# Annexure-II

Details about Structure/Pattern of Syllabus:

1. **Title of the Course: F.Y.B.Sc. Geology Syllabus.**
2. **Course Level:** First year of 3 year B.Sc. Geology Degree course
3. **Syllabus to be implemented from the Academic year**: 2020-21
4. **Preamble of the Syllabus**: Our Earth is a cosmic body. It is one of the eight members of the Solar System.Geology is a science that deals with the study of the Earth. The subject of geology deals with the origin, history and evolution of the Earth. It also deals with its materials (rocks, minerals, ores, metals, coal and petroleum deposits etc) that constitute it, andthe processes, both external and internal, that operate on, and within it. Since inception of this branch of Science, Geology has remained a field of active research and has expanded in all possible directions. It is broadly categorized as pure and an interdisciplinary science. Since geology is a very vast and varied subject, for better understanding it has been divided into a number of branches. The fundamental branches of GeologyareMineralogy, Petrology, Dynamic Geology, Physical Geology, Structural Geology,Economic Geology,Palaeontology & Stratigraphy.The applied branches of Geology are Hydrogeology, Geotectonics, Coal Geology, Petroleum Geology, Marine Geology, Environmental Geology, Mining Geology, Geomorphology, Geochemistry, Geophysics, Oceanography, Seismology, Gemmology, EngineeringGeology, Photogeology (Remote Sensing), Historical Geology, Rock Mechanics, Nuclear Geology, Medical Geology.

   Natural resources and their proper exploitation play a vital role in nation building. All the natural resources except the solar energy are directly linked with the earth. Therefore knowledge of different aspects of Geology has become crucial and indispensable to everyone in the society and will help man to manage the available resources and conserve them in the best possible way. There is a continual demand for Geologists in the workforce- education, industry and research.Career opportunities for the graduate students are available in the private and government enterprises, research institutes and as self consultants in the fields of groundwater, soil analysis, gemmology, cutting and polishing of semi precious stones, trading of building materials, small scale mining etc. Also, multinational oil companies are recruiting qualified petroleum geologists.
5. **Introduction**: The present syllabus is sufficient to meet the needs of students for building up their careers in Geology. However looking at the changing scenario at a local and global level, and due to the very existence of the earth which has been threatened by calamities like earthquakes, volcanic eruptions, landslides, floods, tsunamis or droughts, which are directly or indirectly related to geological action on the surface or subsurface. Also looking at the fast depleting natural inorganic resources and the fuel deposits, it has become imperative that geology which incorporates the science of these natural hazards and the associated disasters should be taught rather effectively at the under-Graduate and Post-Graduate levels. Awareness related to the modern concepts of Plate Tectonics, Remote Sensing, and Geographical Information System (GIS) etc. is a must for all Geology graduate students. Theoretical knowledge supplemented with extensive laboratory expertise and field training will help the students, to avail all opportunities available and even start their own consultancy firms. Therefore revision and updating of the curriculum is an essential component and a continuous process of any university system. There has to be a dynamic curriculum with necessary re-orientations, additions and modifications introduced in it from time to time by the respective university so that it is compatible and in tune with the fast paced developments in the subject. It should be able to provide easy placement opportunities for the

students and also good avenues for research activities. Introduction of innovative concepts, providing a multidisciplinary profile in the concerned subject and an updated education to the students at large should be the prime aim while revising/renewing the curriculum. Geology curricula are operated at two levels viz undergraduate and postgraduate. The undergraduate curricula are prepared to impart basic and fundamental concepts of the subject Geology from all possible aspects. In addition field training will have a priority since geology is basically a field science and more practical exposure will benefit the student community at large and produce good geologists for the nation.

**6.Objectives to be achieved:**

1. To help students build-up a progressive and successful career in Geology
2. To enrich students knowledge and train them in the pure geological sciences.
3. To Provide an updated education.
4. To impart more field oriented knowledge.
5. To inculcate sense of scientific, social responsibilities and environment
6. awareness.
7. To introduce the concepts of application and research in Geology.
8. Create a sense of preservation and conservation of natural resources.
9. To study structural dynamics of the earth.
10. To study Stratigraphy and Palaeontology that encompasses the aspects of the age of the earth, chronological arrangement of rocks and appearance and evolution of life through the geologic time.
11. To study the changes that occurred in the history of the earth and relate them to their field observations and also, in understanding the framework of the stratigraphy of India
12. To study basics of mineralogy and crystallography, which helps in understanding and building the overall knowledge in Geology.
13. To study the processes involved in the formation of igneous, sedimentary and metamorphic rocks, their textures, structures, classifications and their importance.
14. To study the dynamic nature of the Earth processes.
15. To study the geodymanics of the lithosphere and concept of isostacy, ocean floor spreading, continental drift and plate tectonics.

