

U.G. 3rd SEMESTER SYLLABUS
DEPARTMENT OF GEOLOGY
COTTON UNIVERSITY

PAPER: GLY301C

STRUCTURAL GEOLOGY
(Credits: 4+0+1=5)

THEORY : *Number of Lectures: 64*

Introduction

Geometric, kinematic and dynamic analysis of rock structures; Penetrative and non-penetrative structural elements; Scales of observation: time & length; Structural Elements and their attitudes; Concept of non-diastrophic and diastrophic structures.

Primary structures

Primary structures in sedimentary rocks: bedding & stratification, primary structures as markers and facing/younging direction, recognition of bedding in deformed terrains; Penecontemporaneous structures; Primary structures in igneous rocks; Unconformities.

Physics of deformation

Analysis of Stress: Concept of Force, Traction & Stress, Stress components, Stress at a point, Principal axes of stress & principal stresses, Stress ellipsoid; Elementary concept of Mohr's stress circle, Terminology of states of stress: Hydrostatic stress, Uniaxial compression & tension, Axial compression & -extension, Triaxial stress, Pure shear & Simple shear, Deviatoric stress, Differential stress, Effective stress.

Analysis of strain: Strain & Strain ellipsoid; Measure of strain- longitudinal and shear strain; Homogeneous & Inhomogeneous Strain; Finite & Infinitesimal strain; Special type of Homogeneous (finite) strain: Plane strain, constriction, & flattening; Pure shear & simple shear.

Deformational behaviour of rocks: Elementary concept of rheology, Basic rheological models: Viscous, Elastic, Plastic; Controls of time, temperature and pressure on deformation.

Rock Fabrics in deformed rocks

Concept of pervasive (material) and non-pervasive (non-material) fabrics; Tectonites.

Lineation: Morphological types of lineation: Discrete structural lineation, Constructed structural lineation, Mineral lineations, slickenlines & slickensides, Rods, Mullions.

Foliation: Cleavage; Morphological types of foliation: Axial planar foliation, Compositional foliation, Disjunctive foliation, Crenulation foliation, Continuous foliation, Transected foliation.

Role of fabric elements in structural interpretations of deformed rocks.

Brittle Deformation in Rocks

Fractures & Joints: Types of fractures: Extension, Shear fracture; Modes of fracture; Feature of fracture surfaces; Classification of joints; Origin of joints.

Faults: Terminology of faults; Rocks associated with faults; Structural elements of faults; Classification & Types of faults; Characteristics & Structural Associations: Normal fault, Reverse (Thrust) fault, and Strike-slip fault; Anderson's classification of faults; Recognition of faults in field.

Boudinage: Types of boudins; Geometrical parts of boudin; Pinch-and-swell Structure.

Ductile Deformation in Rocks

Folds: Geometrical parts of single folded layer & multilayer folded surface; Structural elements of folds; Morphological classification of folds (after Ramsay, 1967); Types of folds.

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PRACTICAL *Number of Practicals: 16*

1. Introduction to structural elements: Structural lines & Structural planes.
2. Graphical method for structural solution.
3. Analysis of bore hole data: Thickness and depth of planes; Solution of three point problems.
4. Geological Maps: Completion of outcrops of beds from surface and borehole data; Drawing of cross-section & Interpretation of structures from geological maps.
5. Stereographic projection: Plotting of i) lines, ii) planes, iii) poles to the planes; Determination of i) attitude of the line of intersection between two planes, ii) angle between two planes, iii) apparent dip(s) in different directions in a plane, iii) strike & true dip from apparent dip(s); Stereo-plot of some different folds.
6. Determination of fault displacement.
7. Exercise on Mohr's Stress Circle: Determination of (i) principal stresses from normal and shear stresses & ii) the normal and shear stresses from the principal stresses and their directions.
8. Plot of different stress types on Mohr's circle.
9. Calculation of Finite Strain from deformed fossils, grains and pebbles.

