

UNIVERSITY OF MUMBAI



**Syllabus for the S.Y.B.Sc.
Program: B.Sc.
Course: GEOLOGY**

(Credit Based Semester and Grading System with
effect from the academic year 2012–2013)

S.Y.B.Sc. GEOLOGY Syllabus
Credit Based and Grading System
To be implemented from the Academic year 2012-2013

SEMESTER III

Course Code	UNIT	TOPICS	Credits	L / Week
USGE301	Palaeontology & Stratigraphy			
	I	Palaeontology I	2	1
	II	Palaeontology II		1
	III	Stratigraphy		1
USGE302	Crystallography			
	I	Characteristic of Crystals	2	1
	II	The thirty-two crystal classes and possible forms of each class		1
	III	X-ray Diffraction and Crystal imperfections		1
USGE303	Applied Geology			
	I	Field Geology	2	1
	II	Geomorphology and Cartography		1
	III	Hydrogeology		1
USGEP301 USGEP302 USGEP303	Practical based on all the three courses in theory		3	9

SEMESTER IV

Course Code	UNIT	TOPICS	Credits	L / Week
USGE401	Economic Mineral Deposits		2	1
	I	Introduction & Ore Genesis I		
	II	Ore Genesis I		
	III	Ore Genesis II		
USGE402	Optical Mineralogy and Systematic Mineralogy.		2	1
	I	Optical Properties of Minerals		
	II	Systematic Mineralogy: part I		
	III	Systematic Mineralogy: part II		
USGE403	Applied Geology		2	1
	I	Field Geology		
	II	Geomorphology and Cartography		
	III	Hydrogeology		
USGEP401 USGEP402 USGEP403	Practical based on all the three courses in theory		3	9

Course Code	Title	Credits
USGE301	PALAEONTOLOGY AND STRATIGRAPHY	2 Credits (45 lectures)
<p>UNIT 1 : PALAEONTOLOGY - I</p> <p>Modern concept of origin of life, principles and theories of evolution, mechanism & pattern of evolution, causes of migration, dispersal and extinction of organisms.</p> <p>Invertebrate Palaeontology: Brief study of evolutionary trends of: Lamellibranches, Gastropods, Cephalopods, and Trilobites, Echinoids, Graptolites.</p> <p>Trace fossils and Index fossils, Value of trace fossils in palaeoenvironmental interpretation,</p>		15 Lectures
<p>UNIT II: PALAEONTOLOGY - II</p> <p>Micro-palaentology: Introduction, definition, different types of microfossils, their size range and composition, branches, uses. Introduction to Palynology: spores and pollens.</p> <p>Palaeobotany: Definition, conditions and different modes of preservation of plant fossils, classification and distribution of plants through geological ages. Brief study of following genera with respect to their characteristics and distribution: Ptillophyllum, Glossopteris, Gangamopteris, Vertebraria and Nilsonia. Record of plant fossils in India with reference to Gondwana and Post-Gondwana Flora.</p>		15 Lectures
<p>UNIT III : STRATIGRAPHY</p> <p>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.</p> <p>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.</p> <p>Unconformity: importance of unconformities, Classification, Structural classification and environmental classification. and evidence of unconformities.</p>		15 Lectures

Semester III USGEP301
PRACTICAL: PALAEONTOLOGY AND STRATIGRAPHY

Cr
1

- a) Identification (morphology, classification, geological distribution) and study of evolutionary trends of: trilobite, brachiopods, lamellibranchs, gastropods, cephalopods, echinoids, graptolites.
- b) Identification of micro fossils (morphology and geological distribution) :
Two each from foraminifera, ostracods and radiolarians.
- c) Identification plant fossils: Gangamopteris, Glossopteris, Ptillophyllum, Nilsonia, Cladophlebis, Schizoneura, Vertebraria.

