Deccan Education Society's

FERGUSSON COLLEGE (AUTONOMOUS), PUNE

Learning Outcomes-Based Curriculum

for 3/4 years B**.** Sc. / B. Sc. (Honours) Programme

as per guidelines of

NEP-2020

for

F. Y. B. Sc. (Geology)

With effect from Academic Year

2023-2024

Program Outcomes (POs) for B. Sc. Programme	
PO1	**Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the disciplines that form a part of a graduate programme. Execute strong theoretical and practical understanding generated from the specific graduate programme in the area of work.
PO2	**Critical Thinking and Problem solving:** Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.
PO3	**Social competence:** Display the understanding, behavioural skills needed for successful social adaptation, work in groups, exhibits thoughts and ideas effectively in writing and orally.
PO4	**Research-related skills and Scientific temper:** Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.
PO5	**Trans-disciplinary knowledge:** Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.
PO6	**Personal and professional competence:** Performing dependently and also collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professionalethics.
PO7	**Effective Citizenship and Ethics:** Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	**Environment and Sustainability:** Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	**Self-directed and Life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

PSO No.	Program Specific Outcomes (PSOs) Upon completion of this programme the student will be able to
PSO1	**Academic competence:** (i) Describe the knowledge of physical and chemical properties of lithosphere and hydrosphere (minerals, rocks, soils and water etc.). (ii) Demonstrate the knowledge of geologic time and earth's history; dynamics of crustal materials with respect to Plate Tectonics theory, outline of regional geology of India. (iii) Articulate the methods of science and explain why current scientific knowledge is both contestable and testable by further inquiry and to appraise the relationship between different science communities of practice. Pursue further learning in Geology with reasonable knowledge, skills and interest.
PSO2	**Personal and Professional Competence:** (i) Demonstrate the competence in fundamental geological skills like- identification of various minerals and rocks in hand specimens and under the microscope. (ii) Express clearly and convincingly about ideas of science and technology.
PSO3	**Research Competence** (i) Interpret analytically aerial photographs, toposheets and satellite data. (ii) Interpret geological maps and construction of cross section, collection of field data and laboratory data.
PSO4	**Entrepreneurial and Social competence** (i) Evaluate data of the societal relevance of earth systems and the processes. (ii) Apply the knowledge of geology in the fields of Engineering, Mining, Hydrogeology and other areas to solve the problems. (iii) Collaborate in various geological services with demonstration of true values of leadership, co-operation, hard work, teamwork etc. during the field works, surveys and field visits. (iv) Illustrate overall personality traits like stage daring, communication skills, presentation which is essential for future career.

Fergusson College (Autonomous), Pune
Proposed First Year Curriculum as per NEP 2020
Department of Geology
Structure for Major / Minor

Semester	Paper	Paper Code	Paper Title	Type	Credits
I	Major	GLY-101	Mineral Science	Theory	4
		GLY-100	Geology Practical - 1	Practical	2
	OE-1	GLY-120	Introduction to Geosciences	Theory	2
	OE-2	GLY-121	World of Minerals	Theory	2
	Minor	GLY-111	Introduction to Earth Science	Theory	2
		GLY-112	Geology Practical - 1	Practical	2
	SEC-1	GLY-140	Earth System Science	Theory	2
II	Major	GLY-151	Petrology	Theory	4
		GLY-150	Geology Practical - II	Practical	2
	Minor	GLY-161	Introduction to Petrology	Theory	2
		GLY-162	Geology Practical - II	Practical	2
	OE-3	GLY-170	Geology and Sustainability	Theory	2
	OE-4	GLY-171	World of Rocks	Theory	2

**OE – Open Elective, SEC- Skill Enhancement Course*

Teaching and Evaluation (Only for FORMAL education courses)

Course Credits	No. of Hours per Semester Theory/Practical	No. of Hours per Week Theory/Practical	Maximum Marks	CE 40 %	ESE 60%
1	15 / 30	1 / 2	25	10	15
2	30 / 60	2 / 4	50	20	30
3	45 / 90	3 / 6	75	30	45
4	60 / 120	4 / 8	100	40	60

Eligibility: As per the rules and regulations of Savitribai Phule Pune University (SPPU)