Recommended Books:

1. Foundation of Structural Geology (1997) – R.G. Park; *Routledge*.
2. Structural Geology- Fundamentals & Modern Developments (1993) – S.K. Ghosh; *Pergamon Press*.
3. Folding and fracturing of rocks (1967) – J.G. Ramsay; *McGraw-Hill*.
4. Structural Geology (2007) – R.J. Twiss and E.M. Moores; *W.H. Freeman and Company*.
5. An outline of Structural Geology (1976) – B.E. Hobbs, W.D. Means & P.F. Williams; *John Wiley*.
6. Structural Geology of Rocks and Regions (2011) – G.H. Davis; *John Wiley*.
7. Structural Geology (2010) - Haakon Fossen; *Cambridge University Press*.
8. Structural Geology (1973) – M.P. Billings; *Pearson College*.

PAPER: GLY302C

IGNEOUS PETROLOGY
(Credits: 4+0+1=5)

THEORY: *Number of Lectures: 64*

Magma: Composition, physical properties, origin & types; Crystallization of magma; Reaction principle; Magmatic differentiation and assimilation.

Mode of occurrence of igneous rocks; Textures & structures; Classification of igneous rocks on textural, mineralogical (*IUGS classification*), quasi-chemical (*CIPW classification*) & chemical (*total alkali-silica*) criteria.

Concepts of system, phase and component; Mineralogical Phase rule; Phase equilibria in igneous rocks: Experimental observation of the following one, two & three component systems and their significance –

- (i) Silica (SiO₂) system
- (ii) Diopside (CaMgSi₂O₆) – Anorthite (CaAl₂Si₂O₈) system
- (iii) Forsterite (Mg₂SiO₄) – Silica (SiO₂) system
- (iv) Albite (NaAlSi₃O₈) – Anorthite (CaAl₂Si₂O₈) system
- (v) Potash feldspar (KAlSi₃O₈) – Albite (NaAlSi₃O₈) – Silica (SiO₂) system.

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Rock series and rock associations; 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; Anorthosites; Carbonatites.

PRACTICAL *Number of Practicals: 16*

Megascopic and microscopic study of the igneous rocks.

Recommended Books:

1. Igneous Petrology - Best, M.G., 2002; 2nd Edition, *Blackwell Publishers*.

2. Igneous Petrology - Bose, M.K., 1997; *World Press, Kolkata*.

3. Igneous Petrology - Hall, A., 1997; *Longman*.

4. Principles of Igneous and Metamorphic Petrology - Philpotts, A.R., 1994; *Prentice Hall*.

5. A Practical Guide to Rock Microstructure - Vernon, R.H., 2004; *Cambridge University Press*.

6. Principles of Igneous & Metamorphic Petrology - Winter, J.D., 2010; *Pearson Prentice Hall*.

7. Igneous Rocks and Processes: a practical guide - Gill, R., 2010; *John Wiley & Sons*.

8. Principles of Igneous and Metamorphic Petrology - Philpotts, A. and Ague, J., 2009; *Cambridge University Press*.

9. Essentials of Igneous and Metamorphic Petrology - Frost, B.R. and Frost, C.D., 2014; *Cambridge University Press*.

PAPER: GLY303C

SEDIMENTARY PETROLOGY AND GEOTECTONICS

(Credits: 4+0+1=5)

THEORY

Sedimentary Petrology : *Number of Lectures: 44*

Introduction; Scope and purpose; Processes of formation of sedimentary rocks: Weathering, erosion, transportation, deposition and diagenesis; Abundance of common sediments; Mineralogical composition of sedimentary rocks; Provenance; Sedimentary cycle; Physico-chemical factors of sedimentation.

Textures of sedimentary rocks: concepts of size, grade scale, sphericity, roundness, fabric, packing, porosity and permeability; grain size analysis and their implications.

Sedimentary structures and their significance: Mechanical, chemical and biological.

General classification of sedimentary rocks; Descriptive petrography of fundamental rock types: conglomerate, breccia, sandstone and limestone.

Basic ideas of depositional environments and their classification.

Concepts of facies and facies association.

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Geotectonics *Number of Lectures: 20*

Introduction; Internal structure of the earth; Classical concepts of Geosynclines; Concepts of Isostasy; Historical perspective of plate tectonics; Continental drift hypothesis; Palaeomagnetism, Sea floor spreading and plate tectonics; Divergent plate boundaries; Convergent plate boundaries; Obduction principle and emplacement of ophiolites; Evolution of Himalayas and structure and tectonics of Himalayan mountain belt; Transform fault boundaries; Triple point junctions; Mantle plumes and hotspots; Seismic belts of the world; Mechanism of plate tectonics; Plate movement over geologic time; Structure and tectonics of North-eastern India.