## 7. Faculty of the Course : As per U.G.C. Rules

## 8. Eligibility for Admission:

**1. First Year B.Sc.:**

Higher Secondary School Certificate (10+2) or its equivalent Examination
Or as per the University of Pune eligibility norms.

**2. Second Year B.Sc.:**

Keeping terms of First Year of B. Sc. with Geology as one of the subjects. In addition to the above students are eligible if they fulfill the conditions approved by the equivalence committee of Faculty of Science of the University of Pune.

**3. Third Year B. Sc.:**

Student shall clear all First Year B. Sc. Geology courses and satisfactorily keeping terms of Second Year of B. Sc. with Geology as one of the subjects.

Note: Admissions will be given as per the selection procedure / policies adopted by

the respective college, in accordance with conditions laid down by the University of Pune.
Reservation and relaxation will be as per the Government rules.

**Standard of Passing**

i. In order to pass in the first year theory examination, the candidate has to obtain 20 marks out of 50 in each course of each semester. (Minimum 14 marks out of 35 must be obtained in the University Theory Examination.)
ii. In order to pass in the Second Year and Third Year theory examination, the candidate has to obtain 20 marks out of 50 in each course of each semester. (Minimum 14 marks out of 35 must be obtained in the University Theory Examination.)
iii. In order to pass in practical examination, the candidate has to obtain 40 marks out of 100 in each course. (Minimum 32 marks out of 80 must be obtained in the University Examination.)

**9. Duration of the Course**: Duration of B.Sc. (Geology) Degree programme shall be 3 years.

**10. Intake Capacity of Students: As per U.G.C. norms**

11. **Examination**:

Theory paper: University Examination – 35 marks (at the end of each semester)
Internal Examination – 15 marks
Practical course: University Examination – 35 marks (at the end of each semester)
Internal Examination – 15 marks
Theory examination will be of two hours duration for each theory course. There shall be 4 questions. The pattern of question papers shall be:
Question 1 - 5 sub-questions, each of 1 marks; objective type and based on entire syllabus
Question 2 and 3- 2 out of 3 sub-questions, each of 5 marks; short answer type questions; answerable in 10 – 15 lines
Question 4 - 1 out of 2 – long answer type questions; answerable in 20 – 25 lines.

I. Pattern of Examination:

i. Internal exam, Term end exam, Practical, Oral, Project.
ii. Pattern of the question paper: As per University rules

II. Standard of Passing: In order to pass in the first year theory examination, the candidate has to obtain 20 marks out of 50 marks in each course. (Minimum 15 marks out of 35 must be obtained in the university theory exam)

III. ATKT Rules:

While going from F. Y. B. Sc. to S. Y. B. Sc. at least 16 courses (out of total 24) should be cleared; however all F. Y. B. Sc. courses should be cleared while going to T. Y. B. Sc. While going from S. Y. B. Sc. to T. Y. B. Sc., at least 12 courses (out of 20) should be cleared (Practical Course at S. Y. B. Sc. will be equivalent to 2 courses).

IV. Award of Class:

The class will be awarded to the student on the aggregate marks obtained during the second and third year in the Principal subject only. The award of the class shall be as follows:

1. Aggregate 70% and above First Class with Distinction
2. Aggregate 60% and more but less than 70% First Class
3. Aggregate 55% and more but less than 60% Higher Second Class
4. Aggregate 50% and more but less than 55% Second Class
5. Aggregate 40% and more but less than 50% Pass Class
6. Below 40% Fail

V. External Students: There shall be no external students

VI. Setting of Question Paper/Pattern of Question Paper:

For theory papers I and II for each semester and also for
the practical examination question papers set by the Savitribai Phule Pune University, Pune.
Centralized assessment for theory papers done as per the University instructions.
Questions should be designed to test the conceptual knowledge and understanding
of the basic concepts of the subject.

VII. Verification/Revaluation: As per SPPU rules

12. **Structure of the Course**:

I. Compulsory Paper:

II. Optional Paper:

III. Question Paper and Paper:

IV. Medium of Instructions: English

13. Equivalence of previous syllabus along with proposed syllabus.:

| **Equivalent papers in Old course** | **Equivalent papers in Present course** |
|---|---|
| GL 111 Fundamentals of Geology | GL 111 Fundamentals of Geology and Understanding the Planet Earth |
| GL 112 Mineralogy and Crystallography | GL 112 Mineralogy and Crystallography |
| GL 113 Practicals related to GL 111 and GL 112 | GL 113 Practicals related to GL 111 and GL 112 |
| GL 121 Stratigraphy and Palaeontology | GL 121 Stratigraphy and Sedimentation |
| GL 122 Petrology | GL 122 Petrology and Geochemistry |
| 123 Practicals related to GL 121 and GL 122 | 123 Practicals related to GL 121 and GL 122 |