F. Y. B. Sc. Semester-I		
GLY-101	**Mineral Science (Major- Theory)**	**Credits:04 Hours:60**
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Describe various physical properties, optical properties ,crystal parameters in minerals and crystal models.	1
CO2	Compare various crystals based on symmetry, symmetry functions and explain crystal systems, mineral groups based on physical and optical properties.	2
CO3	Apply the understanding of physical, optical and other properties to determine the different groups and crystal systems.	3
CO4	Explain industrial applications and economic importance of various minerals.	4
CO5	Compare minerals on the basis of the different properties and estimate a few physical properties like hardness and specific gravity of minerals.	5
CO6	Prepare a report about mineral samples collected individually during the study tour.	6

Unit No.	Title of Unit and Contents	Number of Hours
I	**INTRODUCTION TO MINERALS** ➢ Chemical bonds and formation of compounds ➢ History of Minerals ➢ Definition of Mineral ➢ Nomenclature of Minerals ➢ Branches of mineralogy ➢ Formation of minerals: ➢ Introduction and description of geological processes of mineral formation: ➢ Crystallization from melt ➢ Crystallization from Solution. (evaporation and precipitation) ➢ Crystallization from Vapour (sublimation) ➢ Metamorphic processes ➢ Alteration and related weathering (oxidation and supergene sulphide enrichment) ➢ Organic Formation of Minerals ➢ Synthetic Minerals ➢ Mineral Classes ➢ Life Spans of Minerals	15
II	**PROPERTIES OF MINERALS** ➢ Physical properties of minerals: ➢ Colour, Diaphaneity, streak, lustre, cleavage and partings, fracture, form, habit, tenacity, hardness and specific gravity, Methods of determining specific gravity ➢ Properties based on magnetism, electrical properties, and radioactivity, Luminescence (Phosphorescence and Fluorescence)	15

	➢ Optical mineralogy ➢ Nature of light – ordinary and plane polarized light, Double refraction of light (with the help of calcite crystal), Nicol's prism and polaroids, Petrological microscope, Opaque and Non opaque Minerals, 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, symmetrical and determination of extinction angle), interference colours, twinning (simple, multiple and cross hatching).	
III	**CRYSTAL CHEMSTRY AND CRYSTALLOGRAPHY** ➢ Crystal Chemistry • Geochemical affinity & geochemical classification of elements, Isomorphism, polymorphism, pseudo morphism. • Silicate structures ➢ Crystallography • Definition and conditions conducive for the formation of crystals. • Crystal morphology - faces, forms, edges, solid angles, interfacial angle and its measurement by contact goniometer, law of constancy of interfacial angle. • Symmetry of crystals - Elements of Symmetry-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. • Study of following crystallographic systems with respect to their elements of symmetry, crystallographic axes and their forms with indices. Orthorhombic (Type: Barytes), Tetragonal (Type: Zircon), Cubic (Type: Galena), Hexagonal (Type: Beryl), Monoclinic (Type: Gypsum), Triclinic (Type: Axinite) • Zoning and Twinning in Crystals ➢ Introduction to Analytical Techniques in Crystal Chemistry	15
IV	**MINERAL GROUPS AND USES OF MINERALS** ➢ Mineral Groups- Study of following mineral groups with respect to their silicate structure, chemical composition, physical and optical properties and examples: • Olivine • Pyroxene • Amphibole • Mica • Feldspar • Silica • Garnet • Zeolite • Alluminosilicate ➢ Uses of Minerals in- • Metals	15

	• Gemstones • Ceramic • Refractory • Paint • Glass • Cement • Fertilizer • Electricals and electronics • Oil industry • Pharmaceuticals ➢ Scope of mineralogy and conservation of minerals	

References:

1. Dexter Perkins, 1998, Mineralogy, 3rd Edition, Pearson Education

2. Kevin Hefferan and John O'Brien, 2010 Earth Materials, A John Wiley & Sons, Ltd., Publication

3. Gribble, C. D., 1988, Rutley's Elements of Mineralogy, 27th Edition, Unwin Hyman, London

4. Dana, E. S., and Ford, W. E., 1922, Text Book of Mineralogy, John Wiley, New York, 748p.

5. Deer, W. A., Howie, R. A. and Zussman, J., 2013, An Introduction to Rock Forming Minerals, Essex: Longman Scientific and Technical; New York: Wiley., 696pp.

