University of Pune

Three Year B. Sc. Degree Course in

GEOLOGY

S.Y.B.Sc. Syllabus

(To be implemented from Academic Year 2014-15)

SEMESTER-I

Paper-I: GL: 211 –Mineralogy

UNIT I	**DESCRIPTIVE MINERALOGY (No. of Lecture 12)** **A)** Mineral Kingdom: Crystalline and Non-Crystalline minerals. **B)** Classification of minerals based on Chemical Composition and Silicate Structure. **C)** Study of the following mineral groups with respect to Silicate Structure, Chemical Composition, Physical and Optical properties and Paragenesis. i. Olivine (Olivine) ii. Pyroxene (Augite + Hypersthene) iii. Amphibole (Hornblende + Actinolite)
UNIT II	**DESCRIPTIVE MINERALOGY (No. of Lecture 12)** Study of the following mineral groups with respect to Silicate Structure, Chemical Composition, Physical and Optical properties and Paragenesis. i. Mica (Muscovite, Biotite) ii. Feldspar (Orthoclase, Microcline, Plagioclase) iii. Silica (Quartz) iv. Felspathoid. (Sanidine, Leucite, Hauyene-Nosean)
UNIT III	**CRYSTALLOGRAPHY: (No. of Lecture 12)** **A)** Definition of a Crystal, External and Internal Imperfections in Crystals, Growth of crystals in Cavities, Etch figures and Solution Pits. **B)** Study of Holohedral, Hemihedral and Hemimorphic forms of crystals with suitable examples **C)** i) Study of Cubic system (Type- Pyrite and Type Tetrahedrite) Comparative study of three types of Cubic system. ii) Study of Hexagonal system (Type-Calcite, Type- Quartz, &Type-Tourmaline), Comparative study of four Types of Hexagonal system. **D)** Twinning in crystals: Definition, Causes terms related to Twinning, Types of Twins and Laws of Twinning in the different crystal systems.

UNIT IV	**OPTICS & GEM STONES (No. of Lecture 12)**

A) Optics

i) Isotropism and Anisotropism in minerals

ii) Phenomenon of Extinction, Extinction Position in minerals of different Crystal System with respect to Vibration Direction and Optic Orientation.

iii) Phenomenon of Interference Colours and Newton's Scale of Interference Colours.

iv) Twinning (simple, multiple, cross hatching) & Zoning in Minerals

B) Gemstones

i) Introduction (Three basic attributes of Gemstones, Beauty, Durability and Rarity)
ii) Scope and Importance
iii) Study of the following gemstones with respect to their Physical Properties (Crystal System, Hardness and Sp Gravity), Optical Properties (Colour, Luster, Singly Refracting / Doubly Refracting and Refractive Index) and Indian geographical occurrences.

a) Diamond
b) Corundum (Ruby, Sapphire)
c) Beryl (Aquamarine, Emerald)
d) Silica (Rock crystal, Amethyst, Citrine, Tiger's eye, Opal)
e) Tourmaline
f) Topaz
g) Garnet (Almandine)

(Total Lectures=48)

SEMESTER-II

Paper-I: GL: 221-Petrology

UNIT I	**IGNEOUS PETROLOGY: (12 Lectures)** **A)** Physico-chemical constitution of Magma. a) Temperature b) Pressure c) Viscosity d) Volatiles **(B)** Crystallization of Magma. a) i) Unicomponent Magma ii) Factors controlling grain size of igneous rocks b) Bicomponent Magma i) Eutectic crystallization ii) Solid solutions (Plagioclase series) **(C)** Textures and Microstructures: a) Definition, factors determining the texture of rocks b) Study of following texture with respect to characters examples and genesis - Poikilitic, Ophitic, Subophitic, Intergranular, Intersertal, Directive, Intergrowth (Graphic) c) Study of following structures / micro structures with respect to characters, examples and genesis- Orbicular, Spherulitic, Perlitic, Expansion Cracks and Reaction Rims.
UNIT II	**SEDIMENTARY PETROLOGY (12 Lectures)** **(A)** Derivation of sediments. i. Sources of sediments ii. Mineral composition of clastic / detrital sediments iii. Concept of matrix and cement and its effect on porosity and permeability

