

UNIVERSITY OF MUMBAI

No.UG / 373 of 2008

CIRCULAR :-

A reference is invited to the Ordinances, Regulations and syllabi relating to the B.Sc. degree course vide this office Circular No.UG/58 of 2000 dated 5th February, 2000 and the Principals of the affiliated colleges in Science are hereby informed that the recommendation made by the Board of Studies in Geology at its meeting held on 9th June, 2008 has been accepted by the Academic Council at its meeting held on 13th June, 2008 vide item No.4.13 and that, in accordance therewith, the syllabus in the subject of Geology at the T.Y.B.Sc. examination is revised as per Appendix and that the same has been brought into force with effect from the academic year 2008-2009.

MUMBAI-400 032

13th August, 2008

PRIN.K.VENKATARAMANI

REGISTRAR

To,

The Principals of the affiliated colleges in Science.

A.C./4.13/13.06. 2008

No.UG/373 – A of 2008,

MUMBAI-400 032

13th August, 2008

Copy forwarded with compliments for information to :-

- 1) The Dean, Faculty of Science
- 2) The Chairman, Board of Studies in Geology
- 3) The Controller of Examinations,
- 4) The Co-Ordinator, University Computerization Centre,


(D.H. KATE)
DEPUTY REGISTRAR
(U.G./P.G. SECTION)

Copy to :-

The Director, Board of College and University Development, the Deputy Registrar (Eligibility and Migration Section), the Director of Students Welfare, the Executive Secretary to the Vice-Chancellor, the Pro-Vice-Chancellor, the Registrar and the Assistant Registrar, Administrative sub-center, Ratnagiri for information.

The Controller of Examinations (10 copies), the Finance and Accounts Officer (2 copies), Record Section (5 copies), Publications Section (5 copies), the Deputy Registrar, Enrolment, Eligibility and Migration Section (3 copies), the Deputy Registrar, Statistical Unit (2 copies), the Deputy Registrar (Accounts Section), Vidyanagari (2 copies), the Deputy Registrar, Affiliation Section (2 copies), the Director, Institute of Distance Education, (10 copies) the Director University Computer Center (IDE Building), Vidyanagari, (2 copies) the Deputy Registrar (Special Cell), the Deputy Registrar, (PRO), the Assistant Registrar, Academic Authorities Unit (2 copies) and the Assistant Registrar, Executive Authorities Unit (2 copies). They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above Circular and that, no separate Action Taken Report will be sent in this connection. the Assistant Registrar Constituent Colleges Unit (2 copies), BUCT (1 copy), the Deputy Account, Unit V (1 copy), the In-charge Director, Centralize Computing Facility (1 copy), the Receptionist (1 copy), the Telephone Operator (1 copy), the Secretary MUASA (1 copy), the Superintendent, Post-Graduate Section (2 copies), the Superintendent, Thesis Section (2 copies)

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UNIVERSITY OF MUMBAI



Revised Syllabus

For the
T.Y.B.Sc. Examination
in Geology

(With effect from the academic year 2008-2009)

Paper I:

Stratigraphy and Geology of India, Maharashtra (Special reference Mumbai)

Max. Marks 100.

Number of lectures: 120 (4 lectures per week)

Instructions to Paper Setters:

Set four questions from part A, and two each from part B, C and D covering the entire syllabus.

Instructions to Candidates

Answer a minimum of two questions from Part A and one each from parts B, C and D and a total of five questions in all.

All questions shall carry equal marks.

Part A:

Introduction:

(45 lectures)

Brief Historical Review

Geological Investigations in India

Earth's Crustal Structure and Tectonic Divisions of India:

Tectonic Elements of Continents

Cratons

Folded Mountain Belts

Tectonic Elements of Oceans

Tectonic Divisions of India

Peninsular India

Extra- Peninsular India

Indo-Gangetic Plain

Precambrian Basement of Indian Peninsula:

Precambrian history of the Earth

Precambrian basement

Dharwar Province

Eastern Ghats Province

Central Indian Province

Singhbhum-Orissa Province

Aravalli-Bundelkhand Province

Proterozoic Formations of Indian Peninsula:

Proterozoic History

Basement Cover Transition

Proterozoic Succession

Lower Purana Succession

Delhi Supergroup

Bijawar and Gwalior Groups

Kolhan Group

Cuddapah Supergroup

Kaladgi and Pakhal Groups

Upper Purana Succession
Vindhyan Supergroup
Kurnool Group
Northern Extension of Kurnool Group