Semester III USGEP302
PRACTICAL : CRYSTALLOGRAPHY

Cr
1

- 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:**
- i. CUBIC SYSTEM: Galena, Tetrahedrite & Pyrite classes
 - ii. TETRAGONAL SYSTEM: Zircon, Chalcopyrite, Nickel sulfate classes
 - iii. HEXAGONAL SYSTEM: Beryl, Apatite & Beta- Quartz classes.
 - iv. TRIGONAL SYSTEM: Calcite, Tourmaline and Alpha- Quartz classes.
 - v. ORTHORHOMBIC SYSTEM: Barite class.
 - vi. MONOCLINIC SYSTEM: Gypsum class.
 - vii. TRICLINIC SYSTEM: Axinite class.
- c) **Study of Twin-axis**, Twin plane and composition plane of the following types of Twin crystals:
- i. Simple contact twinning: Spinel, Rutile, Aragonite, Gypsum, Augite, Orthoclase (Baveno, Manebach, Carlsbad).
 - ii. Simple penetration twinning: Staurolite, Augite, Orthoclase (Carlsbad-partially penetrant).
 - iii. Multiple contact twinning: Albite.
 - iv. Multiple penetration twinning: Fluorite, Diamond (Star), Chrysoberyl (Wheel).
 - v. Multiple cyclic twinning: Aragonite, Chrysoberyl (Wheel).
- d) **Measurement of Axial ratios** of Tetragonal and Orthorhombic crystals by Formula calculation and Graphical methods

Semester III USGEP303
PRACTICAL Paper III – APPLIED GEOLOGY

Cr
1

Drawing of Block and Profile Diagrams to indicate following features:

- Dip and strike of beds.
- Current bedding and cross bedding
- Graded Bedding
- Pillow Lavas.
- Contact zone details of Sills, Dykes and Batholiths.
- Laccolith, Lopolith and Phacolith.
- Three-dimensional details of inclined lineation.
- Flow cleavage and fracture cleavage relationship..
- Types of folds and their features.
- Types of faults and their features.
- Horse, Drag and Brecciation in Faults.

GEOMORPHOLOGY AND CARTOGRAPHY

Measurement of areas enclosed within curves.

HYDROGEOLOGY

Problems on permeability, porosity and rate of flow and aquifer depths from resistivity data.

SEMESTER IV

Course Code	Title	Credits
USGE 401	ECONOMIC MINERAL DEPOSITS	2 Credits (45 lectures)
<p><u>UNIT 1</u> ORE GENESIS -I</p> <p>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. Stratabound and stratiform ore deposits. Structural and stratigraphic controls on mineralization, metallogenic epochs and provinces. Processes of formation of mineral deposits. Magmatic concentration (early and late magmatic mineral deposits) Sublimation and pegmatitic deposits</p>		15 Lectures
<p><u>UNIT II</u> ORE GENESIS –II</p> <p>Hydrothermal processes, cavity filling and metasomatism: Hydrothermal processes: Principle, character of solution, types of openings in rocks, factors affecting deposition from hydrothermal solutions, wall rock alterations. 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. Contact Metasomatic Deposits: definition, criteria of replacement, resulting mineral deposits. Sedimentation deposits, Metamorphic deposits. Evaporation deposits: brief account of non-metallic deposits of ocean water, lake water, ground water and hot springs. Residual deposits: conditions favouring formation of residual deposits. Mechanical concentration: principles and processes of formation of placer deposits (eluvial, alluvial, beach and aeolian).</p>		15 lectures
<p><u>UNIT III</u> ORE GENESIS - III</p> <p>Oxidation and solution in the zone of oxidation, ore deposits in the zone of oxidation. Supergene sulphide enrichment: requirements for supergene sulphide deposition, recognition of sulphide enrichment. Gossans and cappings, role of iron gossans, limonite and false gossans. Distribution of mineral deposits Formation, association and Indian distribution of following ore minerals: Mica, Copper, Manganese, Lead and Zinc, Bauxite, Chromite, Gold</p>		15 Lectures