6. Manual of Mineralogy: Cornelius, S. Hurlbut and Cornel Klein

7. Principles of Mineralogy: W.H. Blackburn, W.H. Denman

8. Berry, L. G., Dietrich, R. V., and Mason, B., 1985, Mineralogy, CBS Publishers & Distributors, India, 561p

F. Y. B. Sc. Semester-I		
GLY-100	**Geology Practical - 1 (Major Practical)**	**Credits: 02 Hours: 60**
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Identify various megascopic minerals using different physical properties and various topographic features from toposheets.	1
CO2	Illustrate topographic sections from a given contour map.	2
CO3	Classify various types of landforms on the basis of origin and characteristic features.	3
CO4	Distinguish between crystal systems on the basis of elements of symmetry and forms.	4
CO5	Determine epicentre of earthquake from seismic data.	5
CO6	Perform experiment and calculate specific gravity.	6

Expt. No.	Title of Experiment
1	Study of physical properties of Minerals-I
2	Study of physical properties of Minerals-II
3	Megascopic study of minerals
4	Megascopic study of ore minerals
5	Study of elements of symmetry in crystals
6	Study of crystal Systems-I
7	Study of crystal systems-II
8	Study of natural hazards
9	Finding epicentre of earthquake
10	Study of different landforms
11	Study of topographic maps and toposheets
12	Activity- study of cavity minerals from Deccan Traps

F. Y. B. Sc. Semester-I		
GLY-120	**Introduction to Geosciences (OE-1)**	**Credits:02 Hours:30**
Course Outcomes (Cos) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Describe the origin and evolution of earth and some geogenic disasters occurred in the earth's history.	1
CO2	Explain the interior structure of the earth and plate movements.	2
CO3	Classify various types of landforms and minerals and rocks based on origin and characteristic of features.	3
CO4	Compare various types of earth processes and different types of rocks on the basis of their genesis and characters.	4
CO5	Summarize the various landforms and their causes of formations	5
CO6	Compile the various processes and events involved in shaping of earth.	6

Unit No.	Title of Unit and Contents	No. of Hours
I	**Introduction**: Definition of geology, its divisions, sub-divisions and scope **Planet Earth-** Origin, Size, Shape and density **The Earth's Atmosphere, Hydrosphere, Lithosphere and Biosphere** **Interior of the Earth-** Brief introduction and characteristics of Crust, Mantle and Core **Plate Tectonics-** Introduction to the theory and salient features of different plate boundaries **Volcanoes**: - Genesis, Types, Products and Distribution **Earthquakes-** Definition, terminology, causes, Seismic ones of the world **Types of Mountains**: Fold, fault block, volcanic and residual.	**15**
II	**Concept of Weathering, erosion and denudation** **Study of various erosional and depositional landforms resulting from the action of: River, Wind, Sea and Glaciers** **Age of the Earth:** A brief account of the historical methods and different dating methods **Geological Time Scale and Ancient Life** **Introduction to the minerals**- Definition, examples and their uses **Introduction to the rocks-** Igneous, Sedimentary and Metamorphic rocks with their salient features and general distribution of these rocks in India**.** **Geogenic Disasters-** Study of Different geogenic disasters with the help of examples	**15**

References:

1. General Geology: Radhakrishnan
2. Holmes'Principles of Physical Geology: Edited by P. McL. D. Duff
3. Plate tectonics and Crustal evolution: Condie
4. Our evolving planet: Bergen, Alma Mater Fortag
5. Geomorphology and Global Tectonics: Summerfield M. A.
6. Geomorphology: Thornburry
7. Concepts of Geomorphology: Gupta and Kale

F. Y. B. Sc. Semester-I		
GLY-121	**World of Minerals (OE-2)**	**Credits:02 Hours:30**
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Describe importance of minerals and their formation.	1
CO2	Compare minerals based on physical and optical properties.	2
CO3	Apply the understanding of physical and optical properties for identifying minerals.	3
CO4	Explain applications and economic importance of various minerals.	4
CO5	Compare minerals on the basis of the different properties.	5
CO6	Prepare a write-up describing properties of minerals.	6