Part B:

(25 lectures)

Precambrians of Extra-Peninsula:
Precambrians of the Tethyan Basement
Salkhala Group
Vaikrita Group
Bhimphedi Group
Jutogh Group
Daling Group
Precambrians of the Lesser Himalaya
Western Sector
Central Sector
Nepal Himalaya
Eastern Himalaya

Palaeozoic History:

Tectonic History
Palaeozoic Life
Precambrian Cambrian Boundary
Marine Palaeozoic Formations of India
Tethyan Regions
Lesser Himalayan Regions

Part C:

(25 lectures)

Mesozoic History:

Tectonic History
History of Mesozoic Life
Marine Forms
Land Forms
Permian-Triassic Boundary
Marine Mesozoic Formations of India
Tethyan Himalaya
Lesser Himalaya (Krol Belt)
Indian Peninsula

Gondwana Sequence of India:

Sedimentation and Palaeoclimates
Lower Gondwana Sequence
Talchir Formation
Marine Intercalations
Bap and Badhaura Formations
Damuda Group
Lower Gondwana of Eastern Himalayas
Upper Gondwana Sequence
Damodar Valley Basin

Satpura Basin
Rajmahal Hills
Mahanadi-Son valley Basin
Pranhita-Godavari Basin

Part D:

(25 lectures)

Cenozoic History:

Tectonic History
Rise of the Tertiary Mountains
History of Cenozoic Life
Boundary Problems
Indian Cenozoic Formations
Himalayan Palaeogene Succession
Himalayan Neogene Succession
Indus Belt
Deccan Traps
Assam-Arakan Region
Andaman-Nicobar Islands
Northwestern Peninsula
Cauveri and Godavari Basins

Geology of Maharashtra (Special reference Mumbai):

Geology of the State and Geological distribution of minerals

Reference Books:

- Prasad, C.V.R.K (2005), Elementary Exercises in Geology; Universities Press (India) Pvt. Ltd., Hyderabad.
- Geology and Mineral Resources Of Maharashtra (2000). Directorate of Geology and Mining, Nagpur.
- Deshpande G.G.(1998), Geology of Maharashtra; Geological Society of India, Bangalore.
- Ravindra Kumar (1996), Fundamentals Of Historical Geology and Stratigraphy of India; 4th ed., New Age International Limited.
- Cesare Emiliani (1995), Planet Earth- Cosmology, geology and the evolution of life and environment; Low Price Ed. Cambridge University Press, U. K.
- Roy, R. Lemon (1990), Principles of Stratigraphy; Merrill Publishing Company, Ohio.
- Levin H.L.(1987), The Earth Through Time; 3rd Ed. Saunders College Publishing, New York.
- Wadia D.N.(1984), Geology of India; 4th Ed. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
- Krishnan.M.S. (1982), Geology of India and Burma; 6th Ed. CBS Publishers & Distributors (India).

Paper II

Igneous, Sedimentary and Metamorphic Petrology

Max. Marks 100.

Number of lectures : 120 (4 lectures per week)

Instructions to Paper Setters:

Set four questions from part A, and three each from part B and C covering the entire syllabus.

Instructions to Candidates

Answer a minimum of Two questions from Part A and one each from parts B and C and a total of five questions in all.

All questions should carry equal marks.

A. Igneous Petrology

(60 lectures)

Experiments with Molten Silicates: Uniary and Binary Systems

Phase Relations and Textures – One Component System and the Phase Rule; Two Component Systems: – Congruent Melting, Incongruent Melting and Solid Solution relationships; Textures and Structures (Mega & Micro) of Igneous Rocks.

Ternary Systems :- Simple and Complex

The effects of Pressure on the Melting and Crystallization of Magma; Time and Crystallization; Rock Types and Mode of Occurrence.

Classification and Description of Igneous Rocks:

The IUGS Classification System, Other aspects of classification;

Chemical Classification;

Characters of the Common Igneous Rocks: Plutonic and Volcanic types; Examples of Common Igneous Rock Types.

The Evolution of Magmas:

Differentiation: Fractional Crystallization; Other Differentiation Mechanisms.

Magmatic Mixing and Assimilation.

The Interior of the Earth:

Evidence of the Earth's Composition and Mineralogy: Seismic data, The Geothermal Gradient, Meteorites, Xenocrysts, High-Pressure Experimentation.

