University of Mumbai

Syllabus
for B.Sc IIIrd Semester Courses in Geology
(June 2017 onwards)

Contents:

S.Y. B.Sc. Geology **Course Code : USGE 301**
Title: Stratigraphy, General and Invertebrate Palaeontology

Learning Objectives: Among the first of the core courses, developed keeping in mind the needs of a professional geologist and a learner who is likely to pursue his career in the subject, this course communicates the basis of stratigraphy and correlation of strata among rock sequences. The correlation between the rocks and the evolving life on our planet is dealt with in two units. They specifically deal with the characteristic features, origin, evolution and preservation of life in sedimentary rocks.

Number of lectures: 45

Unit 1 Stratigraphy **(15 lectures)**

Stratigraphic classification & nomenclature, study of stratigraphic elements, Stratigraphic Units: lithostratigraphic, geochronologic, chronostratigraphic and biostratigraphic.
Concept of biozones and applications of biostratigraphic units.
Walther's law of facies and its application in the field.
Introduction to sequence stratigraphic.

Unit 2 Paleontology - I **(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, Mass extinctions
Introduction to paleontology, Potential and preservation of fossils, Types and applications of fossils
Taphonomy

Study of functional morphology and evolutionary trends of:
-Trilobite
-Brachiopoda

Unit 3 Paleontology-II **(15 lectures)**
Study of functional morphology and evolutionary trends of:
-Mollusca: Pelecypoda, Gastropoda, and Cephalopods
-Corals
-Echinoidea
-Graptololoidea
Ichnofossils: introduction, types and applications in paleoenvironmental interpretation.

List Of Recommended Reference Books

1. Benton M.J. and Harper D.A.T. (2009), Introduction to Paleobiology and Fossil Record, Wiley-Blackwell Publication.
2. Nichols G. (2009), Sedimentology and Stratigraphy, Wiley-Blackwell.
3. Ray Anis. K, (2008), Fossils in Earth Sciences, Prentice Hall of India.
4. Catuneanu O. (2006), Principles of Sequence Stratigraphy, Elsevier.
5. Dasgupta, A., (2005), Introduction to Palaeontology, (1st Edition), World Press.
6. Kumar R. (1996), Fundamentals of Historical Geology and Stratigraphy of India, 4th ed., New Age International Limited.
7. Clarkson E. (1993), Invertebrate Paleontology and Evolution, Chapman and Hall.
8. Raup D. and Stanley S.M. (1971), Principles of Paleontology, W.H. Freeman.
9. Shrock Robert R. and Twenhofel William H. (1953), Principles of Invertebrate Paleontology, McGraw Hill Co., New York.
10. Spencer E.W. (1962), Basic Concepts of Historical Geology, Thomas Y. Crowell, New York.
11. Weller J.M. (1960), Stratigraphic Principles and Practice, Harper.
12. Woods H (1958), Paleontology-Invertebrate, University Press London.

Practicals

1. Identification (morphology, classification, and geological distribution) and study of evolutionary trends of: trilobite, brachiopods, lamellibranches, gastropods, cephalopods, echinoids, and graptolites.
2. Identification and interpretation of biozones in stratigraphy.

S.Y. B.Sc. Geology **Course: USGE 302**
Title: Crystallography

Learning Objectives:
The aim of the course is to communicate and facilitate the understanding of concepts of crystal structures, symmetry and point groups. The course is also aimed to relate the application of crystallography in various fields with special emphasis on mineralogy. This course becomes the prerequisite to advanced level (S.Geo.5.0 courses) in petrology and gemology.

Number of lectures: 45

Unit 1:
Characteristic of Crystals: (15 lectures)
Atomic arrangement in crystals, Bravais Lattices, Crystal symmetry, Elements of symmetry: Planes, Axes and Centre, Axis of inversion symmetry, Crystallographic axes, Miller Indices, Axial ratios, Classification of crystals, Stereographic projections of symmetry, Graphical symbols used in stereographic illustrations.

Unit 2:
The thirty-two crystal classes and possible forms of each class (15 Lectures)
Forms and crystal morphology, Name of forms, Illustration and description of forms, open forms and closed forms, point groups and crystal systems, Derivation of 32 classes of symmetry with Hermann-Mauguin symbols, Characteristic symmetry, and relationships between crystal axes and symmetry notation of crystal systems.

Unit 3:
X-ray Diffraction and Crystal imperfections (15 Lectures)
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, Manebech, Baveno, Albite, Albite-Carlsbad.
X-ray Diffraction: Brief introduction of X-rays, Diffraction effects and Bragg equation, Application of X-rays in crystallography and mineralogy.

List Of Recommended Reference Books

1. Read H.H. (Rev. ed. C.D. Gribble) (1988), Rutley's Elements of Mineralogy" (27TH Edition), CBS Publications.
2. Cornelius K. and Hurlbut Jr. S. (1994), Manual of Mineralogy, Twenty first Edition and Minerals and Rocks Exercises in Crystallography, J. Wiley & Sons.
3. Dana J.D. and Ford W.E. (rev. ed.) (2010), Dana's Manual of Mineralogy, J. Wiley & Sons.
4. Rogers A.F. and Kerr P.F. (1942), Optical Mineralogy (2nd Edition), McGraw-Hill Co. Inc., New York.
5. Berry L.G., Mason B.H. and Dietrich R.V. (1983), Mineralogy, concepts, descriptions, determinations, W.F. Freeman and Co.