	(B) Transportation of Detrital/ Clastic sediments: i. Modes of Transportation (Including phases of traction) ii. Definition of Competence, Capacity and Load of transporting Medium iii. Progressive changes in sediments during transport with respect to size, shape and mineral composition. **(C)** Diagenesis: Outline of following diagenetic processes:- Cementation, Authigenesis, Diagenetic Metasomatism, Diagenetic Differentiation and Intrastratal Solution. **D)** Primary Sedimentary Structures: Description of following primary structures with respect to their origin and environmental significance:- Lamination, Bedding, Cross Bedding, Graded Bedding, Ripple Marks, Mud-Cracks.
UNIT III	**METAMORPHIC PETROLOGY (12 Lectures)** **A)** Metamorphism and Metamorphic minerals: a) Salient features of metamorphism as a process b)Difference between Metamorphism, Weathering, Diagenesis and Metasomatism c) Metamorphic minerals- Stress and anti-stress minerals, Idioblastic and Xenoblastic crystals. **B)** Metamorphism and Metamorphic Products: Definition, general characteristics, textures/structures and mineral transformation involved during - a) Regional Metamorphism of i) Argillaceous rocks ii) Quartzofeldspathic rocks iii) Basic igneous rocks

	b) Cataclasis and its products- Crush Breccia, Crush Conglomerate, Cataclasite c) Thermal Metamorphism of i) Pure and impure limestones ii) Arenaceous rocks
UNIT IV	**CLASSIFICATION OF ROCKS AND FIELD WORK (12 Lectures)** **A)**Tabular classification of igneous rocks based on Colour Index, Depth of Formation, Feldspar Content, Chemical Composition and Saturation Concept showing the position of the following rocks- Granite, Gabbro, Dunite, Pegmatite, Dolerite, Rhyolite, Pumice, Basalt, Syenite, Diorite, Trachyte, Andesite, Graphic granite, Porphyries, Obsidian and Pitchstone. **B)** Study of following secondary deposits with respect to definition, texture/structure, mineral composition and their varieties. i) Residual-Latertite, Bauxite, Soil ii) Rudaceous- Conglomerate, Breccia iii) Arenaceous- Sandstones iv) Siltstones v) Argillaceous- Clays, Mudstone, Shale vi) Chemical deposits- Siliceous, Carbonates, Ferruginous and Salts. vi) Biochemical- Organic Limestone, Phosphatic Siliceous- and Carbonaceous Deposits. **C)** Description of megascopic Metamorphic rocks. **D)** Field Work.

(Total Lectures=48)

Paper-II:SEMESTER I GL-212: Structural Geology

UNIT I	**A. INTRODUCTION: (12 Lectures)** i) Definition and its relation with other branches of geology ii) Tectonic and Non-tectonic structures. iii) Scale of tectonic structures (Micro, Meso, Macro & Regional) **B. PLANAR/LINEAR STRUCTURES, OUTLIER/INLIER** i) Attitude of planar feature - Strike and Dip ii) True & Apparent Dip, True & Apparent thickness, True & Apparent Width of Outcrop and Vertical Thickness of planar feature. iii) Attitude of Linear Feature, Bearing, Plunge and Rake of Linear Feature in given Planar Feature. iv) Outlier and Inlier- Definition & Formation. v) Brunton Compass & its uses.
UNIT II	**A. FOLDS: (12 Lectures)** i) Introduction: Definition, causes and parts of folds: - axis, axial plane, limb, hinge, crystal line, crystal plane, trough line and trough plane. ii) Definition, causes and characters of the following types of folds: - anticline, syncline, anticlinorium, synclinorium, symmetrical, asymmetrical, overturned, recumbent, isoclinal, chevron, box, fan, monocline, homocline, Structural terrace, open, close, drag, plunging and nonplunging, doubly plunging, dome and basin. Decollement, diapir, disharmonic, suprataneous. iii) Concepts of fold systems and refolding iv) Method to determine the depth of folding- Principle, assumptions, merits and limitations. v) Recognition of folds by direct observation, plotting attitude of beds on map, topographic studies, drilling and mining data. vi) Methods of representation of folds
UNIT III	**FAULTS : (12 Lectures)** i) Definition of fault as a Planar zone, terms associated with Faults / fault zones ii) Movements along faults- absolute, relative, apparent, translational and rotational iii) Slips, separations, shift along faults iv) Effects of faulting on disrupted strata