Mantle Petrology: Low Velocity Zone.

The Formation of Magmas at Rift Zones:

Melting Processes; Partial Melting; Observations at the Mid-Ocean-Ridges.

Igneous Rocks at the Continental Margins:

The Ophiolite Suite; Calcalkaline and Tholeiite Groups; Plutonic Rocks – Batholiths related to subduction zones.

Continental Igneous Rocks:

Gabbroic Layered Intrusions; Anorthosites; Alkali Basalts and Nephelinites; Carbonatites, Kimberlites and Related Rocks.

B. Sedimentary Petrology

(30 lectures)

The Occurrence of Sedimentary Rocks:

Types of Sedimentary Rocks- Mudrocks, Sandstones and Carbonate Rocks
Depositional Basins, Geosynclines and Plate Tectonics; Ocean Basins- Rifted Continental Margins,
Arc-Trench Systems, Suture Belts and Intracontinental Basins.

The Formation of Sediment:

Chemical Weathering: Granite; The effect of vegetation;
Basalt; Submarine Alteration.
Clay Minerals; Clay Mineralogy and Climate;
Laterite. Mechanical Weathering.

Sedimentary Texture:

Grain Size, Grain Size Measurement, Roundness and Shape, Grain to Grain relationship.

Mudrocks:

Field Observations: Textures, Structures, Colour, Nomenclature
Laboratory Studies: Mineral composition; Bentonites; Mudrocks and Source areas.

Sandstones and Conglomerates:

Field Observations: Textures, Colour, Distance from source, Structures, Mineral composition.
Laboratory Studies: Textures, Mineral composition; Recycling of Grains.
Classification of Sandstones and conglomerates.

The Diagenesis of Sandstones:

Compaction – Field Observations; Laboratory Studies.
Cementation: Pore-Filling Cements, Intrastratal solution.

Limestones and Dolomites:

Field Observations of Limestones: Textures; Noncarbonate Mineralogy; Classification; Structures;
Reefs and Palaeoclimate; Diagenesis.
Laboratory Studies: Allochemical and Orthochemical Particles.
Sites of Calcium Carbonate Deposition; Modern Reef Environments.
Dolomites: Laboratory Studies; Modern Dolomite. Dolomitization and dedolomitization.

Other Types of Sedimentary Rocks:

Evaporites, Origin of Giant Evaporite Deposits; Evaporites and Climate.

Bedded Cherts: Phanerozoic Marine Cherts; Phanerozoic Nonmarine Cherts; Precambrian Cherts.

Bedded Phosphate Rocks: Origin of Phosphorites; The Phosphorite Formation.

Bedded Iron Deposits: Oolitic Iron Formations; Bedded Iron Formations.

5

The Occurrence of Metamorphic Rocks:

Recognition of Metamorphic Rocks; Common Metamorphic Rocks.

Field Observations of Metamorphic Rocks: Regional Metamorphism, Contact Metamorphism, Other types of Metamorphism; Isograds.

Facies and Graphic Representation:

The Facies Concept; Equilibrium; The Phase Rule; Graphic Representation.

Controls and Processes of Metamorphism:

The Controls: Pressure, Temperature and Composition.

Metamorphic Processes: Initiation of metamorphism, Contact Metamorphism, Metamorphism of Igneous Rocks, Submarine Metamorphism; Porphyroblasts; Preferred Orientation; Metamorphic Differentiation. Metamorphic Reactions.

The Upper Limits of Metamorphism.

Mineral Changes During Metamorphism:

Mineral Variation and Metamorphic Facies: Zeolite and Prehnite-Pumpellyite-Metagraywacke Facies, Greenschist Facies, Epidote-Amphibolite Facies, Amphibolite Facies, Granulite Facies, Blueschist Facies, Eclogite Facies, Hornfels and Sanidinite Facies.

Mineral Variation Related to Initial Rock Composition: Carbonate rocks, Mudrocks, Mafic Igneous Rocks and Tuffs, Ultrabasic Rocks.

Time, Temperature and Deformational Relationships:

Porphyroblasts and Tectonism: Pre-tectonic, Syntectonic and Post-Tectonic Porphyroblasts; More complex situations.

Polymetamorphism.

Determination of Pressure and Temperature: Use of Total Assemblage, Changes in Mineral Composition.