Unit No.	Title of Unit and Contents	Number of Hours
I	**INTRODUCTION TO MINERALS** ➢ Importance of Minerals ➢ History of Minerals ➢ Definition of Mineral ➢ Nomenclature of Minerals ➢ Branches of mineralogy ➢ Formation processes of minerals ➢ Minerals and Mineral Varieties ➢ Crystalline and Non-Crystalline Mineral Materials ➢ Biominerals ➢ Synthetic Minerals ➢ Mineral Classes ➢ Life Spans of Minerals	15
II	**PROPERTIES AND USES OF MINERALS** ➢ Physical properties of minerals: • Colour, transparency, streak, lustre, form, cleavage, fracture, hardness and specific gravity • Properties based on magnetism, electrical properties and radioactivity, Luminescence (Phosphorescence and Fluorescence) ➢ Optical mineralogy • Petrological microscope, Opaque and Non opaque Minerals • Introduction to optical properties: – Colour, form, cleavage, cracks, pleochroism, isotropism and anisotropism, DR Colours ➢ Uses of minerals in everyday life ➢ Scope of mineralogy and conservation of minerals	15

References:

1. Dexter Perkins, 1998, Mineralogy, 3rd Edition, Pearson Education
2. Kevin Hefferan and John O'Brien, 2010, Earth Materials, A John Wiley & Sons, Ltd., Publication
3. Gribble, C. D., 1988, Rutley's Elements of Mineralogy, 27th Edition, Unwin Hyman, London
4. K. M. Bangar, 2015, Principles of Engineering Geology, 2nd Edition, Standard Publishers Distributors

F. Y. B. Sc. Semester-I		
GLY-111	**Introduction to Earth Science (Minor- Theory)**	**Credits:02 Hours:30**
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Describe the interior structure of the earth and plate movements.	1
CO2	Explain the various uses of minerals and evolution of earth.	2
CO3	Classify the different types of rocks on the basis of their origin and characteristic features.	3
CO4	Compare various types of plate movements and its associated geogenic disasters.	4
CO5	Summarize the various landforms and their causes of formations.	5
CO6	Compile the various processes and events involved in shaping of earth.	6

Unit No.	Title of Unit and Contents	No. of Hours
I	**Introduction**: Definition of geology, its divisions, sub-divisions and scope **Planet Earth-** Origin, Size, Shape and density **The Earth's Atmosphere, Hydrosphere, Lithosphere and Biosphere** **Interior of the Earth-** Brief introduction and characteristics of Crust, Mantle and Core **Plate Tectonics-** Introduction to the theory and salient features of different plate boundaries **Volcanoes**: - Genesis, Types, Products and Distribution **Earthquakes-** Definition, terminology, causes, Seismic ones of the world **Types of Mountains**: Fold, fault block, volcanic and residual.	15
II	**Concept of Weathering, erosion and denudation** **Study of various erosional and depositional landforms resulting from the action of: River, Wind, Sea and Glaciers** **Age of the Earth:** A brief account of the historical methods and different dating methods **Geological Time Scale and Ancient Life** **Introduction to the minerals-** Definition, examples and their uses **Introduction to the rocks-** Igneous, Sedimentary and Metamorphic rocks with their salient features and general distribution of these rocks in India**.** **Geogenic Disasters-** Study of Different geogenic disasters with the help of examples	15

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1. General Geology: Radhakrishnan
2. Holmes'Principles of Physical Geology: Edited by P. McL. D. Duff
3. Plate tectonics and Crustal evolution : Condie
4. Our evolving planet : Bergen, Alma Mater Fortag
5. Geomorphology and Global Tectonics: Summerfield M. A.
6. Geomorphology: Thornburry
7. Concepts of Geomorphology: Gupta and Kale

F. Y. B. Sc. Semester-I		
GLY -112	**Geology Practical -I (Minor-I Practical)**	**Credits:02 Hours:60**
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Identify various megascopic minerals using different physical properties.	1
CO2	Illustrate topographic sections from a given contour map.	2
CO3	Classify various types of landforms on the basis of origin and characteristic features.	3
CO4	Distinguish between various topographic features from toposheets.	4
CO5	Determine epicentre of earthquake from seismic data.	5
CO6	Perform experiment and calculate specific gravity.	6

