

UNIVERSITY OF MUMBAI
No.UG/195 of 2009

CIRCULAR: -

A reference is invited to the Ordinances, Regulations and syllabi relating to the B.Sc. degree course vide this office Circular No.UG/261 of 2007, dated 8th June, 2007 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 19th March, 2009 has been accepted by the Academic Council at its meeting held on 21st April, 2009 vide item No.4.2 and that, in accordance therewith, the syllabus in the subject of Geology at the S.Y.B.Sc. is modified as per Appendix and that the same has been brought into force with effect from the academic year 2009-2010.

MUMBAI-400 032
5th June, 2009

PRIN. K. VENKATARAMANI
REGISTRAR

To,
The Principals of the affiliated colleges in Science.

A.C./4.2/21.04.2009

No. UG/195-A of 2009.

MUMBAI-400 032

5th June, 2009

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 Center.


(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 Personal Assistants to the Vice-Chancellor, the Pro-Vice-Chancellor, the Registrar and the Assistant Registrar, Administrative, 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, Enrollment, Eligibility and Migration Section (3 copies), the Deputy Registrar, Statistical, Affiliation Section (2 copies), the Director, Institute of Distance Education, (10 copies) the Director University Computer Center (TNE Building), Vidyantagari, (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



UNIVERSITY OF MUMBAI



Modified Syllabus

For the
S.Y.B.Sc.
in
Geology

(With effect from the academic year 2009-2010)

MODIFIED S. Y. B. Sc. SYLLABUS—GEOLOGY
2009 – 2010 ONWARDS

PAPER-I
(PALAEONTOLOGY, STRATIGRAPHY AND ORE GENESIS)

Unit 1:

Palaeontology

(15 Lectures)

Modern concept of origin of life, principles and theories of evolution, mechanism & pattern of evolution, causes of migration, dispersal and extinction of organisms.

Invertebrate Palaeontology :

Brief study of evolutionary trends of: trilobite, brachiopods, lamellibranches, gastropods, cephalopods, echinoids, graptolites.

Trace fossils: Behavioral Classification, Value of trace fossils in palaeoenvironmental interpretation, understanding conditions of deposition and in understanding biostratigraphic evolution.

Unit 2:

Stratigraphy

(15 lectures)

Development of stratigraphic concepts, importance of stratigraphy.

Stratigraphic classification & nomenclature, study of stratigraphic elements, lithostratigraphy and its units.

Chronostratigraphy and its units, biostratigraphy and its units; inter-relationship between lithostratigraphic, chronostratigraphic and biostratigraphic units.

Introduction to chemostratigraphy (oxygen and carbon), magnetostratigraphy and seismic stratigraphy.

Unit 3:

Ore genesis

(15 lectures)

Processes of Mineralisation:

Introduction, definition of metalliferous and non-metalliferous deposits, ore mineral, gangue, tenor of ore, industrial minerals, overburden and country rock.

Classification of economically important metalliferous and non-metalliferous mineral deposits.

Processes of formation of mineral deposits.

Magmatic concentration (early and late magmatic mineral deposits)

Hydrothermal processes, cavity filling and metasomatism:

- i) Hydrothermal processes: Principle, character of solution, types of openings in rocks, factors affecting deposition from hydrothermal solutions, wall rock alterations.
- ii) Cavity filling deposits: processes of formation and characteristic features of: fissure veins and its types (in brief), stock work, saddle veins, ladder veins, pitches and flats, breccia filling deposits, solution cavity fillings.
- iii) Metasomatic replacement: definition, criteria of replacement, resulting mineral deposits.

Unit 4:

Palaeontology

(15 Lectures)

Micro-palaeontology:

Introduction, definition, different types of microfossils, their size range and composition, branches, uses.
Morphology and geological history of: foraminifera, Ostracoda and Radiolaria
Application of micro-fossils in palaeoclimatic and palaeo-oceanic studies.
Introduction to Palynology: spores and pollens.

Palaeobotany:

Definition, conditions and different modes of preservation of plant fossils, classification and distribution of plants through geological ages.
Study of following genera with respect to their classification, generic definition, characteristics and distribution: Ptillophyllum, Glossopteris, Gangamopteris, Vertebraria and Nilsonia.
Introduction to Palynology: spores and pollen.

Unit 5:

Stratigraphy

(15 lectures)

Stratification: processes controlling stratification- physical, chemical and biological.
Vertical succession, lithological uniformity, heterogeneity, patterned succession, alternations, varves, cycles (symmetrical and asymmetrical).
Lateral variations and facies concept.
Unconformity: importance in stratigraphy environmental classification and stratigraphic evidence of unconformities.