6. Deer W.A., Howie A.H. and Zussman J. (1992), An introduction to rock forming minerals, Longman Scientific and Technical.
7. Shelly David (1985), Optical Mineralogy (2nd Edition), Elsevier.
8. Nesse W.D. and Schulze D.J. (2004), Introduction to Optical Mineralogy" (Third Edition) and An Atlas of Minerals in Thin Section, Oxford University Press.
9. Perkins Dexter (2011), Mineralogy (International Edition), Pearson Education.
10. Wenk H.R. and Bulakh A. (2004), Minerals: their constitution and origin, Cambridge University Press.

Practicals:

Study of Symmetry: Symmetry elements of 32 classes of symmetry

Stereographic projections of Symmetry elements of 32 classes of symmetryStudy of 48 possible forms in crystallography with special emphasis on crystals belonging to the following Fourteen classes of symmetry:

Cubic system: galena, tetrahedrite & pyrite classes

Tetragonal system: zircon, chalcopyrite, nickel sulfate 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.

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 (Bavano, 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).

S.Y. B.Sc. Geology **Course: USGE 303**
Title: Geomorphology and Cartography

Learning Objectives:
Understanding of -

- **Concepts of Geomorphology & Cartography**
- **Types & Origin of Landforms**
- **Cartographic Techniques, their applications & interpretations**

Number of lectures: 45

Unit 1: **(15 lectures)**

Concepts of Geomorphology:
Energy for landform change, methods of dating.
Geomorphic Systems: people as Geomorphic Agents, People as creators of Landforms.

Structure controlled Landforms:
Landforms controlled by various structures like faults and folds and resulting peculiarities of drainage patterns

Volcanogenic landforms :
Energy of volcanic eruptions, Products of Volcano, Types of Volcanoes, Types of Eruptions, Landforms produced by Erosion of Volcanic features

Landforms controlled by predominantly Weathering process:
Landforms produced by weathering and the various processes that lead to the formation of Corestones, Tors, Pits, Pans, Caverns, Rills, Duricrust.

Landforms resulting from fluvial processes:
Concept of Fluvial Transport and Deposition, Formation of Alluvial Fans, Floodplains and Terraces, Alluvial river channels, Alluvial Bars, Braided Channels, Straight and Meandering Channels.

Unit 2: **(15 lectures)**

Eolian Processes and Landforms:
Landforms resulting from Eolian Erosion, Transport and Deposition.

Coastal Processes and resulting Landforms:
Erosional landforms of the coast. Depositional landforms of the coast.
Influence of Current rates of Erosion, Climatic influences past and present, Sea level changes.

Karst Processes and resulting Landforms:
Limestone Solution and erosion rates.
Surface landforms in karst terrain, Minor solution Sculpture, Enclosed Depressions.

Karst landforms of fluvial erosion, Underground water, caves and springs.

Glaciers and resulting Landforms:
Ice Movement, Flow patterns, Forms of Glacier surfaces, Erosional and depositional landforms.

Unit 3: **(15 lectures)**

Topographic Analysis:
Topographical profiles, Projected profiles, Superimposed profiles, Spur Profiles, Cross Valley Profiles, Geomorphological Mapping Using I.G.U symbols.

Slope Analysis:
Morphological Mapping by Savigear's Method. Average Slope Map, Generalized Contour Map.

Drainage Basin Analysis:
Drainage Basin as a Unit of Study. Discharge of Water from a Watershed, Hydrograph Shapes, Flood Frequency, Patterns of Discharge. Drainage basin morphometry – Linear and areal aspects.

References:

1. Wilson J.P. and Gallant J.C. (ed) (2000), Terrain Analysis Principles and Applications, John Wiley.
2. Saha P. and Basu P. (2004), Advanced Practical Geography - A laboratory Manual.,Books and Allied (P) Ltd. Kolkata, India
3. King .C.A.M., (1967) Techniques in Geomorphology., Edward Arnold, London.
4. Misra R.P. and Ramesh A. (1989), Fundamentals of Cartography, Concept Publ. India.
5. Morisawa M. (1985), Rivers - Form and Process, Longman Publ.
6. Doornkamp J.C. and King C.A.M. (1971), Numerical Analysis in Geomorphology - an Introduction, Butler and Tanner, London.
7. Selby M.J. (1985), Earth's Changing Surface - An Introduction to Geomorphology, Oxford University Press.
8. Zavoianu I. (1985), Morphometry of Drainage Basins, Elsevier.
9. Mitchell C.W (1973), Terrain Evaluation, Longman
10. Judson S. and Kauffman M.E. (1990), Physical Geology, 8th edn. Prentice Hall
11. Robinson A. H,Sale R.D. and Morrison J.L. (1978), Elements of Cartography, 4th ed. John Wiley.

Practicals:
1. Measurement of lengths, and areas enclosed within curves. (1 session)
2. Projected Profiles, Superimposed Profiles and interpretation(1 session)
3. Longitudinal, Cross valley Profiles and interpretation(1 session)

4. Generalised contours, Altimetric frequency and interpretation (1 Session)
5. Drainage basin delineation on topographical map, Ordering streams using Strahlers scheme. (1 session)
6. Linear Aspects (Stream number, bifurcation ratios, weighted mean bifurcation ratios, regression of stream numbers vs. order) (1 session).
7. Linear aspects(stream lengths, length ratios and regression of stream lengths vs. order) (1 session)
8. Areal aspects – (delineating lower order basins and measuring the area of each, order wise and regression of basin areas vs. order) (1 session)
9. Hypsometric analysis (2 session)
10. Hypsometric analysis
11. Geomorphic mapping using IGU symbols (2 sessions)
12. Geomorphic mapping using IGU symbols