Expt. No.	Title of Experiment
1	Study of various geological specimens in Geology Museum
2	Study of physical properties of Minerals-I
3	Study of physical properties of Minerals-II
4	Megascopic study of minerals
5	Megascopic study of ore minerals
6	Study of elements of symmetry in crystals
7	Finding epicentre of earthquake
8	Study of different landforms
9	Study of topographic maps
10	Study of toposheets
11	Study of Drainage Basins
12	Activity- study of cavity minerals from Deccan Traps

F. Y. B. Sc. Semester-I		
GLY-140	**Earth System Science (SEC-1)**	**Credits:02 Hours:30**
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Describe the origin and evolution of earth.	1
CO2	Explain the interior structure of the earth and plate movements.	2
CO3	Classify various types of landforms based on origin and characteristic of features.	3
CO4	Compare various types of earth processes.	4
CO5	Evaluate various processes involved in shaping the earth.	5
CO6	Compile a report on landforms studied during field work.	6

Unit No.	Title of Unit and Contents	No. of Hours
I	**EARTH: ITS ORIGIN, AGE, INTERIOR AND PROCESSES** **Introduction**: Definition of geology, its divisions, sub-divisions and scope **Planet Earth-** Origin of the Universe, Origin of the Solar System **Earth:** Its size, shape and density. Temperature, pressure and magnetism within the earth, Present day hypsographic curve **Age of the Earth:** A brief account of the historical methods. a) Determination of age by the K/Ar, U/Th and Carbon dating methods b) Geological Time Scale: Concept and Criteria. **The Earth's Atmosphere, Hydrosphere, Lithosphere and Biosphere Interior of the Earth**	15
II	**DYNAMICS OF THE EARTH** **Plate Tectonics-** Historical Overview, Different types of plate movements with their salient characters, Various plates of the world and their movements **Volcanoes**: Genesis of volcanoes, Central and fissure type of eruptions. Products of volcanoes, effects of volcanoes, earth's volcanic belts. **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. **Types of Mountains**: Fold, fault block, volcanic and residual. **Geomorphic processes and landforms-** Weathering, erosion and denudation **Types of weathering:** Mechanical and Chemical Study of various erosional and depositional landforms resulting from the action of: River, Wind, Sea and Glaciers	15

References:

1. General Geology: Radhakrishnan
2. Holmes'Principles of Physical Geology: Edited by P. McL. D. Duff
3. Plate tectonics and Crustal evolution: Condie
4. Our evolving planet : Bergen, Alma Mater Fortag
5. Geomorphology and Global Tectonics: Summerfield M. A.
6. Geomorphology: Thornburry
7. Concepts of Geomorphology: Gupta and Kale
8. The Dynamic Earth System: Prof. Patwardhan

F. Y. B. Sc. Semester-II		
GLY-151	**Petrology (Major- Theory)**	**Credits:04 Hours:60**
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Describe various rock properties in hand specimens.	1
CO2	Compare various rocks based on mineral composition and textures.	2
CO3	Examine rocks in hand specimens.	3
CO4	Explain formation processes of different types of rocks, different primary and secondary structures.	4
CO5	Compare rocks on the basis of different characters like mineral composition, textures, structures, depth of formation, colour etc.	5
CO6	Compose a report about rock samples collected individually during the study tour.	6

Unit No.	Title of Unit and Contents	Number of Hours
I	**INTRODUCTION TO PETROLOGY AND IGNEOUS PETROLOGY** **A] Introduction to Petrology** ➢ Definition of petrology, lithology, petrography, petrogenesis ➢ Types of rocks- igneous, sedimentary and metamorphic ➢ Diagnostic characteristic of rocks ➢ Rock cycle **B] Introduction to Igneous Petrology** ➢ Magma and Lava, composition, physico-chemical constitution of magma, Bowen's reaction series and formation of crystals and glass ➢ Types of Magma: Primary and derivative, equilibrium between crystals and melt, crystallization of unicomponent and bicomponent magma (solid solution series, eutectic) ➢ Forms of Igneous bodies: • Central and fissure type of eruptions • Intrusive-Concordant-sill, laccolith, lopolith, phacolith Discordant-dyke, volcanic neck and batholith • Extrusive-Lava flows, pyroclastic flow	15
II	**IGNEOUS PETROLOGY** ➢ Textures and Structures • Textures: Definition and factors controlling igneous textures • Study of following textures: granitic, graphic, porphyritic, glomeroporphyritic, poikilitic, ophitic, sub-ophitic, intergranular, intersertal, directive, glassy • Structures: Vesicular, amygdaloidal, ropy, blocky, pillow, flow, pyroclastic, xenolithic, columnar	15