Course Code	Title	Credits
USGE 402	OPTICAL MINERALOGY AND SYSTEMATIC MINERALOGY	2 Credits (45 lectures)
<p><u>UNIT I:</u> OPTICAL PROPERTIES OF MINERALS</p> <p>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, Polarizing Microscope: Its Construction and Working.</p> <p>Optical characteristics: Relief, Becke's test, Twinkling, Pleochroism, Birefringence, Polarization colours, Newton's scale, Extinction and Extinction angle, Anomalous polarization colours, Uniaxial and Biaxial minerals, Optical indicatrix, Interference figures, Optic sign, Sign of elongation, Use of Quartz wedge, Mica plate and Gypsum plate.</p>		15 Lectures
<p><u>UNIT II:</u> SYSTEMATIC MINERALOGY: PART I</p> <p>Stability relationships, Condition of formation, Crystallography, Physical and optical properties, Composition and structure, Diagnostic Features, Occurrence and Uses of:</p> <ol style="list-style-type: none"> i. Silica Group ii. Feldspar Group iii. Feldspathoid Group iv. Mica Group 		15 lectures
<p><u>UNIT III:</u> SYSTEMATIC MINERALOGY: PART II</p> <p>Stability relationships, Condition of formation, Crystallography, Physical and optical properties, Composition and structure, Diagnostic Features, Occurrence and Uses of:</p> <ol style="list-style-type: none"> i. Amphibole Group ii. Pyroxene Group iii. Olivine Group iv. Garnet Group v. Zeolite Group 		15 Lectures

Course Code	Title	Credits
USGE403	APPLIED GEOLOGY	2 Credits (45 lectures)
<p>UNIT I: APPLIED GEOLOGY</p> <p>Preparation of Geological Reports: 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.</p> <p>Instruments and Methods of Geologic Mapping:</p> <ol style="list-style-type: none"> Clinometer and Brunton Compass: their construction and use. Clinometer and compass method of reconnaissance mapping. Hand Levels: Their construction and use. Hand Level Method of Determination of Dip and Strike. Hand Level Traverses. Altimeter: Its construction and use. Altimeter techniques, including horizontal control, system of recording stations, note taking and correction of readings. 		15 Lectures
<p>UNIT II: GEOMORPHOLOGY AND CARTOGRAPHY</p> <p>Coastal Processes and Landforms: Dominant influences on Coastal Landforms, Sea level changes. Erosional land forms of the coast. Depositional landforms of the coast.</p> <p>Karst Processes and Landforms: Limestone Solution and erosion rates. Surface landforms: Minor solution sculpture, Enclosed depressions. caves and springs.</p> <p>Glaciers and Glaciated landforms: Glaciers: Ice movement, flow patterns, forms of glacier surfaces Glaciated erosional landforms and glaciated depositional landforms</p> <p>CARTOGRAPHIC AND MORPHOMETRIC ANALYSIS:</p> <p>Topographic Analysis: Topographical profiles Projected profiles and Superimposed profiles Spur Profiles.</p> <p>Slope Analysis: Morphological Mapping by Savigear's Method. Generalized Contour Map.</p> <p>Drainage basin analysis:</p> <ol style="list-style-type: none"> Linear aspects. Areal aspects 		15 Lectures

UNIT III :	HYDROGEOLOGY	15 Lectures
<p>Artificial recharge of ground water: Concept, methods, water spreading. waste water reused. Recharge mounds. Induced recharge.</p> <p>Surface Investigations of Ground water: Test-drilling. Resistivity logging. Potential logging. Temperature logging.</p>		

Semester IV USGEP401 PRACTICAL: ECONOMIC MINERAL DEPOSITS	
<p>Identification (with the help of physical properties), chemical composition, origin and Indian occurrences of Ore minerals and Industrial minerals of following minerals.</p>	
<p>Barite Barytes Bauxite Biotite Calcite Chalcopyrite Chromite Cuprite Dolomite Fluorite Galena Garnet Graphite Gypsum Hematite</p>	<p>Ilmenite Kyanite Limonite Magnesite Magnetite Malachite Marble Muscovite Psilomelane Pyrite Pyrolusite Serpentine Sphalerite Stibnite Talc Tourmaline</p>

Semester IV USGEP402 PRACTICAL: MINERALOGY		Cr 1
<p>Study of Physical and Optical characters, mode of formation and occurrence in Rock types of the following Igneous and Metamorphic Minerals:</p> <p>Igneous rock forming minerals: Quartz, Orthoclase, Microcline, Albite, Labrador Nepheline, Sodalite, Muscovite, Biotite, Hornblende, Augite, Aegirine, Hypersther Tourmaline and Apatite.</p> <p>Metamorphic minerals: Garnet, Staurolite, Chlorite, Talc, Serpentine, Actinolite, Tremolite, Anthophyllite, Epidote, Andalusite, Kyanite, Sillimanite, Calcite, Dolomite, Asbestos, Chrysolite, Magnesite.</p> <p>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, Mesolite, Chabazite, Laumontite,, Apophyllite (Prismatic & Pyramidal), Gyrolite and Okenite.</p>		

Determination of An-content of Plagioclase by symmetrical extinction method on Polarizing Microscope stage.