Correlation: definition and evidence for correlation- physical and palaeontological.
Methods of collecting stratigraphic data (stratigraphic procedures on outcrop and subsurface).

Unit 6:

Ore genesis

(15 lectures)

Secondary processes:

- i) Evaporation deposits: brief account of non-metallic deposits of ocean water, lake water, ground water and hot springs.
- ii) Oxidation and solution in the zone of oxidation, ore deposits in the zone of oxidation.
- iii) Supergene sulphide enrichment: requirements for supergene sulphide deposition, recognition of sulphide enrichment. Gossans and cappings, role of iron gossans, limonite and false gossans.
- iv) Residual deposits: conditions favouring formation of residual deposits.
- v) Mechanical concentration: principles and processes of formation of placer deposits (eluvial, alluvial, beach and aeolian).

Structural and stratigraphic controls on mineralization, metallogenic epochs and provinces.

LIST OF RECOMMENDED REFERENCE BOOKS

- Elements of Micropalaeontology: G. Bignot
- Introduction to Palaeontology: Arnold
- Invertebrate Palaeontology and Evolution: Clarkson
- Principles of Invertebrate Palaeontology: R. Shrock & W. Twenhofel
- Principles of Palaeontology: D. Romp & S. Stanley
- Principles of Palaeontology: T. Olivier
- Micropalaeontology: Jones
- A Practical Approach to Sedimentology: Roy Lindholm
- Basic Concepts of Historical Geology: E.W.Spencer
- Historical Geology: Dunbar
- Principles of Stratigraphy: Weller
- Fundamentals of Historical Geology & Stratigraphy of India: Ravindra Kumar

Unit 1:

CRYSTALLOGRAPHY

(15 Lectures)

CHARACTERISTICS OF CRYSTALS: Atomic arrangement in crystals. Bravais Lattices. Crystal symmetry. Elements of symmetry: Planes, Axes and Centre. Axis of inversion symmetry. Crystallographic axes. Indices, Rational indices. Axial ratios. Imperfect crystals.

CLASSIFICATION OF CRYSTALS: Seven systems of crystals. Derivation of 32 classes of symmetry with Hermann-Mauguin and Schoenflies symbols. Stereographic projections of symmetry.

Unit 2:

CRYSTAL OPTICS

(15 Lectures)

NATURE AND BEHAVIOUR OF LIGHT: Non-polarised and Polarised light. Refraction and Refractive index. Double refraction. Nicol prism and Filter polaroid. Isotropic and Anisotropic substances. Polarising Microscope: Its Construction and Working.

Physical, Crystallographic and Optical properties (Pleochroism, Twinkling, Polarisation Colours, Uniaxial and Biaxial minerals, Determination of uniaxial and Biaxial sign using mica plate, gypsum plate and quartz wedge.

Unit 3:

PHYSICAL MINERALOGY

MINERAL GROUPS:

(15 Lectures)

Stability relationships, Crystallisation temperatures, Conditions of formation and Distribution in rocks of the following Mineral Groups: Silica, Feldspar, Felspathoid.

Stability relationships, Crystallisation temperatures, Conditions of formation and Distribution in rocks of the following Mineral Groups: Mica, Amphibole, Pyroxene.

Unit 4:

CRYSTALLOGRAPHY

FORMS OF CRYSTALS: Study of generalized forms of 11 main classes of crystals. (15 lectures)
Octahedron, Cube, Rhombododecahedron, Trapezohedron, Trisoctahedron, Tetrahedron, Hexoctahedron, Pyritohedron, Diploid, Tetrahedron, Tristetrahedron, Hexitetrahedron, Deltoid-Dodecahedron, Prisms, Pyramids, Domes, Pinacoids, Rhombohedrons, Scelenohedrons, Sphenoids.

TWIN CRYSTALS: Twin axis, Twin plane, Composition plane. Types of Twinning. Simple and Multiple contact twins, Simple and Multiple penetration twins, Cyclic twins, Twinning in Feldspars: Carlsbad, Manebach, Baveno, Albite, Albite-Carlsbad.

Unit 5:

CRYSTAL OPTICS

OPTICAL CHARACTERISTICS: Relief, Becke's test, Twinkling, Pleochroism. (15 lectures)
Birefringence, Polarisation colours, Newton's scale, Extinction and Extinction angle, Anomalous polarisation colours.