	v) Geometric classification of faults vi) Genetic classification of faults vii) Recognition of faults in the field
UNIT IV	**A) JOINTS: (12 Lectures)** i) Definition and general characteristics of joints ii) Rupturing under tension, compression, couple and torsion iii) Geometric and genetic classification of joints with examples **B) UNCONFORMITY:** i) Definition, stages in development of unconformities, ii) Structural classification of unconformities, Recognition of unconformity in the field. iii) Distinguishing unconformable contacts from intrusive contacts and faults. **C) LANDFORMS ASSOCIATED WITH TECTONIC STRUCTURES** **D) DETERMINATION OF TOP OF BED WITH THE HELP OF PRIMARY STRUCTURES (SEDIMENTARY & IGNEOUS) AND INTERPRETATION OF MAJOR STRUCTURES WITH WHICH THEY ARE ASSOCIATED**.

(Total Lectures: 48)

SEMESTER-II

Paper-II: GL: 222 - Stratigraphy and Palaeontology

STRATIGRAPHY	
UNIT I	**(12 Lectures)** i) Introduction, definition, principles of stratigraphy, development of stratigraphic concepts, importance of stratigraphy. ii) 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. iii) Methods of collecting stratigraphic data (stratigraphic procedures on outcrop and subsurface)
UNIT II	**(12 Lectures)** i) Stratification : processes, Controlling stratification-physical, chemical and biological. Vertical succession, alternations, varves, cycles (symmetrical and asymmetrical) ii) Unconformity: definition, importance in stratigraphy environmental classification and stratigraphic evidence of unconformities. iii) Correlation: definition and evidence for correlation-physical and palaeontological.
PALAEONTOLOGY	
UNIT III	**(12 Lectures)** i) Concepts of organic evolution. (Definition, Evidence of evolution, Macro & Micro evolution, Darwinism, Lamarckism & Mutation) ii) Evolutionary trends in Ammonoids and Trilobites iii) Introduction to Micropalaeontology iv) Definition, different types of microfossils, their size range and composition. v) Different branches of Micropalaeontology. Uses of microfossils
UNIT IV	**(12 Lectures)** A) Field and Laboratory Techniques (i) Field techniques for collection of microfossils (sampling methods) (ii) Laboratory techniques for separation- Mechanical and chemicals methods, Recovery of microfossils from shale and limestone. Separation of microfossils from coal (maceration), Preservation and Illustration. B) Study of the following microfossils: (with respect to their morphology, environmental and paleo-ecological significance) (i) Foraminifers (ii) Ostracods (iii) Pollens and Spores (iv) Diatoms, Dinoflagellates, Radiolarian

(**Total Lectures: 48)**

Paper III: GL:-223 - Geology Practical

Total Practicals-20

Total Units-8

Unit I: MINERALOGY **No. of Practicals-3**

a) Megascopic: (At least 15 minerals from amongst the following) Study & identification of the following minerals in hand specimens):

Neso silicates: Staurolite, Topaz.

Inosilicates (Single chain):Hypersthene, Wollastonite.

Inosilicates (Double chain): Actinolite, Tremolite, Asbestos.

Phyllosilicates: Phlogopite, Chlorite, Serpentine, Kaolinite.

Tectosilicates: Sanidine, Labradorite, Sodalite, Leucite.

Cyclosilicates: Beryl, Tourmaline, Apatite, Corundum.

Sorosilicate: Epidote.

b) i) Ore minerals (any four)-

Wolframite, Stibnite, Malachite, Azurite, Iron pyrite, Iron glance, Psilomalaene.

ii) Gemstones (any four)-

Corundum (ruby, sapphire), Tourmaline, Beryl (aquamarine, emerald), Amethyst, Garnet.

c) Microscopic :

Study and identification of the following minerals under microscope:

Colourless Minerals: Tremolite, Quartz, Orthoclase, Sanidine, Leucite, Hauyne / Nosean.

Coloured Minerals: Staurolite, Andalusite, Sphene, Hypersthene, Diopside, Actinolite, Chlorite, Tourmalene.