Semester IV USGEP403
PRACTICAL: GEOMORPHOLOGY AND CARTOGRAPHY

Cr
1

GEOMORPHOLOGY AND CARTOGRAPHY

Topographic Profiles, Projected Profiles,
Superimposed Profiles and Spur Profiles.
Longitudinal and cross valley profiles.
Drainage basin analysis – Linear aspects. Hypsometric analysis.

HYDROGEOLOGY

Skeleton diagrams to plot shape of water table.
Seismic Refraction problem,
Resistivity problem
Construction of Flow nets.

LIST OF RECOMMENDED REFERENCE BOOKS**USGE301**

1. Elements of Micropalaeontology: G. Bignot
2. Introduction to Palaeontology: Arnold
3. Invertebrate Palaeontology and Evolution: Clarkson
4. Principles of Invertebrate Palaeontology: R. Shrock & W. Twenhofel
5. Principles of Palaeontology: D. Romp & S. Stanley
6. Principles of Palaeontology: T. Olivier
7. Micropalaeontology: Jones
8. A Practical Approach to Sedimentology: Roy Lindholm
9. Basic Concepts of Historical Geology: E.W.Spencer
10. Historical Geology: Dunbar
11. Principles of Stratigraphy: Weller
12. Fundamentals of Historical Geology & Stratigraphy of India: Ravindra Kumar
13. Sedimentology and Stratigraphy : G. Nichols

RECOMMENDED REFERENCE BOOKS**LIST OF RECOMMENDED REFERENCE BOOKS****USGE302**

1. "Rutley's Elements of Mineralogy" (27TH Edition) H.H. Read and Revised by C.D. Gribble (CBS Publications)
2. "Manuel of Mineralogy" (21st Edition) Cornelius, S. Hurlbut Jr., Cornelius Klein (J. Wiley & Sons)
3. "Textbook of Mineralogy" Dana and Ford (Asia Publishing House)
4. "Elements of Mineralogy": Berry, Mason and Dietrich (W.H Freeman and Company)
5. Rock Forming Minerals: Deer, Howie, Zussman.
6. "Mineralogy" (2nd Edition) Dexter Perkins (PHI Learning Pvt. Ltd)
7. "Minerals" Hans- R. Wenk and A. Bulakh (Cambridge University Press)

LIST OF RECOMMENDED REFERENCE BOOKS**USGE303 and 403**

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

LIST OF RECOMMENDED REFERENCE BOOKS USGE 401

1. A Practical Approach to Sedimentology: Roy Lindholm
2. Basic Concepts of Historical Geology: E.W.Spencer
3. Historical Geology: Dunbar
4. Principles of Stratigraphy: Weller
5. Fundamentals of Historical Geology & Stratigraphy of India: Ravindra Kumar
6. Sedimentology and Stratigraphy : G. Nichols
7. Economic mineral deposits: Jensen and Bateman
8. Ore geology and Industrial minerals, An introduction : A.M. Evans

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1. "Rutley's Elements of Mineralogy" (27TH Edition) H.H. Read and Revised by C.D. Gribble (CBS Publications)
2. "Manuel of Mineralogy"(21st Edition) Cornelius,S. Hurlbut Jr., Cornelius Klein (J. Wiley & Sons)
3. "Textbook of Mineralogy" Dana and Ford (Asia Publishing House)
4. "Optical Mineralogy" (2nd Edition) A.F Rogers an P.F Kerr (McGraw- Hill)
5. "Elements of Mineralogy": Berry, Mason and Dietrich (W.H Freeman and Company)
6. Rock Forming Minerals: Deer, Howie, Zussman.
7. "Optical Mineralogy" (2nd Edition) David Shelly (Elsevier)
8. "Introduction to Optical Mineralogy" (Third Edition) W.D Nesse (Oxford University Press)
9. "Mineralogy" (2nd Edition) Dexter Perkins (PHI Learning Pvt. Ltd)
10. "Minerals" Hans- R. Wenk and A. Bulakh (Cambridge University Press)