Metamorphic Rocks and Global Tectonics:

Metamorphism at Transform Faults and Divergent Junctions; Metamorphism at Convergent Junctions,

Time of Formation of Paired Belts.

Reference Books:

- Tyrrel G.W. (1998). The Principles of Petrology. B.I. Publications Pvt. Ltd.
- Bose M.K. (1997). Igneous Petrology. The World Press Pvt. Ltd.
- Bowen N.L. (1928). The evolution of Igneous Rocks. Princeton Univ. Press. N.J.
- Hall A. (1987). Igneous Petrology. Longman.
- Hatch F.H., Wells A.K and Wells M.K. (1984) Petrology of the igneous rocks. CBS Publishers.
- Philpotts A.R. (1994). Principles of igneous and metamorphic Petrology, Prentice Hall of India.
- Turner F.J & Verhoogen J., Igneous and Metamorphic Rocks, Mc Graw- Hill
- Williams H, Turner F.J & Gilbert C.M. (1955) Petrography. San Francisco: W.H. Freeman and company.
- Sengupta S.M (1994). Introduction to Sedimentology. Oxford & IBH Publishing Co. Pvt. Ltd.

- Blatt H, Middleton G. & Murray R. (1972). Origin of Sedimentary rocks. Prentice-Hall, Englewood Cliff, N.J.
- Pettijohn F.J (1952) Sedimentary Rocks.
- Tucker E.M Introduction to sedimentary petrology
- Yardley, introduction to metamorphic petrology
- Bhaskar B. Rao..(1987), Metamorphic Petrology.

Paper III

Structural Geology and Engineering Geology.

Max. Marks 100.

Number of lectures : 120 (4 lectures per week)

Instructions to Paper Setters: Set Six questions from part A, and Four from part B covering the entire syllabus.

Instructions to Candidates

Answer a minimum of three questions from Part A and two from part B and a total of five questions in all.

All questions should carry equal marks.

A. Structural Geology

(90 lectures)

1. Introduction, Types of Structures, Stress, Strain, Measurements of Stress and Strain, Mechanical Behaviour of Rocks

(40 lectures)

Introduction and Review

A. Structures and Structural Geology

B. Fundamental Concepts

C. Plate Tectonics

Nontectonic Structures

- Primary Sedimentary Structures
- Sedimentary Facies
- Dewatering Structures
- Unconformities

Stress

- Definitions
- Stress on a Plane
- Stress at a Point
- Mohr Construction
- Mohr's Hypothesis
- Stress Ellipsoid

Strain

- Definitions
- Kinds of Strain
- Strain Ellipsoid
- Mohr Circles for Strain
- Simple and Pure Shear

Measurement of Strain in Rocks

- Kinds of Strain
- Strain Markers
- Flinn Diagram

Mechanical Behavior of Rock Materials

- Elastic (Hooken) Behavior
- Permanent Deformation – Ductility
- Controlling Factors

2. Study of Structures: Joints, Faults, Folds, Cleavage and Foliation, Linear structures. (50 lectures)

Joints and Shear Fractures

- Joints and Fracture Mechanics
- Joint in Plutons

Fault Classification and Terminology

- Anatomy of Faults
- Andersonian Classification
- Criteria for Faulting

Fault Mechanics

- Anderson's Fault Types
- Brittle versus Ductile Faults
- Shear Zones
- Shear – Sense Indicators

Thrust Faults

- Nature of Thrust Faults
- Detachment within a Sedimentary Sequence
- Small – Scale Features of Thrust Sheets

Strike – Slip Faults

- Properties and Geometry
- Environments of Strike – Slip Faulting
- Fault Geometry and Other Fault Types
- Termination of Strike – Slip Faults
- Transforms

Normal Faults

- Properties and Geometry

Fold Geometry and Classifications

- Descriptive Anatomy of Simple Folds
- Map – Scale Parallel Folds and Similar Folds
- Fold Classifications

Mechanics of Folding

- Fold Mechanisms and Accompanying Phenomena
- Deformation Mechanisms and Strain
- Noncylindrical and Sheath Folds
- Fundamentals of Lineations and Fold Mechanics
- Fundamentals of Parallel Folds and Similar Folds

Complex Folds

- Occurrence and Recognition
- Fold Interference Patterns
- Recognition of Multiple Fold Phases
- Noncylindrical and Sheath Folds

Cleavage and Foliations

- Cleavage – Bedding Relationships
- Cleavage Refraction
- Strain and Slaty Cleavage
- Crenulation Cleavage
- Cleavage Fans and Transecting Cleavages

Linear structures

- Lineations as Shear – Sense Indicators
- Folds and Lineations
- Deformed Lineations

B. Engineering Geology

(30 lectures)

1. The Engineering Properties of Rocks: (8 lectures)

Specific Gravity

Porosity

Sorption

Compressive Strength

Tensile Strength

Elasticity of Rocks

Residual Stress and Shear Stress in Rocks.