Unit II: CRYSTALLOGRAPHY **No. of Practicals-2**

A) Study of Crystallographic Axes, Elements of Symmetry and Forms

with Indices of:-

i) Cubic system (Type-Pyrite and Type-Tetrahedrite)

ii) Hexagonal system (Type- calcite, Type-Tourmaline and Type- Quartz)

B) Study of the Twinned crystals

At least one twin crystal from each crystal system representing different types of twins.

Unit III: IGNEOUS PETROLOGY **No. of Practicals-2**

Megascopic and Microscopic study and identification of the following rocks.

a) Megascopic:-

Plutonic: Syenite, Diorite, Dunite.

Hypabyssal: Graphic granite, Pitchstone, Syenite - Porphyry, Dolerite.

Volcanic: Obsidian, Trachyte, Andesite

b) Microscopic:-

Plutonic: Granite, Syenite, Gabbro, Dunite.

Hypabyssal: Graphic granite, Pitchstone.

Volcanic: Rhyolite, Trachyte, Andesite, Basalt.

B) SEDIMENTARY PETROLOGY: **No. of Practicals-3**

a) Megascopic:-

Arkose, Grit, Sandstones (siliceous, ferrugineous and calcareous), Nummulitic Limestone, Meliolitic Limestone,Oolitic Limestone.

b) Study of following Primary Sedimentary Structures in hand specimen with their Environmental Significance.

1. Bedding 2. Cross bedding 3. Graded bedding 4. Ripple marks 5. Mud/ Sun cracks.

c) Microscopic:-

Ferruginous Sandstone, Arkose, Oolitic Limestone, Nummulitic Limestone.

C) METAMORPHIC PETROLOGY: No. of Practicals-2

a) Megascopic:

Any two varieties of Marble, Banded Haematite Quartzite, Phyllite, Chlorite schist, Mica garnet schist, Actinolite schist, Kyanite schist, Staurolite schist. Granite gneiss.

b) Microscopic:

Quartzite, Marble, Mica garnet schist, Hornblende schist, Biotite gneiss, Hornblende gneiss.

4. MICRO-PALAEONTOLOGY: No. of Practicals-1

Micro fossils- Two each from Foraminifera, Ostracod, Pollens/ Spores.

5.STRUCTURAL GEOLOGY

A) Study of Geological Maps:

a) One conformable series A with one vertical dyke.

b) Two conformable series.

c) One conformable series with one/ two vertical faults.

d) One unconformity and one vertical fault.

B) Structural problems:

a) Problems involving hill slope (hill slope given/ hill slope to be determined), true dip, true thickness, true width of outcrop and vertical thickness of the bed.

b) Problems involving true and apparent Dip, true and apparent thickness, true and apparent width of outcrop and vertical thickness of the bed (True dip & true thickness/ Vertical thickness/ width of the outcrop given).

c) Problems involving true and apparent dip of the bed-

i) True dip of the bed given- To find out apparent dip amount in the

given apparent dip direction

ii) True dip of the bed given- To determine apparent dip direction for given apparent dip amount.

iii) Two apparent dip amounts in two different directions given-

To find out strike direction, true dip direction and true dip amount.

Note- (Problems B and C to be solved by using descriptive geometry method involving construction of vertical section in desired directions)

*Dip angle to be given in degrees.

*Field Work- Compulsory Geology field work for 4 to 7 days in a region with geologically diversified rock types and structures in any suitable Indian occurrences under the guidance of a teacher. Students should submit a written field study report along with representative field samples.

REFERENCE BOOKS:

1. Structural Geology: M.P. Billings
2. Invertebrate Palaeontology : Henry Wood
3. Elements of Micropalaeontology : G.Bignot
4. Invertebrate Palaentology and Evolution: Clarkson
5. Principles of Invertebrate Palaentology:
   Robert Shrock and William Twenhofel
6. Principles of Palaentology:
   David Romp and Steven Stanely
7. Principles of Palaentology: T. Olivier
8. Basic Concepts of Historical Geology: E.W.Spencer
9. Historical Geology: Dunbar
10. Principles of Stratigraphy: Weller
11. Fundamentals of Historical Geology and
    Stratigraphy of India: Ravindra Kumar
12. Introduction to Microfossils: Danial Jones
13. Structural Geology: Miyashiro
14. Principles of Stratigraphy: Leman
15. Sedimentation and Stratigraphy:
    Krumbein and Sloss.
16. Calcareous Algae: John Wray