Uniaxial and Biaxial minerals. Optical indicatrix. Interference figures. Optic sign. Sign of elongation. Use of Quartz wedge, Mica plate and Gypsum plate.

Unit 6:

MINERALOGY

MINERAL GROUPS: Physical, Crystallographic and Optical properties, Stability relationships, Crystallisation temperatures, Conditions of formation and Distribution in rocks of the following Mineral Groups: Olivine, Garnet and Zeolite. (15 lectures)

GEOLOGICAL THERMOMETERS: Direct measurements, Melting points, Dissociation, Inversion points, Exsolution, Recrystallisation, Liquid inclusions, Change in physical properties, Association of minerals.

LIST OF RECOMMENDED REFERENCE BOOKS

- Rutley's Elements of Mineralogy: H.H. Read and Revised by C.D. Gribble.
- Manuel of Mineralogy: Cornelius, S. Hurlbut Jr., Cornelius Klein.
- Textbook of Mineralogy: Dana and Ford.
- Optical Mineralogy: Paul Kerr.
- Mineralogy: Berry, Mason and Dietrich.
- Rock Forming Minerals: Deer, Howie, Zussman.

Unit 1:

FIELD GEOLOGY

(15 lectures).

Nature of Geologic Surveying:
Definition & Aim. Uses of geologic surveying. Diversity of Surveys. Scope of geological field-work. Study of Outcrops: Likely places. Examination. Discrimination. Tracing. Importance of Contacts: Discrimination between different types of contacts. Contacts buried under soil. Eruptive contacts. Obscure bedding. Discrimination of Strike and Dip: Degree of accuracy. Cross-bedding. Bevelling of outcrops. Settling of beds.

Field Correlation: Attitude of contorted strata. Attitude of eruptive contacts.

Field Observations: Schedule for Field Observations. General Suggestions for Field work: Beginning a field problem. Collecting and trimming samples. Taking photographs. Degree and accuracy of field work.

Unit 2:

GEOMORPHOLOGY AND CARTOGRAPHY

(15 lectures)

Basic Concepts of Geomorphology:

- a) Energy for landform change, Isotopic dating, other methods
- b) Geomorphic Systems: people as Geomorphic Agents, People as creators of Landforms, Problems of using the Environment.
- c) Landforms controlled by Faults: Rift valley, Fault scarp features, Features associated with strike slip faulting, Block faulted landscape.
- d) Landforms controlled by Folds: Anticlines and Monoclines. Landforms of eroded folds.
- e) Drainage patterns on folds: Antecedent, Superimposed, Captured, drainage.

Volcanogenic landforms and intrusions:

- a) Energy of volcanic eruptions,
- b) Products of Volcano: Lava Flow, Pyroclasts.
- c) Types of Volcano: Scoria or Cinder Cones, Composite or Strato Volcanoes, Shield Volcanoes, Domes.
- d) Types of Eruptions: Volcanic Explosion, Pyroclastic flow.
- e) Erosion of Volcanic features: Plutons Intrusions.

Weathering and Landforms:

- I. Weathering process: Physical, Chemical
- II. Landforms produced by weathering: Corestones, Tors, Pits, Pans, Caverns, Rills, Duricrust.

Fluvial processes and landforms:

- 8
- I. Fluvial Transport and Deposition: Alluvial Fans, Floodplains and Terraces, Alluvial river channels, Alluvial Bars, Braided Channels, Straight and Meandering Channels.
 - II. Drainage Basin as a Unit of Study.
 - III. Discharge of Water: Hydrograph Shapes, Flood Frequency, Patterns of Discharge.

Eolian Processes and Landforms:

- I. Eolian Erosion.
- II. Eolian Transport and Deposition.
- III. Loess.

Unit 3:

HYDROGEOLOGY

(15 lectures)

Ground Water: Definition, Utilisation

Hydrogeologic Cycle: Precipitation. Evapo-transportation and Phreatophytes. Runoff and Hydrograph components. Infiltration. Subsurface movement of water. Zones of Groundwater. Watertable. Aquifers. Confined and Unconfined water. Artesian System and Artesian Head. Presentation of Water, Level data on Maps and Graphs. Discharge of Groundwater. Springs. Artificial discharge.

Groundwater Exploration: Conventional methods. Geophysical exploration by (a) Resistivity method and (b) Seismic method.

Occurrence of Groundwater: Origin of groundwater. Rock properties affecting groundwater. Vertical distribution of groundwater. Geological formations as aquifers. Types of aquifers.

Groundwater Movement: Darcy's Law. Coefficient of permeability. Groundwater flow rate. Laboratory and field measurements of permeability. Tracing groundwater movements. Groundwater flow-lines and flow-nets.