2. Rocks as Construction Materials: (7 lectures)

Types of Rocks used in construction: How are they obtained in nature?

Use of Rocks as facing stone.

Factors influencing Engineering usefulness of Rocks.

Use of Rocks as aggregates: Use of rock as an aggregate in different types of constructions, sources of different grades of aggregates. Properties of aggregates (Shape, Size, Surface Texture, Roundness, Coating), Cement aggregate reaction, Thermal effects on aggregate. Highway aggregate, Rail – road ballast, Runway aggregate.

3. Geological and Geotechnical investigations for Civil Engineering Projects:

(12 lectures)

a) Tunnels: Terminology, Geological conditions for tunnel sites, Tunnels in folded rocks and bedded rocks. Influence of divisional planes, Effects of faults, Crushed zones, Tunnels near slopes, Role of Groundwater in tunneling.

b) Dams and Reservoirs: Geological conditions for the selection of dam and reservoir sites. Terminology associated with dams. Types of dams: Masonary Dams (Gravity Buttress and Arch types), Earthen dams. Types of spillways. Locations of all the important dams and Hydro – electric projects in India.

c) Landslides: Causes, types and prevention of landslides. Influence of divisional planes, effects of faults, Crushed zones.

4. Drilling

(3 lectures)

Working of any one Percussion drill and one Rotary drill.

Reference Books:

Structural Geology

- Hatcher, Jr R.D., (1990), Structural Geology, Merrill Publishing Company.
- Ghosh S.K., (1993), Structural Geology, Pergamon Press.
- Pradeep Raj., (1997), Geological Maps, Concepts of Interpretation Practical Record with Key, Creative Educators.
- Hobbs D.W., Means W.D. And Williams P.F. (1976), An Outline of Structural Geology, John Wiley.
- Billings M.P., (1972), Structural Geology, 3rd ed., Prentice- Hall, Inc., Englewood cliffs, New Jersey.
- De Sitter L.U., (1956), Structural Geology, McGraw-Hill Book Company, INC.
- Ragan D.M., (1968) Structural Geology- An Introduction to Geometrical Techniques, 2nd ed., John Wiley and Sons, 166p
- Badgley P.C., (1959) Structural Methods For the Exploration Geologist, Oxford Book Company.

Engineering Geology

- Narayanswami S.B.S. (2000), Engineering Geology, Dhanpat Rai & Co, India.
- Legget F. R and Hatheway A.W. (1988), Geology and Engineering., 3rd ed. McGraw-Hill.
- Gupte R.B. (1992), A Textbook of Engineering Geology. 2nd ed. Pune Vidyarthi Griha Prakashan.
- Krynine D.P. And Judd W.R (2003), Principles of Engineering Geology and Geotechnics., CBS Publishers.
- Wahlstrom E.E. (1974), Dams, Dam Foundations and Reservoir Sites., Elsevier Scientific.
- Dunn I.S., Anderson L.R and Kiefer F.W. (1980), Fundamentals of Geotechnical Analysis., John Wiley.
- Maslov N.N. (1987), Basic Engineering Geology and Soil Mechanics., Mir Publishers.
- Gokhale K.V.G.K and Rao D.M. (1981), Experiments in Engineering Geology., Tata McGraw- Hill.
- "Courses in Mining Geology"; Arogyaswami, (Oxford & IBH).

Paper IV

Remote Sensing, Photogrammetry and Geographical Information Systems.

Max. Marks 100.

Number of lectures : 120 (4 lectures per week)

Instructions to Paper Setters

Set four questions from part A and Part B, and two from part C covering the entire syllabus.

Instructions to Candidates

Answer a minimum of Two questions from Part A and part B and one question from Part C.
All questions should carry equal marks.

A. Remote Sensing And Image Interpretation

(50 lectures)

1. Concepts and Foundations of Remote Sensing: (18 lectures)

Definition of Remote Sensing.