14. University Terms:

15. Subject wise Detailed Syllabus: Attached seperately

16. Recommended Books:


1. Rutley's Elements of Mineralogy: H.H. Read
2. Text Book of Mineralogy: Dana and Ford
3. Principles of Petrology: Tyrrell
4. Manual of Mineralogy: Cornelius, S. Hurlbut and Cornel Klein

5. Invertebrate Palaeontology: Henry Woods
6. General Geology: Radhakrishnan
7. Invertebrate Paleontology: Shrock & Twenhofel
8. Miller, (1949) An Introduction to Physical Geology. East West Press Ltd.
9. Spencer, E.V., (1962) Basic concepts of Physical Geology. Oxford & IBH.
10. Mahapatra, G.B., (1994) A text book of Physical Geology. CBS Publishers.
11. Press and Siever (1998) Understanding Earth, WH Freeman & Co.
12. Emiliani, C. (1992). Planet earth: cosmology, geology, and the evolution of life and environment. Cambridge University Press
13. Wadia, D., (1973) Geology of India. McGraw Hill Book co.
14. Krishnan, M.S., (1982) Geology of India and Burma, 6th Edition. CBS Publ.
15. Ramakrishnan M, and Vaidynadhan, R (1994) Geology of India, Geological Society of India Publication, Bangalore. Vol. I &II.
16. Friedman & Sanders, (1978) Principles of Sedimentology. John Wiley and sons.
17. Pettijohn, F.J., (1975. Sedimentary rocks, Harper & Bros. 3rd Ed.
18. Sengupta. S., (1997) Introduction to sedimentology. Oxford-IBH.
19. Pettijohn F.J. (1984) Sedimentary Rocks (3rd Edition), CBS Publishers and Distributors, New Delhi.
20. Sengupta S.M. (2007) Introduction to Sedimentology (2nd Edition), CBS Publishers and Distributors, New Delhi.
21. Boggs S., Petrology of Sedimentary rocks (2nd edition), Cambridge University Press.
22. Greensmith J. (1989) Petrology of the Sedimentary rocks (7th Edition), CBS Publishers, New Delhi.
23. Tucker E.M. (2001) Sedimentary Petrology (3rd Edition), Blackwell Science Ltd.
24. Ram S. Sharma and Anurag Sharma (2013) Crystallography and Mineralogy - Concepts and Methods. Text Book Series, Geological Society of India, Bangalore
25. Dana, E.S. and Ford, W.E., (2002) A textbook of Mineralogy (Reprints).
26. Flint, Y., (1975) Essential of crystallography, Mir Publishers.
27. Phillips, F.C., (1963)An introduction to crystallography. Wiley, New York.

28. Berry, L.G., Mason, B. and Dietrich, R.V., (1982) Mineralogy. CBS Publ.
29. Read, H.H., (1968)Rutley's Element of Mineralogy (Rev. Ed.). Thomas Murby and Co.
30. Berry and Mason, (1961) Mineralogy. W.H. Freeman & Co. Kerr, B.F., (1995) Optical Mineralogy 5th Ed. McGraw Hill, New York.
31. Ram S. Sharma (2016) Metamorphic Petrology Concepts and Methods. Text Book Series, Geological Society of India, Bangalore
32. Bose M.K. (1997) Igneous Petrology. The World Press Pvt. Ltd. 568 p.
33. Ehlers, WG, and Blatt, H.(1987) Petrology, Igneous, Sedimentary and Metamorphic rocks, CBS Publishers
34. Turner, F.J., (1980) Metamorphic petrology. McGraw Hill.
35. Mason, R., (1978) Petrology of Metamorphic Rocks. CBS Publ.
36. Winkler, H.G.C., (1967) Petrogenesis of Metamorphic Rocks. Narosa Publ.
37. Best M.G. Igneous and Metamorphic Petrology, Blackwell Publications
38. Blatt H., Tracy R.J. and Owens B.E. (2006) Petrology – Igneous, sedimentary and Metamorphic rocks (3rdEdition), W.H. Freeman and Company, New York.
39. Collinson J.D and Thompson D.B (1989) Sedimentary Structures (2nd Edition), Unwin Hyman Ltd, Sydney.
40. Hatch F.H., Wells A.K and Wells M.K. (1984) Petrology of the igneous rocks. CBS Publishers, 551 p.
41. Turner F.J and Verhoogen J. (1960) Igneous and Metamorphic Petrology, McGraw- Hill.
42. Winter J. D. (2001) An Introduction to Igneous and Metamorphic Petrology, Prentice Hall, 697p
43. Rollinson, H. (2007) Using geochemical data – evaluation, presentation and interpretation. 2nd Edition. Publisher Longman Scientific & Technical.
44. Philpotts, A. and Ague, J. (2009). Principles of igneous and metamorphic petrology. Cambridge University Press.
45. Raymond, L. A. (2002). Petrology: the study of igneous, sedimentary, and metamorphic rocks. McGraw-Hill Science Engineering
46. Patwardhan, A.M. (2012)The dynamic Earth System, PHI Learning Pvt. Ltd.,
47. MooresE.M. and Twiss R.J. (1995) Tectonics, W. H. Freeman
48. Valdiya, K.S.,(1984) Aspects of Tectonics: Focus on Southcentral Asia,Tata-McGraw