	➢ Tabular classification of igneous rocks on the basis of depth of formation, silica percentage, type of feldspar content and colour index ➢ Study of following rocks - dunite, granite, gabbro, syenite, diorite, pegmatite, dolerite, rhyolite, basalt, trachyte, andesite	
III	**SEDIMENTARY PETROLOGY** ➢ Sediments and derivation of sediments ➢ Source of sediments, mineral composition of clastic/detrital sediments ➢ Transportation of sediments- modes of transportation and progressive changes in sediments during transport ➢ Deposition of sediments- lithification, diagenesis and post depositional changes, carbonates and other precipitates ➢ Depositional environments: Introduction to depositional environment and classification ➢ Textures and structures • Textures- concept of matrix and cement, clastic and non-clastic textures • Structures- Types of structures, Primary sedimentary structures- lamination, bedding, cross bedding, graded bedding, ripple marks and mud cracks, Chemical structures - stylolites, nodules and concretions, Biogenic structures - stromatolites, tracks and trails, burrows ➢ Classification of sedimentary rocks and study of following rocks- laterite, bauxite, conglomerate, breccia, varieties of sandstone, shales, chemical and organic deposits	15
IV	**METAMORPHIC PETROLOGY** ➢ Definition of metamorphism, protolith and their types, limits of metamorphism ➢ Agents of metamorphism ➢ Metamorphic minerals- Stress and antistress minerals ➢ Types of metamorphism- cataclastic, thermal, regional ➢ Metamorphism and metamorphic products- ➢ Cataclastic- crush breccias, cataclasite, mylonite ➢ Thermal metamporphism- quartzite, marble ➢ Regional metamorphism- slate, phyllite, schist and gneiss ➢ Textures and structures in metamorphic rocks formed by different types of metamorphism ➢ Introduction to metasomatism ➢ Introduction to migmatisation ➢ Tabular classification of metamorphic rocks along with type of metamorphism and protolith	15

References:

1. Ernest Ehlers, Harvey Blatt, Petrology: Igneous, Sedimentary and Metamorphic, 1999, CBS Publishers

2. J. D. Winter, Principles of Igneous and Metamorphic Petrology, 2015, Pearson Publishers

3. Tyrrell, G.W., The Principles of Petrology: An Introduction to the Science of Rocks, 1949, Methurn Publisher

4. Dexter Perkins, 1998, Mineralogy, 3rd Edition, Pearson Education

5. Kevin Hefferan and John O'Brien, 2010 Earth Materials, A John Wiley & Sons, Ltd., Publication

6. S. M. Sengupta, Introduction to Sedimentology, 2018, 2nd Edition, CBS Publishers

F. Y. B. Sc. Semester-II		
GLY-150	**Geology Practical -2 (Major- Practical)**	**Credits:02 Hours:60**
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Identify different textures and structures in rocks.	1
CO2	Classify various rocks using megascopic and microscopic properties.	2
CO3	Examine different rocks in hand specimens.	3
CO4	Distinguish different optical properties in minerals under microscope.	4
CO5	Determine different minerals in micro-sections.	5
CO6	Write a report on different rocks, minerals and topographic features observed during the study tour.	6

Expt. no.	**Title of Experiment**
1	Study of optical properties of Minerals-I
2	Study of optical properties of Minerals-II
3	Microscopic study of Minerals
4	Preparation of Geochemical plots
5	Preparation of lithologs
6	Megascopic study of Igneous rocks
7	Microscopic study of Igneous rocks
8	Megascopic study of Sedimentary rocks
9	Microscopic study of Sedimentary rocks
10	Megascopic study of Metamorphic rocks
12	One day Geological Fieldwork to be conducted in an area of geological interest for study of various geomorphic landforms, minerals and rocks and geological report to be submitted for the same