Energy Sources and Radiation Principles.

Energy interactions in the Atmosphere: Scattering, Absorption.

Energy interactions with earth surface features: Spectral Reflectance of Vegetation, Soil and Water, Spectral response patterns, Atmospheric Influences on Spectral Response Patterns.

Brief history of Remote Sensing from the advent of photography till today's aerial and space based remote sensing systems.

The concept of resolution: Spatial, Spectral, Temporal and Radiometric.

Space Borne Imaging Systems- The Landsat, IRS, SPOT and High resolution Land

Satellites (the characteristics of these satellites- their orbits, their sensors, and their resolutions)

2. Multispectral, Thermal and Hyperspectral Sensing: (12 lectures)

Across track scanning.

Along track Scanning.

Operating principles of Across track Multispectral Scanners.

Across track Thermal Scanning.

Thermal Radiation principles.

Interpretation of Thermal Scanner Imagery.

Geometric Characteristics of Across track scanner Imagery.

Geometric Characteristics of Along-Track Scanner Imagery.

Radiometric Calibration of Thermal Scanners.

Temperature Mapping with Thermal Scanner Data.

Hyperspectral Sensing.

3. Introduction to Visual Image Interpretation: (20 lectures)

Fundamentals of Visual Image Interpretation.

Basic Visual Image Interpretation Equipment- Construction and Working.

Land-use/Land cover mapping.

Geologic and Soil mapping.

Agricultural Applications.

Forestry Applications.

Water Resource Applications.

Archaeological Applications.

Environmental Assessment

Principles of Landform Identification.

Digital Image Processing:

Introduction.
Image Rectification and Restoration.
Image Enhancement.
Contrast Manipulation.
Spatial Feature Manipulation.
Multi-Image Manipulation.
Image Classification: Supervised Classification.
The Classification Stage: Minimum-Distance to Means Classifier, Parallelepiped Classifier, Gaussian Maximum Likelihood Classifier.
The Training Stage.
Unsupervised Classification.
Classification Accuracy Assessment.

Basic Principles of Photogrammetry:

Introduction.
Basic Geometric Characteristics of Aerial Photographs: Geometric types of Aerial Photographs, Taking Vertical Aerial Photographs, Geometric Elements of Vertical Photograph.
Photographic Scale.
Ground Coverage of Aerial Photographs.
Area Measurement.
Relief Displacement of Vertical Features: Characteristics of Relief Displacement, Object height determination from Relief Displacement
Measurement Correction for Relief Displacement.
Image Parallax: Characteristics of Image Parallax, Parallax Measurement.
Ground Control for Aerial Photography.
Mapping with Aerial Photographs: Stereoscopic Plotting Instruments, Orthophotos, Photogrammetric Work Stations, Basics of The collinearity condition, Basics of Space Intersection. Flight Planning

C. Introduction to Geographical Information System s**(20 lectures)**

What is GIS? - Definitions of GIS
The components of a geographical information system.
Basic requirements for a GIS.
Data Models: Conceptual models of real world geographical phenomena.
Conceptual models of space.
Geographical Data models: Vector models of Entities – Simple points, lines and polygons.
Raster Data Structures-The grid Cell.
Data Types: Boolean, Nominal, Ordinal, Integer, Real, Topological.
Data Input: Sources of Geographical Data, Geographical data Collectors and providers, Creating digital data sets by manual input.
Data Presentation

Reference Books:

Remote Sensing and Image Interpretation:

- Lillisand Thomas M, Ralph W. Kiefer and Jonathan W. Chapman, (2004), Remote Sensing and Image Interpretation., 5th ed, Wiley.
- Jensen John R., (2000), Remote Sensing of the Environment – An Earth Resource perspective., Pearson Education Series, Low Price Edition.
- Drury S.A., (1993), Image Interpretation in Geology., 2nd ed., Chapman and Hall., London.
- Schowengerdt Robert A., (2006), Remote Sensing – Models and Methods for Image Processing., 2nd ed., Elsevier (Academic Press).
- Narayan L.R.A., (1999), Remote Sensing and its Applications., Universities Press.
- Ramasamy S.M., (2005), Remote Sensing in Geomorphology, New India Publishing Agency.
- Mather Paul M., (2004), Computer Processing of Remotely Sensed Images- An Introduction., 3rd Ed., John Wiley.
- Wanless Harold R. (1969), Aerial Stereo Photographs., Hubbard Press, USA.