Hill, New Delhi,

49. Beloussov, V.V. (1980) Geotectonics, Springer-Verlag Berlin Heidelberg

50. Condie, K.C.(1989) Plate Tectonics &Crustal Evolution, Butterworth-Heinemann

51. Billings, M.P. (1942) Structural Geology, Prentice Hall,

52. Badgley,P. C. (1965) Structural & Tectonic Principles, Harper & Row

17. Qualification of Teacher: As per U.G.C. norms
18. Detailed Syllabus CD ( only word file) :

**Savitribai Phule Pune University, Pune**
**F.Y. B.Sc. – Geology**
**Course Structure**

| **Semester I (5.5 Credits)** | | |
|---|---|---|
| **Core Courses** | | |
| **Subject Code** | **Subject Title** | **Number of Credits** |
| GL 111 T | Fundamentals of Geology and Understanding the Planet Earth | 2 Credits |
| GL 112 T | Mineralogy and Crystallography | 2 Credits |
| GL 113 P | Practicals related to GL 111 and GL 112 | 1.5 Credit |
| | **Total** | **5.5 Credits** |
| **Semester II (5.5 Credits)** | | |
| **Core Courses** | | |
| **Subject Code** | **Subject Title** | **Number of Credits** |
| GL 121 T | Stratigraphy and Sedimentation | 2 Credits |
| GL 122 T | Petrology and Geochemistry | 2 Credits |
| GL 123 P | Practicals related to GL 121 and GL 122 | 1.5 Credit |
| | **Total** | **5.5 Credits** |

**GL 111: Fundamentals of Geology and Understanding the Planet Earth (2Credits)**

**CC- I (Lectures 36)**

| Topics | No. of Lectures |
|---|---|
| **Credit I:** | |
| A) Introduction<br>Definition of Geology, its divisions, sub-divisions and scope | 1 |
| B) Planet Earth<br>Origin of the Universe (Big Bang Theory), Origin of the Solar System (Nebular, Encounter and Tidal Hypothesis)<br>a. Earth: Its size, shape and density. Temperature, pressure and magnetism within the Earth, Present day Hypsographic curve<br>b. Age of the Earth: A brief account of the historical methods. Determination of age by U/Pb, Th/Pb, K/Ar and Carbon method of Dating. | 6 |
| C) Historical Geology (Introduction) | 1 |
| D) Geological time scale: Concept and Criteria | 2 |
| E) Fossils (Definition, Condition and Modes of preservation of fossils; Uses and Importance of fossils) | 3 |
| F) Mass Extinction Events (List of Events, Six different events and Causes of mass extinction) | 3 |
| G) Climate change (Introduction, Causes, Physical evidences for climate change) | 2 |
| **Credit II:** | |
| A) Earth's Atmosphere: (Introduction, Classification of Atmosphere, Introduction to Atmospheric circulation, land-air-sea interactions), Hydrosphere (Introduction to ocean currents, types, causes and significance), Lithosphere (Structure and composition) and Biosphere (Ecology and food chain) | 3 |
| B) Earth's Crust, Mantle and Core | 1 |
| C) Evolution of the Earth's Crust (Earth crustal evolution: Introduction, Early crust; Crustal dichotomy; Types of crust and Crustal growth rates) | 2 |
| D) Evolution of the Oceans (Introduction, Formation of the Oceans) | 2 |
| E) Rock deformation (Definition, Stress, Types of differential stress; Strain; Types of deformation; Types of Forces; Introduction to Fold, Fault, Joints and Fracture) | 2 |
| F) Plate Tectonics: Plate, Platform and Shield; Different tectonic settings on Earth, Mid oceanic ridges, rift valley and island arcs. Sea floor spreading. | 2 |
| G) Volcanoes: Genesis of volcanoes, central and fissure types of eruptions, products of volcanoes, effects of volcanoes and Earth's volcanic belts. | 2 |
| H) Earthquakes: Definition, terminology, causes, intensity and magnitude; Recording of earthquakes (modern recording methods), Use of seismic waves and their importance in interpreting the earth's internal structure; Seismic zones; History and susceptibility of the Indian subcontinent to earthquakes. | 2 |
| I) Meteorites (Definition, types and origin) | 2 |