F. Y. B. Sc. Semester-II		
GLY-161	**Introduction to Petrology** **(Minor- Theory)**	**Credits:02** **Hours:30**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Describe various rock properties in hand specimens.	1
CO2	Compare various rocks based on mineral composition and textures.	2
CO3	Examine rocks in hand specimens.	3
CO4	Explain formation processes of different types of rocks, different primary and secondary structures.	4
CO5	Compare rocks on the basis of different characters like mineral composition, textures, structures, depth of formation, colour etc.	5
CO6	Compose a report about rock samples collected individually during the study tour.	6

Unit No.	Title of Unit and Contents	Number of Hours
I	**INTRODUCTION TO PETROLOGY AND IGNEOUS PETROLOGY** **A] Introduction to rock forming minerals and petrology** ➢ Definition of minerals and Introduction and description of geological processes of mineral formation: • Crystallization from melt • Crystallization from Solution. (evaporation and precipitation) • Metamorphic processes • Alteration and related weathering ➢ Intoduction to rock forming mineral groups and their silicate structure ➢ Definition of petrology, lithology, petrography, petrogenesis ➢ Types of rocks- igneous, sedimentary and metamorphic ➢ Diagnostic characteristic of rocks ➢ Rock cycle **B] Introduction to Igneous Petrology** ➢ Magma and Lava, composition, physico-chemical constitution of magma, Bowen's reaction series and formation of crystals and glass ➢ Forms of Igneous bodies: • Central and fissure type of eruptions • Intrusive and Extrusive forms-lava flow, dyke, batholith ➢ Textures and Structures- granitic, porphyritic, glassy,	15

	vesicular, amygdaloidal, ropy, columnar ➢ Tabular classification of igneous rocks on the basis of depth of formation, silica percentage, type of feldspar content and colour index ➢ Study of following rocks - dunite, granite, gabbro, pegmatite, dolerite, rhyolite, basalt	
II	**SEDIMENTARY AND METAMORPHIC PETROLOGY** **A] Introduction to Sedimentary Petrology** ➢ Sediments, their derivation and types ➢ Transportation of sediments- modes of transportation and progressive changes in sediments during transport ➢ Introduction to depositional environment ➢ Textures and structures • Textures- concept of matrix and cement, clastic and non-clastic textures • Primary sedimentary structures- lamination, bedding, cross bedding, graded bedding, ripple marks and mud cracks, • Biogenic structures - stromatolites, tracks and trails, burrows ➢ Classification of sedimentary rocks and study of following rocks- laterite, bauxite, conglomerate, breccia, varieties of sandstone, shales, chemical and organic deposits **B] Introduction to Metamorphic Petrology** ➢ Definition of metamorphism and Agents of metamorphism ➢ Types of metamorphism- cataclastic, thermal, regional ➢ Metamorphism and metamorphic products- ➢ Cataclastic- cataclasite, mylonite ➢ Thermal metamporphism- quartzite, marble ➢ Regional metamorphism- slate, phyllite, schist and gneiss ➢ Textures and structures in metamorphic rocks ➢ Tabular classification of metamorphic rocks along with type of metamorphism and protolith	15

References

1. G.B. Mahapatra, A Textbook of Geology, CBS Publishers & Distributors
2. Tyrrell, G.W., The Principles of Petrology: An Introduction to the Science of Rocks, 1949, Methurn Publisher
3. Dexter Perkins, 1998, Mineralogy, 3rd Edition, Pearson Education
4. Kevin Hefferan and John O'Brien, 2010 Earth Materials, A John Wiley & Sons, Ltd., Publication
5. S. M. Sengupta, Introduction to Sedimentology, 2018, 2nd Edition, CBS Publishers

F. Y. B. Sc. Semester-II		
GLY -162	**Geology Practical -2 (Minor- Practical)**	**Credits:02 Hours:60**
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Identify different textures and structures in rocks.	1
CO2	Classify various rocks using megascopic and microscopic properties.	2
CO3	Examine different rocks in hand specimens.	3
CO4	Distinguish different optical properties in minerals under microscope.	4
CO5	Determine different minerals in micro-sections.	5
CO6	Write a report on different rocks, minerals and topographic features observed during the study tour.	6

Expt. No.	Title of Experiment
1	Study of optical properties of Minerals-I
2	Study of optical properties of Minerals-II
3	Study of Megascopic rock forming Minerals
4	Megascopic study of Igneous rocks
5	Megascopic study of textures and structures of Igneous rocks
6	Megascopic study of Sedimentary rocks
7	Megascopic study of Primary sedimentary structures
8	Megascopic study of Metamorphic rocks
9	Preparation of lithologs
10	Soil analysis
11	Geological Fieldwork at Fergusson College Hill.
12	One day Geological Fieldwork to be conducted in an area of geological interest for study of various geomorphic landforms, minerals and rocks and geological report to be submitted for the same.