Photogrammetry:

- Lillisand Thomas M, Ralph W. Kiefer and Jonathan W. Chapman, (2004), Remote Sensing and Image Interpretation., 5th ed., Wiley.
- Miller, V. C., (1961), Photogeology, McGraw-Hill.
- Linder Wilfried (2003), Digital Photogrammetry- Theory and Applications., Springer.
- Misra R.P. and A. Ramesh, (1999), Fundamentals of Cartography., 2nd ed, Concept Publishing Company. New Delhi.

Introduction to Geographical Information Systems:

- Nag P. and Smita Sengupta., (2008), Introduction to Geographical Information System., Concept Publishing Company, New Delhi.
- Burrough Peter A. and Rachael A. McDonnell., (1998), Principles of Geographical Information Systems., Oxford University Press.
- Chang K. (2002), Introduction to Geographical Information Systems., Tata McGraw-Hill Edition.
- Morain Stan and Shirley Lopez Baros. (ed), (1996), Raster Imagery in Geographical Information Systems., Onward Press.
- Davis Bruce E. (1996), GIS – A Visual Approach., Onward Press.

T.Y. B.Sc – Geology

Syllabus (Practicals and Fieldwork)

Max Marks : 200.

Practical examination

Each practical of minimum 4 hours duration.

Marks to be allotted for Field work and field report from each of the four practical papers.

FIELD WORK: 10 days of geological field work to carry out geological mapping in an area outside Mumbai city.

Local field work 3 days for understanding the local geology of Mumbai and surrounding areas.

Practical I

Stratigraphy and Geology of India, Maharashtra and Mumbai

I Study of common sedimentary, igneous & metamorphic rocks in hand specimen from different stratigraphic horizons.

II Study of common fossils characteristics of a particular stratigraphic horizons.

III Diagrammatic examples of Lithostratigraphic boundaries and classification.

IV Study of Geological maps with geological history of the area in chronological order.

V Problems:

- Stratigraphic sequence from geological section.
- Stratigraphy of a geological section- fossils & radiometric age.
- Characteristics of a Fold & Fault from a geological map.
- Boundary Problem.
- Preparation of Geological Time Scale.

Practical II

Igneous, Sedimentary and Metamorphic Petrology.

I. Study of Megascopic and Microscopic textures and structures in Rocks.

A. Igneous Textures.

1. EQUIGRANULAR:

- Coarse –grained, Holocrystalline, Panidiomorphic.
- Coarse –grained, Holocrystalline, Hypidiomorphic
- Medium –grained, Holocrystalline, Hypidiomorphic
- Fine –grained, Holocrystalline, Panidiomorphic. (Orthophyric)
- Fine –grained, Holo/ Hemicrystalline, Hypidiomorphic
- Fine-grained, Holocrystalline, Allotriomorphic (Aplitic)
- Fine- grained, Hemicrystalline, Aphanitic, (Felsitic)
- Fine –grained, Holohyaline, Aphanitic

2. INEQUIGRANULAR:

- Coarse/Medium/Fine, Holo/Hemicrystalline, Porphyritic
- Coarse/Medium/Fine, Holo/Hemicrystalline, Glomeroporphyritic
- Coarse/Medium, Holo/Hemicrystalline, Ophitic/ Subophitic
- Medium/ Fine, Holo/Hemicrystalline, Poikilitic
- Medium/Fine, Holocrystalline, Intergranular

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- Medium/Fine, Hemicrystalline, Intersertal
 - Medium/Fine, Intergranular-cum-ophitic (Ophimottling)
3. DIRECTIVE:
- Fine, Hemicrystalline/Holohyaline, Banded (Fuidal)
 - Fine, Hemicrystalline, Trachytic
4. INTERGROWTH:
- Graphic/Micrographic
 - Perthitic
 - Granophyric

B. Igneous Mega-Structures

- Vesicular/ Amygdaloidal Lava
- Blocky/ Clinkery Lava
- Ropy Lava Surface
- Columnar Joint Block
- Flow Banding
- Glomeroporphyritic Clusters
- Intrusive Contacts and Xenoliths

C. Igneous Micro-Structures

- Reaction: (a. Corona , b. Myrmekite)
- Xenolithic
- Spherulitic/ Variolitic
- Perlitic Fracture

D. Sedimentary Textures.

- Clastic.
- Rudaceous (Conglomeratic/ Brecciated)
- Arenaceous (Gritty/ Sandy)
- Argillaceous.

