University of Pune

Three Year B. Sc. Degree Course in

GEOLOGY

F.Y.B.Sc. Syllabus

(To be implemented from Academic Year 2013-14)

Preamble:

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, and the 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.

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.

Objectives to be achieved:

- To help students build-up a progressive and successful career in Geology
- To enrich students' knowledge and train them in the pure geological sciences.
- Provide an updated education.
- To impart more field oriented knowledge.
- To inculcate sense of scientific responsibilities and social and environment awareness.
- To introduce the concepts of application and research in Geology.
- Create a sense of preservation and conservation of natural resources.

Eligibility

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 40 marks out of 100 in each course. (Minimum 32 marks out of 80 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 16 marks out of 40 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.)

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

ATKT Rules

While going from F. Y. B. Sc. to S. Y. B. Sc. at least 8 courses (out of total 12) 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).

Equivalence of Previous Syllabus

No equivalence required at F. Y. B. Sc. level for Theory Paper I and Practical Paper III as the course titles are same as previous syllabus. For Theory Paper II equivalence with the old course shall be Paper II General Geology & Palaeontology.

External Students

There shall be no external students.

University Terms

Dates for commencement and conclusion for the first and second terms will be declared by the University authorities. Terms can be kept by only duly admitted students. The term shall be granted only on minimum 80 percent attendance at theory and practical course and satisfactory performance during the term.

Course Structure:

Duration: The duration of B.Sc. (Geology) Degree Program shall be three years.
Medium of Instruction: The medium of instruction for the course shall be **English.**

As geology is not taught at the Pre-University (10+2 level) except in few schools and Junior colleges teaching of geology would require special attention and treatment. The students of the first year of the undergraduate course are given exposure to some of the fundamental branches of geology. Hence emphasis has been given to those aspects of geology which would make students aware of larger perspectives of the subject and develop interest in the study of earth processes. In the second and third year the same sub-branches and some new branches of geology will be covered at higher academic levels, incorporating certain topics which are normally covered at the Post-Graduate levels.

At **first year of under-graduation**, the basic topics are covered related to the fundamental branches of Geology such as Mineralogy, Petrology, Structural

Geology, Physical Geology and Palaeontology. Mineralogy deals with the study of Minerals. These are the basic constituents of the rocks. It deals with the formation, physics, chemistry and occurrence of the minerals. Petrology covers the study of Igneous, Sedimentary and Metamorphic rocks with reference to their formation, distribution, type, composition etc. Structural Geology comprises the study of deformation of rocks and the architecture of the Earth. Physical Geology deals with the external agents, processes of deposition and erosion of the earth's surface. Mainly the depositional and erosional works of the rivers, lakes, glaciers, wind, sea etc are studied. Earth phenomena like earthquakes, volcanoes, formation of mountain chains, plate tectonics, isostacy, and continental drift are also included. Palaeontology deals with the study of ancient life, preserved in the form of fossils. Practicals related to the above topics are formulated in the practical course. In addition geological field work for at least two days and also preparation of laboratory journal will be a compulsory part of the syllabus.

At **second year under-graduation**: Mineralogy and Petrology shall be continued in one of the theory papers with more details and depths. Structural Geology which deals with the study of Faults, Folds, joints, unconformities in the rocks can be taken up in detail in one semester along with Stratigraphy and Paleontology in the second semester.Stratigraphy deals with the relative ages of rocks. It mainly deals with the study of layered rocks and their arrangement according to the geological age. The Practicals shall be more exhaustive and students will be made familiar with solving structural problems and Geological maps which are essential tools for unraveling many mysteries of the earth. Field work for 4to 7 days in a region with geologically diversified rock types and structures in any suitable Indian occurences under the guidance of a teacher is a compulsory component of the practical course. Students along with the practical journals should also submit a written field study report along with representative field samples.

At **third year under-graduation**, six theory papers in each semester deal with the further detail studies of the fundamental branches of Geology namely Mineralogy,Petrology,Structural Geology.Stratigraphy of India, Economic Geology and applied branches like environmental Geology, Remote Sensing,Geotectonics etc are taken up to cover up the essential aspects of geological studies at the undergraduate level. The three practical courses shall be based on the theory courses .Field work for about two weeks, in an area of geological interest anywhere in India ,systematic collection of geological samples, data collection and preparation of geological field report along with the preparation of Laboratory journals for all the practical courses is an compulsory part ofthecurricula.The systematic and planned curricula from first year to the third year shall motivate and encourage the students for pursuing higher studies in Geology with confidence.