**GL 112 Mineralogy and Crystallography Credits: 02**

**(Lectures: 36)**

| Topics | No. of lectures |
|---|---|
| **Credit I:Mineralogy** | |
| **A) Introduction:** Definition, branches and scope of mineralogy. Importance and conservation of minerals. | 1 |
| **B) Chemistry of Minerals**<br>a. Atoms and Ions.<br>b. Bonding forces in crystals:- Ionic, Covalent, Vander Waal's and Metallic bond, crystals with more than one type ofbonds.<br>c. Major element constituting ofminerals.<br>d. Geochemical affinity & geochemical classification ofelements.<br>e. Geometrical and electrical stability of minerals. (concept of relative size ofions, radius ratio, co-ordination number & ionicsubstitution)<br>f. Isomorphism, polymorphism, pseudomorphism.<br>g. Silicate structures | 4 |
| **C) Formation of minerals:**<br>Introduction and description of geological processes of mineral formation;<br>a. Crystallization frommelt.<br>b. Crystallization from solution. (Evaporation andprecipitation)<br>c. Crystallization from vapour.(Sublimation)<br>d. Metamorphic processes.<br>e. Alteration and related weathering. (oxidation and supergeneenrichment) | 3 |
| **D) Uses of Minerals in Industries:**<br>Ceramic, Refractory, Pharmaceutical, Paint, Glass, Cement, Fertilizer, Oil Industry, Electrical and Electronics. | 2 |
| **E) Physical properties of minerals**<br>a. Colour, streak, luster, cleavage, fracture, hardness, form, magnetic and electrical properties, radioactivity, specific gravity & luminescence. (Phosphorescenceand Fluorescence)<br>b. Methods of determining specific gravity – Chemical balance,Walker's steelyard, Jolly's spring balance, pycnometer, heavyliquids | 4 |
| **F) Optical mineralogy**<br>a. Nature of light – ordinary and plane polarizedlight.<br>b. Double refraction of light. (with the help of calcitecrystal)<br>c. Nicol's prism andpolaroids.<br>d. Petrologicalmicroscope.<br>e. Opticalproperties of Minerals:–<br>• In plane polarized light: Colour, form, cleavage, cracks, relief, twinkling, pleochroism.<br>• In between crossed nicols: Isotropism, anisotropism, extinction positions (straight, oblique and symmetrical), extinction angle, interferencecolours, twinning, crosshatching | 4 |

| **Credit II: Crystallography** | |
|---|---|
| **A.** Definition and conditions conducive for the formation of crystals. | 1 |
| **B.** Crystal morphology – faces, forms, edges, solid angles, interfacial angle andits measurement by contact Goniometer, law of constancy of interfacialangle. | 2 |
| **C.** Symmetry ofcrystals – Plane, axis and center of symmetry, crystallographic and geometrical symmetry. Crystallographic axes, lettering and order of crystallographic axes, parameters, axial ratio, indices, parameter system of Weiss, index system of Miller, Law of rationalindices. | 3 |
| **D.** Bavarias crystal lattice: Study of following crystallographic systems with respect to their elements of symmetry, crystallographic axes and theirforms withindices.<br>i. Orthorhombic (Type:Barytes)<br>ii. Tetragonal (Type:Zircon)<br>iii. Cubic (Type:Galena)<br>iv. Hexagonal (Type:Beryl)<br>v. Monoclinic (Type:Gypsum)<br>vi. Triclinic (Type:Axinite)<br>vii. Trigonal | 12 |

**REFERENCE BOOKS -**


1) Rutley's Elements of Mineralogy by H.H. Read.
2) Mineralogy by Berry & Mason
3) Mineralogy by Dexter Perkins
4) An Introduction to the rock forming minerals by Deer, Howie, Zussman
5) Manual of Mineralogy by Kleine&Hurlbut C.S.
6) Optical Mineralogy by Kerr P.F.
7) Optical Mineralogy by Whalstrom E.E.
8) Optical Mineralogy & Non opaque minerals by Philip W.R. &Griffen D.T.
9) Dana's textbook of Mineralogy by William E. Ford.
10) Optical Mineralogy by S.Ray and PRJ Naidu