E. Sedimentary Structures

- Stratification
- Current Bedding
- Graded Bedding
- Ripple Marks
- Rain Prints
- Concretions/Secretions

F. Metamorphic Textures

- Idioblastic
- Porphyroblastic
- Granuloblastic
- Xenoblastic

G. Metamorphic Structures

- Cataclastic
- Slaty Cleavage
- Maculose
- Granulose
- Schistose
- Gneissose

II. Study of the Texture, Mineral composition, Mode of occurrence, and association of the following Rock Types.

A. Igneous Rocks.

- Granite
- Rhyolite
- Pegmatite
- Aplite
- Quartz porphyry
- Pitchstone
- Obsidian
- Syenite (Hornblende / Biotite)
- Trachyte
- Feldspar porphyry
- Nepheline Syenite
- Diorite
- Gabbro
- Norite
- Dolerite
- Basalt (Vesicular/ Non- Vesicular/ Porphyritic)
- Picrite
- Peridotite
- Dunite
- Anorthosite
- Carbonatite
- Volcanic Breccia

B. Sedimentary Rocks

- Conglomerate
- Breccia
- Grit
- Sandstone
- Slate
- Limestone
- Fossiliferous Limestone
- Oolitic Limestone
- Laterite

C. Metamorphic Rocks

- Quartzite
- Marble
- Chistacite- Slate
- Phyllite
- Mica Schist (with Staurolite/ Garnet)
- Actinolite/ Chlorite Schist
- Mica- Gneiss
- Hornblende Gneiss.
- Granulite
- Eclogite
- Serpentinite
- Khondolite
- Charnockite

Practical III

Structural Geology and Engineering Geology.

Structural Geology:

- Profiles and cross sections across geological maps with: folds, plunging folds, dipping faults, dipping dykes, two series of dipping beds, overturned folds. (10 maps)
- Patterns of Dipping strata; Three-Point problems.
- Thickness and depth of strata
- Apparent dips and structure sections of folded strata
- Geometrical construction of folds
- Trigonometric solution of fault problems
- Solution of three-point problems and vertical fault problems by descriptive geometry
- Solution of inclined fault problems by descriptive geometry
- Equal-area net
 - Plotting a line that lies in a plane
 - Determining the angle between two lines
 - True strike and Dip from apparent dips
 - Attitude of intersection of two planes
- Equal-area net part II
 - Determining the angle between two planes
 - Determining the orthographic projection of a line on a plane
 - Determining the angle between a line and a plane
 - Bisecting the angle between two lines
 - Bisecting the angle between two planes
 - Calculating the attitude of a bed from bore hole data.

Engineering Geology:

Five geological maps to demarcate and evaluate suitable sites for engineering projects for Tunnels and Dam construction.

Practical IV

Remote Sensing and Image Interpretation, Photogrammetry .

- Test and Exercise for Stereoscopic vision
- Determination of Photo Scale and numerical problems on photo scale.
- Orientation of Stereographic pair of aerial photographs under a mirror stereoscope and point transfer. Plotting of principal point, flight line and matchline.
- Construction of stereograms
- Handling of a parallax bar and height calculation
- numerical problems on height calculation using measured relief displacement on a single aerial photograph.
- Flight Planning: Calculations necessary to develop a flight plan and draw a flight map.
- Interpretation of aerial photographs:
 - various landforms, erosion types ,
 - horizontally bedded sandstones, shales and limestones.
 - Intrusive igneous rocks, extrusive (lava flows).
 - Aeolian Landforms: transverse sand dunes, longitudinal sand dunes, loess.
 - Glacial landforms: terminal moraine, basal moraine, drumlins, eskers.
 - Fluvial Landforms: alluvial fans, deltas.
 - Coastal landforms: beach ridges, beach cusps, dunes.
- Interpretation of multi band imagery in individual bands and FCC
- Interpretation of satellite imageries for land use/land cover.
- Interpretation of Thermal imagery data.
- Digital Image Processing (using – number matrix): enhancement, manipulation and classification.
- Demonstration lab only:
of digital image processing on Computer using free software and data available in book by Mather Paul M., (2004), Computer Processing of Remotely Sensed Images- An Introduction., 3rd ed., John Wiley.