First Year B. Sc. Geology

Paper/Course No.	Title	Pattern of examination	Total Number of lectures/practicals Per Term	Standard of passing		
				Internal marks out of **20**	External marks out of **80**	Total passing marks out of **100**
Theory Paper I (First term)	Mineralogy	Annual	Three lectures/Week (Total36 per term)	08	32	40 *
Theory Paper I (Second term)	Petrology		Three lectures/Week (Total36per term)			
Theory Paper II (First term)	Physical Geology	Annual	Three lectures/Week (Total36 per term)	08	32	40 *
Theory Paper II (Second term)	Palaeontology		Three lectures/Week (Total36 per term)			
Practical paper III (First & Second Term)	Practicals	Annual	11 Practicals of four lectures in each term (In all 22 practicals per year)	08	32	40 *

* Subject to compulsory passing in external examination and getting minimum 40 marks out of 100

Note: Total marks: Theory 200 + Practical 100 = 300 marks

Examination Pattern

Theory paper:	University Examination	– 80 marks (at the end of 2nd term)
	Internal Examination	– 20 marks
Practical course:	University Examination	– 80 marks (at the end of 2nd term)
	Internal Examination	– 20 marks

Theory examination will be of three hours duration for each theory course. There shall be 5 questions each carrying equal marks. The pattern of question papers shall be:

Question 1	8 sub-questions, each of 2 marks; answerable in 2 -3 line and based on entire syllabus
Question2 and3	4 out of 6– short answer type questions; answerable in 6 – 8 lines
Question 4	2 out of 4 – long answer type questions; answerable in 12 – 16 lines
Question 5	1 out of 2 –essay / long answer type question; answerable in 25 – 30 lines

Internal examination: Internal assessment of the student by respective teacher will be based on written test, 10 marks each term. The written test shall comprise of objective type questions – Multiple Type Questions, True / False, Definitions, Answer in Two or three line question (Describe/Explain).There shall be 20 questions, each question of 0.5 marks.
For practicals: one internal assessment tests + marks for journals + attendance + tour report. One practical internal assessment test to be taken.

Practical Examination: Practical examination shall be conducted by the respective college at the end of the academic year. Practical examination will be of minimum 4 hours duration. Certified journal is compulsory to appear for practical examination. There shall be one expert and two examiners per batch for the practical examination.

Setting question papers: For theory papers I and II annual question papers set by the university of Pune and assessment done at the respective colleges. Questions should be designed to test the conceptual knowledge and understanding of the basic concepts of the subject.

Second Year B. Sc. Geology

Paper/ Course No.	Title	Pattern of examination	Total Number of lectures/practicals Per Semester	Standard of passing		
				Internal marks out of 10 (theory) Out of 20 (practicals)	External marks out of 40 (theory) Out of 80 (practicals)	Total passing marks out of 50 (theory) and out of 100 (practicals)
Theory Paper I (GL 211)	Mineralogy	Semester I	Four lectures/Week (Total 45 per Semester)	04	16	20 *
Theory Paper II (GL 212)	Structural Geology		Four lectures/Week (Total 45 per Semester)	04	16	20 *
Theory Paper I (GL 221)	Petrology	Semester II	Four lectures/Week (Total 45 per Semester)	04	16	20 *
Theory Paper II (GL 222)	Stratigraphy and Palaeontology		Four lectures/Week (Total 45 per Semester)	04	16	20 *
Practical paper III (GL 223) (First & Second	Practicals	Annual	10 Practicals of four lectures in each Semester (In all 20	08	32	40 **

Semester)			practicals per year)			

* Subject to compulsory passing in external examination and getting minimum 20 marks out of 50

** Subject to compulsory passing in external examination and getting minimum 40 marks out of 100

Notes:

1. Total marks: Theory for each semester (50 + 50) = 100 marks
2. Total marks per year 200 (Theory) + 100 marks (practicals) = 300 marks
3. Internal marks for theory papers given on the basis of internal assessment tests and for practicals on internal assessment tests + journals + attendance + tour reports.
4. For all theory papers of both the semesters and practicals question papers set and assessed by the university of Pune

Examination Pattern

Theory paper:	University Examination	– 40 marks (at the end of each semester)
	Internal Examination	– 10 marks
Practical course:	University Examination	– 80 marks (at the end of 2nd semester)
	Internal Examination	– 20 marks

Theory examination will be of two hours duration for each theory course. There shall be 4 questions each carrying equal marks. The pattern of question papers shall be:

Question 1	10 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.