PRACTICAL *Number of Practicals: 16*

Identification and study of the clastic and nonclastic rocks in hand specimens.
Particle size distribution and statistical treatment.
Exercises on sedimentary structures.
Identification & study of sandstone, limestone and heavy minerals in thin sections.

Recommended Books:

1. Sedimentary Petrology by F. J. Pettijohn; *CBS Publishers and Distributors.*
2. Introduction to Sedimentology by S. M. Sengupta; *CBS Publisher & Distributors.*
3. Sedimentary Petrology: An Introduction to the Origin of Sedimentary Rocks by M. E. Tucker; *Blackwell Science.*
4. Sedimentology and Stratigraphy by G. Nichols; *Wiley and Blackwell.*
5. Depositional Sedimentary Environments by H. E. Reineck & I. B. Singh; *Springer.*
6. Sedimentary Rocks in the Field by M. E. Tucker; *John Wiley & Sons Ltd.*
7. Geotectonics – V.V. Belousov; *Springer Berlin Heidelberg*
8. Plate Tectonics and Crustal Evolution – K.C. Condie; *Pergamon Press*
9. Seismology and Plate Tectonics – D. Gubbins; *Cambridge University Press*
10. Plate Tectonics – R.L. Johnson; *Twenty-First Century Books*
11. Global Tectonics – P. Keary & F.J. Vine; *Blackwell Scientific Publications*
12. Plate Tectonics – S.M. Tomecek; *Infobase publishing*
13. Aspects of Tectonics – K.S. Valdiya; *Tata McGraw-Hill Publishing Company Ltd.*
14. The Evolving Continents – B.F. Windley; *John Wiley and Sons, Inc.*
15. Geodynamics of Northeastern India and the adjoining region – D.R. Nandy; *acb publications*

(Generic Elective)

PAPER: GLY304G

MINERALOGY, IGNEOUS & METAMORPHIC PETROLOGY

(Credits: 3+0+1=4)

MINERALOGY: *Number of Lectures: 16*

Crystallography: Crystalline and amorphous substance, Morphological features of crystal, External symmetry of crystal, Crystallographic axis, Axial ratio, Parameter and Indices, Crystal forms and habit

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

Descriptive Mineralogy : Scope of Mineralogy: Definition of mineral; Physical properties of mineral; Relationship of physical properties with atomic structure; Mineral Classification; Structure of silicate minerals.

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

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

Optical Mineralogy : Scope of optical mineralogy; Nature of light, Wave front and wave surface, Isotropism/Anisotropism, Pleochroism, Refractive index – its determination, Polarization of light, Double refraction, Uniaxial & biaxial minerals, Extinction in minerals, Interference colour, Relief, Nicol prism, Polarizing microscope. Optical properties of minerals in conoscopic light.

IGNEOUS PETROLOGY : *Number of Lectures: 16*

Igneous rocks; Mode of occurrence of igneous rocks; Textures and structures; Classification of igneous rocks.

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

Mineralogical phase rule; phase equilibria in igneous rocks.

Brief petrographic discussion of the following rock types- Granite, Rhyolite, Gabbro, Basalt, Andesite, Syenite and Pegmatite.

METAMORPHIC PETROLOGY : *Number of Lectures: 16*

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, serpentinite, blueschist, eclogite, granulite, migmatite.

PRACTICAL : *Number of Practicals: 16*

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

Mineralogy :

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

Study of the following minerals in thin section under Petrological Microscope: Olivine, Augite, Hornblende, Muscovite, Biotite, Orthoclase, Microcline, Plagioclase, Quartz.

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Igneous Petrology :

Identification of common igneous rock hand specimens.

Metamorphic Petrology :

Identification of the following metamorphic rock hand specimens:

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

Recommended Books:

1. Mineral Science – Cornelis Klein, *John Wiley and Sons*.
2. Mineralogy – Dexter Perkins, *Pearson*.
3. Manual of Mineralogy – C. Klein and C. S. Hurlbut, *Wiley*.
4. Igneous and Metamorphic Petrology – M.G. Best; *CBS Publishers and Distributors*
5. An introduction to igneous and metamorphic petrology - John D. Winter; *Prentice Hall*.
6. Petrology – W.T. Huang; *McGraw-Hill book Company*;