**GL 113: Practicals related to GL 111 and GL 112 (2 Credit)**

| Topics | No. of Practicals |
|---|---|
| **Mineralogy**<br>**A)** Physical properties of minerals:<br>Colour, form, streak, luster, cleavage, fracture, hardness and specific gravity. | 1 |
| **B)** Identification of following **Megascopic minerals** in hand specimens with the help of physical properties: (Any 15)<br>Quartz, Rock crystal, Rose Quartz, Milky Quartz, Smoky quartz, Amethyst, Chalcedony, Agate, Jasper, Flint, Opal, Orthoclase, Plagioclase, Biotite, Muscovite, Garnet, Olivine, Hornblende, Apophyllite, Stilbite, Kyanite, Talc, Calcite, Fluorite, Gypsum, Baryte. | 2 |
| **C**) Optical Mineralogy:<br>Study of optical properties of minerals in plane polarised light and between crossednicols. | 1 |
| D**) Microscopic minerals:(Any 6)**<br>Olivine, augite, hornblende, microcline, plagioclase, muscovite, biotite, calcite, garnet, quartz and orthoclase. | 1 |
| **E) Crystallography**<br>Study of elements of symmetry, crystallographic axes and forms with indices of the following crystal systems representing all the fundamental crystal forms:<br>a) Cubic System (Type:Galena)<br>b) Orthorhombic System (Type:Baryte)<br>c) Tetragonal System (Type:Zircon)<br>d) Hexagonal System (Type:Beryl) | 2 |
| **F) Toposheets and study of landform models:**<br>Reading of toposheets with reference to toposheet number, latitude and longitude, state/districts, scale, adjacent toposheet number and conventional signs. | 1 |
| **No. of Practicals** | 8 |

**SEM II**

## GL 121: Principles of Stratigraphy and Sedimentation (2 Credits)

**CC-III** **(Lectures: 36)**

| Topics | No. of Practicals |
|---|---|
| **Credit I: Principles of Stratigraphy and Sedimentation** | |
| **A) STRATIGRAPHY**<br>**c)** Introduction, definition, principles of stratigraphy, development of stratigraphic concepts, importance of stratigraphy.<br>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.<br>iii) Methods of collecting stratigraphic data - stratigraphic procedures on outcrop | 8 |
| **Sedimentary Petrology**<br>A) Weathering (mechanical and chemical), erosion, denudation, Sediments, sedimentation and formation of sedimentary rocks –transportation, deposition, compaction, cementation and lithification Classification and description of sedimentary rocks. Sedimentary environment (definition and types)<br>B) Derivation of sediments.<br>i. Sources of sediments<br>ii. Mineral composition of clastic / detrital sediments<br>iii. Concept of matrix and cement and its effect on porosity and permeability<br>C) Transportation of Detrital/ Clastic sediments:<br>i. Modes of Transportation (Including phases of traction)<br>ii. Definition of Competence, Capacity and Load of transporting Medium<br>iii. Progressive changes in sediments during transport with respect to size, shape and mineral composition. | 4<br><br><br><br><br>3<br><br><br><br>3 |
| **Credit II: Sedimentation** | |
| A) Textures and Primary structures of sedimentary rocks:<br>a. Definition of texture & factors controlling textures of sedimentary rocks<br>b. Clastic and non-clastictextures.<br>primary sedimentary structures & their significance (a brief mention of their varieties):<br>1. Bedding<br>2. Lamination<br>3 Cross bedding<br>4 Graded bedding<br>5 Ripple marks<br>6. Chemical structures: stylolites, concretions, nodules<br>7. Penecontemporaneous sedimentary Structures: Load-cast, flute-cast, mud-cracks,ball & pillow, clastic dykes, slump folds, Dewatering folds<br>8. Study of organic sedimentary structures (in brief), Biogenic (Tracks and trails) | 9<br><br><br><br><br><br><br><br><br><br>9 |

| | |
|---|---|
| B) Study of following secondary deposits with respect to sedimentary environments, definition,texture/structure, mineral composition and their varieties.<br>i) Residual-Latertite, Bauxite, Soil<br>ii) Rudaceous- Conglomerate, Breccia<br>iii) Arenaceous- Sandstones<br>iv) Siltstones<br>v) Argillaceous- Clays, Mudstone, Shale<br>vi) Chemical deposits- Siliceous, Carbonates, Ferruginous and Salts.<br>vi) Biochemical- Organic Limestone, Phosphatic Siliceous- and Carbonaceous Deposits. | |