Unit 4:

FIELD GEOLOGY

Preparation of Geological Reports:

(15 lectures)

General instructions. Parts of Manuscript report. General outline of Report. Abstract. Introduction. Summary and Conclusions. Recommendations. Geography. Stratigraphy and Petrography. Geologic structure. Geologic History. Economic considerations. Quotations and Footnotes. Table of contents. Index.

Instruments and Methods of Geologic Mapping:

- a) Clinometer and Brunton Compass: their construction and use. Clinometer and compass method of reconnaissance mapping.
- b) Hand Levels: Their construction and use. Hand Level Method of Determination of Dip and Strike. Hand Level Traverses.
- c) Altimeter: Its construction and use. Altimeter techniques, including horizontal control, system of recording stations, note taking and correction of readings.

UNIT 5

Geomorphology and Cartography

(15 lectures)

Coastal processes and landforms.

Dominant influences on Coastal Landforms: Structure and Lithology, Current rates of Erosion, Climatic influences past and present, Sea level changes. Erosional landforms of the coast. Depositional landforms of the coast.

Karst processes and landforms.

Limestone Solution and erosion rates.

Surface landforms: Minor solution Sculpture, Enclosed Depressions.

Karst landforms of fluvial erosion.

Underground water, caves and springs.

Glaciers and glaciated landforms.

Glaciers: Ice Movement, Flow patterns, Forms of Glacier surfaces, Meltwater.

Glaciated Erosional landforms.

Glaciated Depositional landforms.

Cartographic and morphometric analysis

Topographic analysis

Topographical profiles

Projected profiles

Superimposed profiles

Spur Profiles.

Geomorphological Map Using I.G. U symbols.

Slope analysis

Morphological Mapping by Savigear's Method.

Average Slope Map

Generalized Contour Map.
Drainage basin analysis
a) Linear aspects.
b) Areal aspects

UNIT 6

HYDROGEOLOGY

(15 lectures)

Artificial Recharge of Groundwater: Concept. Methods. Water Spreading. Waste water reused. Recharge mounds. Induced recharge.

Surface Investigations of Groundwater: Test-drilling. Resistivity logging. Potential logging. Temperature logging.

LIST OF RECOMMENDED REFERENCE BOOKS

- Manuel of Field Geology: Compton R.J.
- Field Geology: Lahee.
- Earth's changing Surface. By M.J. Selby
- Techniques in geomorphology. By C.A.M. King
- Groundwater Hydrology: Todd D.K.
- Groundwater Assessment, Development and Management: Karant K.R.
- Groundwater: Raghunath H.M.

PRACTICALS

3 Practicals, each of 2 ½ hours' duration.

PRACTICAL – I

1. Study of evolutionary trends of: trilobite, brachiopods, lamellibranches, gastropods, cephalopods, echinoids, graptolites.
2. Micro fossils: Two each from foraminifera, ostracods and radiolarians.
3. Plant fossils: Gangamopteris, Glossopteris, Ptillophyllum, Nilsonia, Cladophlebis, Schizoneura, Vertebraria.
4. Identification (with the help of physical properties), chemical composition, origin and Indian occurrences of Ore minerals and Industrial minerals.

PRACTICAL – II

1. CRYSTALLOGRAPHY:

a) Study of Symmetry:

- i. Symmetry elements of 32 classes of symmetry
- ii. Stereographic projections of Symmetry elements of 32 classes of symmetry

b) Study of all possible forms of crystals belonging to the following Fourteen classes of symmetry:

- CUBIC SYSTEM: Galena, Tetrahedrite & Pyrite classes
- TETRAGONAL SYSTEM: Zircon & Chalcopyrite classes
- HEXAGONAL SYSTEM: Beryl, Apatite & Beta- Quartz classes.
- TRIGONAL SYSTEM: Calcite, Tourmaline and Alpha- Quartz classes.
- ORTHORHOMBIC SYSTEM: BARITE CLASS
- MONOCLINIC SYSTEM: Gypsum class.
- TRICLINIC SYSTEM: Axinite class.

c) Study of Twin-axis, Twin plane and composition plane of the following types of Twin crystals:

- Simple contact twinning: Spinel, Rutile, Aragonite, Gypsum, Augite, Orthoclase (Bavono, Manebach, Carlsbad).
- Simple penetration twinning: Staurolite, Augite, Orthoclase (Carlsbad-partially penetrant).
- Multiple contact twinning: Albite.
- Multiple penetration twinning: Fluorite, Diamond (Star), Chrysoberyl (Wheel).
- Multiple cyclic twinning: Aragonite, Chrysoberyl (Wheel).

d) Measurement of Axial ratios of Tetragonal and Orthorhombic crystals by Formula calculation and Graphical methods .

