T+P=0+0+4=4 credits**
Geological Fieldwork

PAPER: GLY 604E **L+T+P=1+(1+1)=3 credits**
Economic Geology and Indian Mineral Deposits
Economic Geology Practical
Field Work

PAPER: GLY 601C **L+T+P=3+1+0=4 credits**
Number of Lectures=48

THEORY

Ore Genesis:

Scope of Economic Geology; Definition of ore, ore deposit, gangue, tenor, host rock; Concept of ore genesis; Processes of formation of economic mineral deposits with Indian examples; Classification of economic mineral deposits; Mode of occurrence of ore bodies; Concept of paragenesis and zoning of ores; Definition of metallogenetic belts, epochs and provinces with examples; Wall rock alteration; structural, physico-chemical and stratigraphic control of ore localization with examples.

Prospecting:

Methods of geological, geophysical, geochemical and geobotanical prospecting.

Mining Geology:

An introduction to mining; Mining terminology in open cast & underground mine; Mining methods with respect to following : open cast, breast stoping, cut & fill, sub-level caving, board & pillar and longwall method; Mine ventilation.

Methods of sampling and their applications.

Recommended Books:

1. Economic Mineral Deposits – M.L.Jensen and A.M.Bateman (3rd Edition); *John Wiley and Sons, Inc.*
2. Ore Deposits – C.F.Park,Jr. and R.A.MacDiarmid; *W.H.Freeman and Company.*
3. Studies of Mineral Deposits – V.I.Smirnov (Ed.); *Mir Publishers, Moscow.*
4. Elements of Prospecting for Non-fuel Mineral – P.K. Banerjee and S. Ghosh; *Allied Publishers Ltd.*
5. Prospecting of Minerals – Y.D. Kitaisky; *Foreign Language Publishing House, Moscow*
6. Geophysical Prospecting – M.B. Dobrin; *McGraw Hill Book Company, Inc.*
7. Courses in Mining Geology – R.N.P.Arogyaswamy; *Oxford and IBH Publishing Company Pvt. Ltd.*
8. Mining of Ores and Non-Metallic Minerals – M.Agoshkov; S.Borisev and V.Boyarsky; *Mir Publishers, Moscow.*
9. Introductory Mining Engineering - H.L.Hartman; *John Wiley and Sons, Inc.*

PAPER: GLY 602C

L+T+P=3+0+1=4 credits

Number of Lectures=48

THEORY

Indian Mineral Deposits:

A study of mineralogy, mode of occurrence, origin and uses of the following economic mineral deposits with reference to Indian occurrences:

Metallic mineral deposits : Aluminum, Copper, Chromite, Iron, Manganese, Lead & Zinc, Gold, Silver, Nickel and Radioactive minerals.

Non-metallic mineral deposits : Limestone, Mica, Clay, Sillimanite, Asbestos, Diamond.

Industrial Raw materials : Cement, Glass & Ceramics, Fertilizer, Refractory, Abrasive, Strategic minerals, Gemstones and Building materials.

Mineral Economics:

Concept of Mineral Economics, National Mineral Policy, Mineral conservation and utilization of minerals.

Fuel Geology:

Petroleum – Chemical composition; Concept of source rock, reservoir rock & cap rock; Petroleum traps; Origin of petroleum; Migration & accumulation; Occurrence of petroleum; Brief idea about the petroliferous basins of India; Oilfields of NE India.

Coal – Definition; Physical properties, rank, type, grade & class of coal; Chemical constituents of coal; Origin of coal – In situ and Drift theory; Coal deposits of India with special reference to NE India.

Non-Conventional Energy – Solar energy, wind energy and geothermal energy.

PRACTICAL

Identification and study of the diagnostic physical properties/characters of the following economic minerals in hand specimens:

Apatite, Arsenopyrite, Asbestos, Barite, Bauxite, Bornite, Calcite, Chalcopyrite, Chromite, Covellite, Corundum, Cuprite, Dolomite, Fluorite, Galena, Graphite, Gypsum, Haematite, Laterite, Limonite, Magnesite, Magnetite, Malachite, Molybdenite, Orpiment, Pyrite, Pyrolusite, Psilomelane, Pyrrhotite, Realgar, Rhodocrosite, Siderite, Sphalerite, Stibnite, Sulphur, Zincite,

Identification of groups of economic mineral assemblages for the following industries:

(i) Ceramic (ii) Cement (iii) Iron & Steel (iv) Fertilizer.

Identification of constructional materials for roads and buildings.

Ore reserve estimation on bedded deposits.

Study of coal in hand specimen and in thin section.