F. Y. B. Sc. Semester-II		
GLY-170	**Geology and Sustainability (OE-3)**	**Credits:02 Hours:30**
Course Outcomes (Cos) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Recall the concept of Environmental Geology and Geogenic disaster.	1
CO2	Discuss the various types of pollution.	2
CO3	Solve the various environmental issues by taking remedial measures.	3
CO4	Explain the concept of Environmental Impact Assessment.	4
CO5	Classify the ore and industrial minerals.	5
CO6	Prepare a report on any hydrogeological area.	6

Unit No.	Title of Unit and Contents	No. of Hours
I	**Environmental Geology** A) Scope, Concepts and Objectives of Environmental Geology B) Physical, Biological and Socio-geological Environment, Bio-geochemical cycles. C) Environmental Impact Assessment - Introduction and Methodology D) Types of Pollution: Air, Water and Soil Pollution E) Conservation of Natural Resources	15
II	**Economic Geology and Groundwater** A) Sustainable use of economically important deposits (ore minerals, industrial minerals, petroleum, coal) B) Introduction to hydrogeology and sustainable use of groundwater	15

References:

1.Valdiya, K.S., (1987) Environmental Geology-India. Context. Tata McGraw Hill New Delhi.
2. Keller, E.A. (2000) Environmental Geology. Shales E. Merril Publishing Co., Columbus, Ohio.
3. Montgomery, C., (1984) Environmental Geology. John Wiley and Sons, London.
4. Gokhale & Rao (1978) Ore deposits of India, Thomson press (Inia) limited.
5.Umeshwar Prasad (20030 Economic Geology, Satish Kumar Jain, CBS Publishers and Distributers.
6. Levorsen, A. I., (2004) Geology of Petroleum, CBS Publishers and Distributors
7. Todd D. K. (2007) Groundwater Hydrology, Wiley.
8. Publications by agencies like CGWB, GSDA, ACWADAM and other institutes related to hydrogeology
9. Publications by United Nations (www.un.org)

F. Y. B. Sc. Semester-II		
GLY-171	**World of Rocks (OE-4)**	**Credits:02 Hours:30**
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Describe various rock properties in hand specimens.	1
CO2	Compare various rocks based on mineral composition and textures.	2
CO3	Examine rocks in hand specimens.	3
CO4	Explain formation processes of different types of rocks, different primary and secondary structures.	4
CO5	Compare rocks on the basis of different characters.	5
CO6	Prepare a write-up describing properties of rocks.	6

Unit No.	Title of Unit and Contents	Number of Hours
I	➢ Introduction to Rocks ➢ Importance of Rocks ➢ Classification of Rocks ➢ Igneous Rocks: Magma and Lava Central and fissure type of eruptions Intrusive forms: Concordant-sill, Discordant- dyke, batholith Extrusive forms: Lava flows Textures and Structures Study of few common igneous rocks	15
II	➢ Sedimentary Rocks: Sedimentary processes Textures and structures Study of few common sedimentary rocks ➢ Metamorphic Rocks: Process of metamorphism Agents of metamorphism Types of metamorphism Textures and structures Study of few common metamorphic rocks ➢ Rock Cycle ➢ Uses of the Rocks	15

References:

1. Dexter Perkins, 1998, Mineralogy, 3rd Edition, Pearson Education
2. Kevin Hefferan and John O'Brien, 2010, Earth Materials, A John Wiley & Sons, Ltd., Publication
3. G. B. Mahapatra, A Text Book of GEOLOGY, 1987, CBS Publishers and Distributors
4. K. M. Bangar, 2015, Principles of Engineering Geology, 2nd Edition, Standard Publishers Distributors.