Internal examination: Internal assessment of the student by respective teacher will be based on written test, 10 marks each Semester. The written test shall comprise of objective type questions – Multiple Type Questions, True / False, Definitions, Answer in Two or three line question (Describe/Explain). There shall be 20 questions, each question of 0.5 marks.
For practicals: one internal assessment test + marks for journals + attendance + tour report.

Practical Examination: Practical examination shall be conducted at the respective college at the end of the academic year. Practical examination will be of minimum 4 hours duration. Certified journal is compulsory to appear for practical examination. There shall be one expert and two examiners per batch for the practical examination. One of the examiners will be external.

Setting question papers: For theory papers I and II for each semester and also for the annual practical examination question papers set by the University of 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.

Third Year B. Sc. Geology

Theory Papers

Paper/ Course No.	Title	Pattern of examination	Total Number of lectures Per Semester	Standard of passing		
				Internal marks out of 10 (theory)	External marks out of 40 (theory)	Total passing marks out of 50 (theory)
GL-331	Mineralogy	**SEMESTER III**	45	4	16	20*
GL-332	Igneous Petrology		45	4	16	20*
GL-333	Sedimentary Petrology		45	4	16	20*
GL-334	Structural Geology		45	4	16	20*
GL-335	Precambrian Stratigraphy of India		45	4	16	20*
GL-336	Applied Geology -I		45	4	16	20*
GL-341	Metamorphic Petrology	**SEMESTER IV**	45	4	16	20*
GL-342	Environmental Geology		45	4	16	20*
GL-343	Economic Geology		45	4	16	20*
GL-344	Geotectonics		45	4	16	20*
GL-345	Phanerozoic Stratigraphy of India and Palaeontology		45	4	16	20*
GL-346	Applied Geology -II		45	4	16	20*

Practical Papers

Paper/Course No.	Title	Pattern of examination	Total Number of Practicals Per Semester	Standard of passing		
				Internal marks out of 20)	External marks out of 80	Total passing marks out of 100
Practical Paper I (GL 347) (Third & Fourth Semester)	Mineralogy and Petrology	Annual	10 Practicals of four lectures in each Semester (In all 20 practicals per year)	08	32	40 **
Practical paper II (GL 348) (Third & Fourth Semester)	Structural Geology, Economic Geology, Palaeontology and Indian Stratigraphy	Annual	10 Practicals of four lectures in each Semester (In all 20 practicals per year)	08	32	40 **
Practical paper III (GL 349) (Third & Fourth Semester)	Applied Geology	Annual	10 Practicals of four lectures in each Semester (In all 20 practicals per year)	08	32	40 **

* Subject to compulsory passing in external examination and getting minimum 20 marks out of 50

** Subject to compulsory passing in external examination and getting minimum 40 marks out of 100

Notes:

1. Total marks: Theory for each semester (50 × 6) = 300 marks
2. Total marks per year 600 (Theory) + 300 marks (practicals) = 900 marks

Examination Pattern

Theory paper: University Examination – 40 marks (at the end of each semester)
Internal Examination – 10 marks
Practical course: University Examination – 80 marks (at the end of 2nd semester)
Internal Examination – 20 marks

Theory examination will be of two hours duration for each theory course. There shall be 4 questions each carrying equal marks. The pattern of question papers shall be:

Question 1	10 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

Internal examination: Internal assessment of the student by respective teacher will be based on written test, 10 marks each Semester. The written test shall comprise of objective type questions – Multiple Type Questions, True / False, Definitions, Answer in Two or three line question (Describe/Explain). There shall be 20 questions, each question of 0.5 marks.

For practicals: one internal assessment test + marks for journals + attendance + tour report.

Practical Examination: Practical examination shall be conducted at the respective college at the end of the academic year. Practical examination will be of minimum 4 hours duration. Certified journal is compulsory to appear for practical examination. There shall be one expert and two examiners per batch for the practical examination. One of the examiners will be external

Setting question papers: For all theory papers of both the semesters and practical question papers, setting and assessment by the University of Pune. Questions should be designed to test the conceptual knowledge and understanding of the basic concepts of the subject.

Qualification of Teachers:

With minimum postgraduate degree in Geology (M. Sc. Geology) and qualified as per UGC regulations.