**GL: 122 PETROLOGY AND GEOCHEMISTRY**

**36 Lectures**

| | |
|---|---|
| **Credit I : IGNEOUS PETROLOGY** | |
| Definition of Petrology and Rock Cycle | 1 |
| Magma<br>i. Magma and its composition and physic chemical characteristics<br>ii. Bowen's Reaction Series<br>iii. Formation of crystal and glass | 3 |
| (A) Crystallisation of Magma<br>i. Crystallisation of Unicomponent Magma<br>ii. Bi- component Magma | 2 |
| (B) Textures and Structures<br>i. Texture : Definition and Factors controlling Texture<br>ii. Types of Textures : Equigranular and Inequigranular-Porphyritic, Poikilitic (Ophitic, Sub-Ophitic), Directive, Intergranular and Intersertal, Intergrowth Texture<br>iii. Structures- Vesicular, Amygdaloidal, Blocky, Pillow, Columnar, Ropy and Flow. | 4 |
| (C) Igneous Classification<br>i. Classification based on- Depth of formation, silica percentage, TAS, QAPF. | 4 |
| **Credit II: GEOCHEMISTRY & METAMORPHIC PETROLOGY** | |
| **1. INTRODUCTION TO GEOCHEMISTRY**<br>a) Nucleosynthesis and Stellar Evolution<br>Formation of elements, stability of Nucleii, structure of nucleus, isotopes, isobars, basic terms of radioactivity like α, β, γdecay.<br>b) Structure of Earth<br>Major elements and base elements in the Earth, Goldschmidt's Classification, Lithophile, chalcophile, siderophile elements, Geochemical Periodic table based On the behavior of elements, geochemical composition of crust, mantle and core, Composition of bulk earth.<br>c) Geochemical behavior in Igneous Processes<br>• Behavior and distribution of trace elements between co-existing phases (solid, liquid, gases), factors governing the value of partition coefficients (in mafic and ultramafic systems), equilibrium melting (batch melting) and fractional melting. The T-P gradient of Earth's crust and mantle.<br>• Equilibrium crystallization and fractional crystallization from magma. | 1<br>2<br>2 |
| 2. Radiogenic Isotope Geochemistry<br>a. Basics of Radioactive decay: -Law of radioactive decay, geochronology, terms like isochrones and dating of rocks.<br>b. Decay systems and their applications<br>Detail Rb-Sr and Re-Os system and its application for all crustal processes and petroleum (source rock) dating, dating calculation. | 2 |
| 3. Stable Isotope Geochemistry<br>Introduction, low stable and radioactive isotope geochemistry in different with different application of δ18O, δ D, δ13 C, δ15 N. Dating of fossils using 14C carbon dating. | 1 |

| **METAMORPHIC PETROLOGY** | |
|---|---|
| A. Definition of Metamorphism, Agents of Metamorphism | 2 |
| B. Metamorphism and types of Metamorphism.<br>a. Definition, General Characteristics, factors controlling textures and structures<br>b. Thermal Metamorphism- Pure and Impure Limestone<br>c. Dynamic/Cataclastic Metamorphism<br>d. Regional Metamorphism and its products<br>Argillaceous Rocks<br>Basic Igneous Rocks | 9 |
| C. Concept of Metamorphic Facies<br>Diagramatic Representation of pressure, temperature conditions (with depth) of the different facies of contact, regional and plutonic metamorphism | 3 |

**GL 123: Practicals related to GL 121 and GL 122 (2Credit)**

| Topics | No. of Practicals |
|---|---|
| A) Petrology<br>Identification of the following megascopic and microscopic rocks with respect to theirtexture/structure, mineral composition and classification | |
| a) Igneous: Granite, gabbro, rhyolite, basalt (its varieties), pegmatite (Classification based on colour index, mineral composition and texture) | 2 |
| b) Sedimentary: Laterite, bauxite, breccia, conglomerate, sandstone, shale, mudstone and limestone. | 2 |
| c) Metamorphic: Slate, marble, quartzite, mica schist and mica gneiss. | 1 |
| **B)** Study of following **Primary Sedimentary Structures** in hand specimen with their Environmental Significance.<br>1. Bedding 2. Cross bedding 3. Graded bedding 4. Ripple marks 5. Mud/ Sun cracks | 1 |
| **C)**Stratigraphic correlation | 1 |
| **D)** One day Geological Fieldwork to be conducted in an area of geological interest and geological report to be submitted for the same. | 1 |
| **No. of Practicals** | 8 |

**List of Reference Books:**


1. Read H.H. (1947): Rutley's Elements of Mineralogy. London:ThomasMurby&Co..
2. Ford W.E. (2006) Dana's Text Book of Mineralogy (Fourth Edition). CBS Publishers and Distributors PvtLtd
3. Tyrrell G.W. (1926): Principles of Petrology. Asia PublishinhHouse
4. Cornelius, S. Hurlbut and Cornel Klein (2002): Manual of Mineralogy. John Wiley & SonsInc.
5. Woods H. (1958): Invertebrate Palaeontology. Cambridge UniversityPress.
6. Radhakrishnan (1987) General Geology. VVP Publishers
7. Shrock R. R. and TwenhofelW. H.( 1935) Invertebrate Paleontology. McGraw Hill Book CompanyInc.
8. Miller, (1949) AnIntroduction to Physical Geology. East West PressLtd.