2. MINERALOGY:

- a) Study of Physical and Optical characters, mode of formation and occurrence in Rock types of the following Igneous and Metamorphic Minerals:
 - i. Igneous rock forming minerals: Quartz, Orthoclase, Microcline, Albite, Labradorite, Leucite, Nepheline, Sodalite, Muscovite, Biotite, Hornblende, Augite, Aegirine, Hypersthene, Olivine, Tourmaline and Apatite.
 - ii. Metamorphic minerals: Garnet, Staurolite, Chlorite, Talc, Serpentine, Actinolite, Tremolite, Anthophyllite, Epidote, Andalusite, Kyanite, Sillimanite, Calcite, Dolomite, Asbestos, Chrysolite, Magnesite.
- b) Study of Physical properties, mode of occurrence and conditions of origin of the following Secondary minerals: Quartz (Rock crystal), Amethyst, Calcite (Rhombohedral, Scalenohedral & Nail-head spar), Stilbite, Scolecite, Gyrolite and Okenite.
- c) Determination of An-content of Plagioclase by symmetrical extinction method on Polorising Microscope stage.

PRACTICAL -III

A. FIELD GEOLOGY

- a. Drawing of block and profile diagrams to indicate following features observed in the field:
 - Dip and strike of stratification
 - Current bedding and cross bedding
 - Graded bedding
 - Transgressive and regressive overlap of beds
 - Pillow lavas
 - Vesicles and joint configuration in simple and compound lava flows
 - Contact zone details of sills, dykes and batholiths
 - Laccolith, Lopolith and Phacolith
 - Three-dimensional details of inclined Lineation
 - Flow cleavage and Fracture cleavage relationship
 - Flow cleavage and Fracture joints in folded alternating competent and incompetent strata
 - Types of folds and their features
 - Types of faults and their features
 - Horse, drag and brecciation in faults
 - Repetition, overlap, gap and offset features of different types of faults
 - Types of Joints
 - Sagging and slumping effect in horizontal and dipping strata
- b. Interpretation of geological details from incomplete data of detached outcrops

B.

Geomorphology and Cartography:
Measurement of areas enclosed within curves.

TOPOGRAPHIC ANALYSIS

Topographic profiles, Projected Profiles.
Superimposed Profiles, Spur Profiles.

DRAINAGE BASIN ANALYSIS

Linear Aspects,
Longitudinal and cross valley profiles
Hypsometric analysis.

b) HYDROGEOLOGY:

Problems on permeability, porosity and rate of flow.
Flow nets.

Skeleton diagrams to plot shape of water table.

Problems on determination of aquifer depths from resistivity data.

FIELDWORK

In addition to the requisite number of lectures and practicals, students are required to undertake geological excursions to study at first hand geological structures and lithology, under the guidance of a teacher. The fieldwork shall aim at developing individual skills of observation, description and interpretation of geological features. Each student shall maintain a field-diary for this purpose and shall write area wise reports.

SCHEME OF EXAMINATION

THEORY

3 Papers each of 60 marks and 2 hours duration at the end of each term.

FIRST TERM

THEORY QUESTION PAPER

2 hours 60 marks

There will be four questions of 15 marks each.

Q.1. Based on Unit Nos 1, 2, 3.

Q.2. Based on Unit No. 1.

Q.3. Based on Unit No. 2.

Q.4. Based on Unit No. 3.

Each question will be set for 22 or 23 marks with internal options.

SECOND TERM

THEORY QUESTION PAPER

2 hours 60 marks

There will be four questions of 15 marks each.

Q.1. Based on Unit Nos 4, 5, 6.

Q.2. Based on Unit No. 4.

Q.3. Based on Unit No. 5.

Q.4. Based on Unit No. 6.

Each question will be set for 22 or 23 marks with internal options

PRACTICAL EXAMINATION WILL BE HELD AT THE END OF THE SECOND TERM

- Each practical for 40 marks.
- Out of 120 marks (3 practicals)
 - 15 marks are to be assigned to the duly certified Laboratory Journal
 - 15 marks for the Field Report.
- Each Practical paper will contribute 05 marks towards 'Field Report' and 05 marks towards the Journal
- Evaluation in Practical exam will hence be for 30 marks per paper i.e. (40-05-05 = 30)

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