University Of Pune
F.Y. B.Sc. - Geology; Revised syllabus wef. June 2013
Paper-I
Mineralogy
(Term – I)

Unit	Topics	No. of lectures
I	**A) Introduction:** Definition, branches and scope of mineralogy. Importance and conservation of minerals. **B) Formation of minerals:** Introduction and description of geological processes of mineral formation; a. Crystallization from melt. b. Crystallization from Solution. (Evaporation and precipitation) c. Crystallization from Vapour. (Sublimation) d. Metamorphic processes. e. Alteration and related weathering. (oxidation and supergene enrichment) **C) Utility of Minerals in Industries:** Ceramic, Refractory, Pharmaceutical, Paint, Glass, Cement, Fertilizer, Oil Industry, Electrical and Electronics.	2 4 3
II	**Crystallography** a. Definition and conditions conducive for the formation of crystals. b. Crystal morphology – faces, forms, edges, solid angles, interfacial angle and its measurement by contact Goniometer, law of constancy of interfacial angle. c. Symmetry of crystals – 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 rational indices. d. Study of following crystallographic systems with respect to their elements of symmetry, crystallographic axes and their forms with indices. i. Orthorhombic (Type: Barytes) ii. Tetragonal (Type: Zircon) iii. Cubic (Type: Galena) iv. Hexagonal (Type: Beryl) v. Monoclinic (Type: Gypsum) vi. Triclinic (Type: Axinite)	9

III	**A) Physical properties of minerals** a. Colour, streak, lustre, cleavage, fracture, hardness, form, magnetism, electrical property, radioactivity, specific gravity & luminescence. (Phosphorescence and Fluorescence) b. Methods of determining specific gravity – Chemical balance, Walker's steelyard, Jolly's spring balance, pycnometer, heavy liquids. **B) Optical mineralogy** a. Nature of light – ordinary and plane polarized light. b. Double refraction of light. (with the help of calcite crystal) c. Nicol's prism and polaroids. d. Petrological microscope. e. Introduction to optical properties:– • In plane polarized light: Colour, form, cleavage, cracks, relief, twinkling, pleochroism. • In between Crossed Nicols: Isotropism, anisotropism, extinction positions (straight, oblique and symmetrical), extinction angle, interference colours, twinning, cross hatching.	5 4
IV	**Crystal Chemistry** a. Atoms and Ions. b. Bonding forces in crystals:- Ionic, Covalent, Vander Waal's and Metallic bond, crystals with more than one type of bonds. c. Major element constituents of minerals. d. Geochemical affinity & geochemical classification of elements. e. Geometrical and electrical stability of minerals. (concept of relative size of ions, radius ratio ,co-ordination number & ionic substitution) f. Isomorphism, polymorphism, pseudomorphism. g. Silicate structures	9
	Total lectures	36

Paper-I
Petrology and Structural Geology
(Term – II)

Unit	Topics	No. of lectures
I	**Petrology** **A) Definition and major divisions** a. Definition of petrology, lithology, petrography, petrogenesis. b. Major divisions and diagnostic characteristic of rocks : igneous, Sedimentary and metamorphic. c. Rock cycle. **Igneous Petrology** **B) Magma** a. Magma and its composition. b. Formation of crystals and glass. **C) Forms of Igneous bodies** a. Intrusive: Concordant and discordant intrusions 1. Concordant: sill, laccolith, lopolith. 2. Discordant: dyke and veins, batholith. b. Extrusive: lava flows **D) Textures and Structures** a. Textures: Definition and factors controlling textures: Equigranular (granitic), Inequigranular (porphyritic), glassy b. Structures: Vesicular, amygdaloidal, blocky, pillow, flow and columnar. **E) Classification of Igneous Rocks** a. Basis of Classification: Depth of formation, silica percentage, Type of feldspar content and colour index. b. Tabular classification.	 1 2 2 2 2