Recommended Books:

1. Mineral Resources of India – D.K.Banerjee; *World Press Pvt. Ltd.*
2. Ore Deposits of India – K.V.G.K.Gokhale and T.C.Rao; *Affiliated East-West Press Pvt. Ltd.*
3. Economic Geology (Economic Mineral Deposits) – U.Prasad; *CBS Publishers and Distributors.*
4. A Handbook of Economic Geology – A.K.Sen; *Modern Book Agency Pvt. Ltd.*
5. Minerals of India – D.N.Wadia (Ed.); *National Book Trust.*
6. Mineral Economics – R.K.Sinha and N.L.Sharma; *Oxford and IBH Publishing Company Pvt. Ltd.*
7. Petroleum Geology – R.E. Chapman, *Developments in Petroleum Science*, 16, Elsevier, 1983.
8. Elements of Petroleum Geology, Richard C. Selley, Academic Press.
9. Petroleum Geology – K.K. Landes; *John Wiley and Sons, Inc.*
10. Petroleum Geology – F.K. North; *Unwin-Hyman.*
11. The World of Petroleum – B.G. Deshpande; *Wiley Eastern Ltd.*
12. Coal – D.W. Van Krevelen; *Elsevier Scientific Publishing Company.*
13. Coal Resources of India – R.M. Singh; *Allied Publishers Ltd.*
14. Non conventional Energy Sources – A. Gupta; *Umesh Publications.*
15. Non conventional Energy Sources – B.H. Khan; *E-Book (downloadable from internet).*
16. Atomic and Non-Conventional Energy – S. Tiwari; *Anmol Publications.*

PAPER: GLY 603C

L+T+P=0+0+4=4 credits

Geological Field Work:

- (a) Duration of the Fieldwork is to be minimum of 6 days.
- (b) An area about 10 sq. km. is to be geologically mapped; planar and linear structures are to be plotted using standard geological symbols.
- (c) Rock specimens collected from the field are to be identified and labelled.
- (d) A detailed Field Report along with the geological map (prepared by the students is to be submitted before the Sixth Semester Examination.
- (e) **Field Work is compulsory** and students who do not attend the field work are to be declared 'Fail' in Paper – GLY 603C.

PAPER: GLY 604E
Number of Lectures: 16

L+T+P=1+(1+1)=3 credits

THEORY

Economic Geology:

Scope of Economic Geology; Definition of ore, gangue and tenor; Processes of formation of economic mineral deposits with Indian examples; Classification of economic mineral deposits.

Concept of metallogenic epochs and provinces with examples.

Origin and occurrence of coal and petroleum in India.

Indian Mineral Deposits:

Study of mineralogy, mode of occurrence, origin and uses of the following economic mineral deposits with reference to Indian occurrences:

Metallic mineral deposits: Aluminium, Chromite, Iron, Lead and Zinc and Gold.

Non-metallic mineral deposits: Limestone, Mica, Sillimanite, Asbestos and Diamond.

Industrial Raw materials: Cement, Glass & Ceramics, Refractory and Gemstones.

PRACTICAL

Recognition of the following economic minerals in hand-specimens:

Calcite, Dolomite, Graphite, Malachite, Chalcopyrite, Pyrite, Hematite, Magnetite, Siderite, Chromite, Pyrolusite, Psilomelane, Magnesite, Rhodocrosite, Sphalerite, Realgar, Orpiment, Stibnite, Molybdenite, Bauxite, Laterite, Apatite, Asbestos, Corundum, Gypsum, Barite, Fluorite, Galena, Cinnabar, Pyrrhotite, Bornite, Covellite, Arsenopyrite, Cryolite, Cuprite, Monazite, Coal.

Identification of groups of economic mineral assemblages for the following industries:

(a) Ceramic, (b) Cement and (c) Iron & Steel.

Identification of constructional material for roads and buildings.

Geological Field Work:

- (a) Duration of the Fieldwork is to be minimum of 3 days.
- (b) An area with good rock exposures in the vicinity of the Institution (Local) is to be selected for this field trip.
- (c) Students are to be trained how to take readings like strike direction, amount & direction of dip; plunge & bearing; front bearing & back bearing with the help of Clinometer and Brunton Compass.
- (d) A short & concise Field report is to be submitted before the Fourth Semester Examination.
- (e) **Field Work is compulsory** and students who do not attend the field work are to be declared 'Fail' in Paper – GLY 604E.

Recommended Books:

1. Minerals of India – D.N.Wadia (Ed.); *National Book Trust*.
2. Mineral Economics – R.K.Sinha and N.L.Sharma; *Oxford and IBH Publishing Company Pvt. Ltd*