9. Spencer, E.V., (1962) Basic concepts of Physical Geology. Oxford &IBH.
10. Mahapatra, G.B., (1994) A text book of Physical Geology. CBSPublishers.
11. Press and Siever (1998) Understanding Earth, WH Freeman &Co.
12. Emiliani, C. (1992). Planet earth: cosmology, geology, and the evolution of life and environment. Cambridge UniversityPress
13. Wadia, D., (1973) Geology of India. McGraw Hill Bookco.
14. Krishnan, M.S., (1982) Geology of India and Burma, 6th Edition. CBSPubl.
15. Ramakrishnan M, and Vaidynadhan, R (1994) Geology of India, Geological Society of India Publication, Bangalore. Vol. I&II.
16. Friedman & Sanders, (1978) Principles of Sedimentology. John Wiley andsons.
17. Pettijohn, F.J., (1975. Sedimentary rocks, Harper & Bros. 3rd Ed.
18. Sengupta. S., (1997) Introduction to sedimentology.Oxford-IBH.
19. Pettijohn F.J. (1984) Sedimentary Rocks (3rd Edition), CBS Publishers and Distributors, NewDelhi.
20. Sengupta S.M. (2007) Introduction to Sedimentology (2nd Edition), CBS Publishers and Distributors, NewDelhi.
21. Boggs S., Petrology of Sedimentary rocks (2nd edition), Cambridge UniversityPress.
22. Greensmith J. (1989) Petrology of the Sedimentary rocks (7th Edition), CBS Publishers, NewDelhi.
23. Tucker E.M. (2001) Sedimentary Petrology (3rd Edition), Blackwell ScienceLtd.
24. Ram S. Sharma and Anurag Sharma (2013) Crystallography and Mineralogy - Concepts and Methods. Text Book Series, Geological Society of India,Bangalore
25. Dana, E.S. and Ford, W.E., (2002) A textbook of Mineralogy(Reprints).
26. Flint, Y., (1975) Essential of crystallography, MirPublishers.
27. Phillips, F.C., (1963)An introduction to crystallography. Wiley, NewYork.
28. Berry, L.G., Mason, B. and Dietrich, R.V., (1982) Mineralogy. CBSPubl.
29. Read, H.H., (1968)Rutley's Element of Mineralogy (Rev. Ed.). Thomas Murby and Co.
30. Berry and Mason, (1961) Mineralogy. W.H. Freeman & Co. Kerr, B.F., (1995)

Optical Mineralogy 5th Ed. McGraw Hill, NewYork.

31. Ram S. Sharma (2016) Metamorphic Petrology Concepts and Methods. Text Book Series, Geological Society of India,Bangalore
32. Bose M.K. (1997) Igneous Petrology. The World Press Pvt. Ltd. 568p.
33. Ehlers, WG, and Blatt, H.(1987) Petrology, Igneous, Sedimentary and Metamorphic rocks, CBS Publishers
34. Turner, F.J., (1980) Metamorphic petrology. McGrawHill.
35. Mason, R., (1978) Petrology of Metamorphic Rocks. CBSPubl.
36. Winkler, H.G.C., (1967) Petrogenesis of Metamorphic Rocks. NarosaPubl.
37. Best M.G. Igneous and Metamorphic Petrology, BlackwellPublications
38. Blatt H., Tracy R.J. and Owens B.E. (2006) Petrology – Igneous, sedimentary and Metamorphic rocks (3rdEdition), W.H. Freeman and Company, NewYork.
39. Collinson J.D and Thompson D.B (1989) Sedimentary Structures (2nd Edition), Unwin Hyman Ltd,Sydney.
40. Hatch F.H., Wells A.K and Wells M.K. (1984) Petrology of the igneous rocks. CBS Publishers, 551p.
41. TurnerF.JandVerhoogenJ.(1960)IgneousandMetamorphicPetrology,McGraw-Hill.
42. Winter J. D. (2001) An Introduction to Igneous and Metamorphic Petrology, Prentice Hall,697p
43. Rollinson, H. (2007) Using geochemical data – evaluation, presentation and interpretation. 2nd Edition. Publisher Longman Scientific &Technical.
44. Philpotts, A. and Ague, J. (2009). Principles of igneous and metamorphic petrology. Cambridge UniversityPress.
45. Raymond, L. A. (2002). Petrology: the study of igneous, sedimentary, and metamorphic rocks. McGraw-Hill ScienceEngineering
46. Patwardhan, A.M. (2012)The dynamic Earth System, PHI Learning Pvt.Ltd.,
47. MooresE.M. and Twiss R.J. (1995) Tectonics, W. H.Freeman
48. Valdiya, K.S.,(1984) Aspects of Tectonics: Focus on SouthcentralAsia,Tata-McGraw Hill, NewDelhi,
49. Beloussov, V.V. (1980) Geotectonics, Springer-Verlag BerlinHeidelberg

50. Condie, K.C.(1989) Plate Tectonics &Crustal Evolution,Butterworth-Heinemann

51. Billings, M.P. (1942) Structural Geology, PrenticeHall,

52. Badgley,P. C. (1965) Structural & Tectonic Principles, Harper &Row

* * *