II	**Sedimentary Petrology** **A)** Sediments, sedimentation, sedimentary environment (definition and types) and formation of sedimentary rocks **-** Weathering (mechanical and chemical), erosion, denudation, transportation, deposition, compaction, cementation and lithification **B)** Textures and structures of sedimentary rocks: a. Clastic and non-clastic textures. b. Structures: Lamination, bedding (concordant and discordant), graded bedding and ripple marks.	6 3
III	**Metamorphic Petrology** **A)** Definition of metamorphism, agents of metamorphism, kinds of metamorphism, characteristics of different types of metamorphism **B)** Tabular classification giving original rock, predominant agent of metamorphism, type of metamorphism and their metamorphic product of the following rocks: Slate, Quartzite, Marble, Hornblende schist, Mica schist, Hornblende gneiss. **C)** Structures in metamorphic rocks: maculose, slaty cleavage, granulose, schistose, gneissose	5 2 2
IV	**Structural Geology** **A)** Introduction and definition. **B)** Planar features and their measurements, Clinometer compass (construction and uses) **C)** Folds: Definition, parts of fold, anticline, syncline, symmetrical, asymmetrical. **D)** Faults: Definition terms associated with fault, normal fault, reverse fault, step fault, horst and graben. **E)** Joints: Definition, general characteristics, sheet joints, columnar joints. **F)** Unconformities: Definition and types (disconformity, angular unconformity, nonconformity)	 1 2 2 2 1 1
	Total lectures	36

Paper-II
Physical Geology
(Term – I)

Unit	Topics	No. of lectures
I	**A) Introduction**: Definition of geology, Its divisions, sub-divisions and scope **B) Planet Earth** Origin of the Universe (Big Bang Theory), Origin of the Solar System (Nebular, Encounter and Tidal theory) a. Earth: Its size, shape and density. Temperature, pressure and magnetism within the earth, Present day hypsographic curve b. Age of the Earth: A brief account of the historical methods. Determination of age by the K/Ar, U/Th and Carbon dating methods c. Geological Time Scale: Concept and Criteria.	1 8
II	**A)** The Earth's Atmosphere (Introduction to Atmospheric circulation, weather and climate changes, land-air-sea interactions, global climatic changes), Hydrosphere (Introduction to ocean currents, types and causes, significance), Lithosphere (Structure and composition) and Biosphere (Ecology and food chain) **B)** Earth's crust, mantle and core. **C)** Continental Drift: Concept and evidences – continental fit, Geological and palaeontological. **D)** Plate Tectonics: A brief introduction. **E)** Concept of Isostacy: Pratt's and Airy's model.	3 1 2 2 1
III	**A)** Weathering, erosion and denudation Types of weathering: • Mechanical – frost wedging, frost action, insolation, activities of organic life and exfoliation • Chemical-hydrolysis, hydration, solution, carbonation and oxidation	2

	B) The dynamics of erosional and depositional landforms resulting from the action of • **River** **Erosional landforms** – Waterfall, Potholes, mesa and butte Meandering and Ox-bow lake. **Depositional** landforms-Delta and types, alluvial fans, Flood Plain and river terraces. • **Wind** **Erosional landforms** - Deflation and Deflation armour, Yardangs, Mushroom rock. **Depositional** landforms - Sand Dunes and its types, loess. • **Sea** **Erosional landforms** - Sea cliff ,sea cave, natural arch, stack **Depositional landforms** - Beach and long shore drift deposits • **Glaciers** **Erosional landforms** - Valleys (U shaped and Hanging valley), crevasse, cirque, crag and tail **Depositional landforms** - Moraines and its types, Drumlins, Eskers.	7
IV	A. **Types of Mountains**: Fold, fault block, volcanic and residual. B. **Volcanoes**: Genesis of volcanoes, Central and fissure type of eruptions. Products of volcanoes, effects of volcanoes, earth's volcanic belts. C. **Earthquakes**: Definition, terminology, causes, intensity and magnitude. Recording of earthquakes (Modern recording method). 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. D. **Disasters and Disaster Management**: Disaster: Definition, types, effects, phases, prevention, mitigation and preparedness. A case study of any one Indian disaster. Disaster Management: Definition, types, warning, precautions, mitigation and management.	1 2 3 3
	Total lectures	36

Paper-II
Palaeontology
(Term – II)

Unit	Topics	No. of lectures
I	**A)** Palaeontology: Definition, branches, Importance and scope. **B)** Fossils: Definition, conditions and modes of preservation of fossils. techniques used in collection (Spot and channel), preservation and illustration of mega fossils.	1 8
II	Systematic position, morphology of hard parts, geological and geographical distribution of the following: **A) Phylum Mollusca:** I. Class Lamellibranchia or Bivalvia: Morphology of hard parts of the shell, ornamentation and types of hinge lines. II. Class Gastropoda: Morphology of hard parts of the shell and forms of the gastropod shell. III. Class Cephalopoda: Morphology of hard parts of Nautilus, Ammonoids, Belemnites and type of suture lines. Comparison between Nautilus and Ammonoids.	 3 3 3
III	**A) Phylum Brachiopoda** Morphology of hard parts of Class Articulata and Inarticulata. Types of brachial skeleton. Comparison between Lamellibranchs and Brachiopods. **B) Phylum Echinodermata** Class Echinoidea: Morphology of hard parts of Regularia. Variation in the apical disc in echinoids.	5 4
IV	**A) Phylum Arthropoda** Class Trilobita – Morphology of hard parts of Trilobites. **B) Phylum Coelenterata** Class Anthozoa- Madreporaria, polyp, medusa, types of septa. **C)** Origin and evolution of life over geological time. **D)** Uses and Importance of fossils.	2 2 3 2
	Total lectures	36

Paper-III
Geology Practical
(Term – I) **No of Practicals: 11**

Unit	Topics	No. of Practicals
I	**Mineralogy** **A)** Physical properties of minerals: Colour, form, streak, luster, cleavage, fracture, hardness and specific gravity. **B)** Identification of following Megascopic minerals in hand specimens with the help of physical properties: 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. **C)** Identification of following Megascopic Ore minerals in hand specimens with the help of physical properties: Magnetite, Haematite, Chromite, Chalcopyrite, Galena, Pyrolusite, Bauxite and Graphite. **D) Experiment** To find out the specific gravity of minerals using Walker's Steelyard.	2 2 1
II	**Crystallography** Study of elements of symmetry, crystallographic axes and forms with indices of the following crystal systems representing all the fundamental crystal forms: a) Orthorhombic System (Type: Barytes) b) Tetragonal System (Type: Zircon) c) Cubic system (Type: Galena) d) Hexagonal System (Type: Beryl) e) Monoclinic System (Type: Gypsum) f) Triclinic System (Type: Axinite) g) Measurement of interfacial angle with Contact Goniometer.	6

Paper-III
Geology Practical
(Term – II) **No of Practicals: 11**

Unit	Topics	No.of Practicals
III	**Optical Mineralogy:** Study of optical properties of minerals in plane polarised light and between crossed nicols. Study of the following minerals: Olivine, augite, hornblende, microcline, plagioclase, muscovite, biotite, calcite, garnet, quartz and orthoclase.	1 2
IV	**Toposheets and study of structural models:** Reading of toposheets with reference to toposheet number, latitude and longitude, state/districts, scale, adjacent toposheet number and conventional signs. Study of structural models showing faults, folds and unconformities (2 structural models of each)	1
V	**Topographic maps and Geological maps :** Study of topographic maps with section drawing Study of geological maps with horizontal beds with reference to section drawing and description(topography, geology of map and geological history)	2
VI	**Petrology** Identification of the following megascopic rocks with respect to their texture/structure, mineral composition and classification **A) Igneous**: Granite, gabbro, rhyolite, basalt (its varieties), pegmatite (Classification based on colour index, mineral composition and texture) **B) Secondary**: Laterite, bauxite, breccia, conglomerate, sandstone, shale, mudstone and limestone. **C) Metamorphic**: Slate, marble, quartzite, mica schist, hornblende schist, mica gneiss and hornblende gneiss.	 1 1 1

VII	**Palaeontology** Study of at least two specimens from each Phylum/Class (Total number of specimens should not be less than 15) A) Phylum MoIlusca – Class Lamellibranchia, Class Gastropoda, Class – Cephalopoda. B) Phylum Brachiopoda. C) Phylum Echinodermata. D) Phylum Arthropoda. E) Phylum Coelenterata.	2
VIII	Geological Fieldwork to be conducted in an area of geological interest for at least two days and geological report to be submitted for the same.	

List of Reference Books:

1. Rutley's Elements of Mineralogy: H.H. Read
2. Text Book of Mineralogy: Dana and Ford
3. Rock Forming Minerals: Deer, Howie, Zussman
4. Manual of Mineralogy: Cornelius, S. Hurlbut and Cornel Klein
5. Principles of Mineralogy: W.H. Blackburn, W.H. Denman
6. Mineralogy: Berry Mason, Dietrich
7. Principles of Petrology: Tyrrell
8. Invertebrate Palaeontology: Henry Woods
9. General Geology: Radhakrishnan
10. Holmes'Principles of Physical Geology: Edited by P. McL. D.Duff
11. Structural Geology: M.P.Billings
12. Invertebrate Paleontology: Shrock & Twenhofel