ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

Model Syllabus for 4-Year UG Honours in B.Sc. (Geology) as Major in consonance with Curriculum framework w.e.f. AY 2025-26

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COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	I	1	Earth and Atmospheric Sciences	3	3
			Earth and Atmospheric Sciences-Practical	2	1
		2	Physical Geology & Geomorphology	3	3
			Physical Geology & Geomorphology -Practical	2	1
	II	3	Fundamentals of Crystallography & Mineralogy	3	3
			Fundamentals of Crystallography & Mineralogy-Practical	2	1
		4	Igneous and Metamorphic Petrology	3	3
			Igneous and Metamorphic Petrology-Practical	2	1
II	III	5	Sedimentology and Stratigraphy	3	3
			Sedimentology and Stratigraphy-Practical	2	1
		6	Structural Geology and Field Geology	3	3

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
			Structural Geology and Field Geology-Practical	**2**	**1**
		7	Engineering Geology & Environmental Geology	**3**	**3**
			Engineering Geology & Environmental Geology-Practical	**2**	**1**
	IV	**8**	Economic Geology	**3**	**3**
			Economic Geology-Practical	**2**	**1**
		9	Indian Geology	**3**	**3**
			Indian Geology-Practical	**2**	**1**
		10	Palaeontology	**3**	**3**
			Palaeontology-Practical	**2**	**1**
III	**V**	**11**	Hydrogeology	**3**	**3**
			Hydrogeology-Practical	**2**	**1**
		12 A	Fundamentals of Remote Sensing	**3**	**3**
			Fundamentals of Remote Sensing-Practical	**2**	**1**
		OR			
		12 B	Fundamentals of Geophysical Exploration	**3**	**3**
			Fundamentals of Geophysical Exploration-Practical	**2**	**1**
		13 A	Digital Image Processing for Geosciences	**3**	**3**
			Digital Image Processing for Geosciences-Practical	**2**	**1**
		OR			
		13 B	Mining Geology	**3**	**3**
			Mining Geology-Practical	**2**	**1**

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
	VI	14 A	Geographic Information System	3	3
			Geographic Information System-Practical	2	1
		OR			
		14 B	Natural Resource Exploration	3	3
			Natural Resource Exploration-Practical	2	1
		15 A	Applications of Remote Sensing	3	3
			Applications of Remote Sensing-Practical	2	1
		OR			
		15 B	Mineral Economics	3	3
			Mineral Economics-Practical	2	1
IV	VII	16	Advanced Mineralogy	3	3
			Advanced Mineralogy-Practical	2	1
		17	Advanced Igneous and Metamorphic Petrology	3	3
			Advanced Igneous and Metamorphic Petrology-Practical	2	1
		18	Advanced Structural Geology	3	3
			Advanced Structural Geology-Practical	2	1
		Skill Enhancement Courses			
		SEC-5 A	Hydrogeology and Groundwater Exploration	3	3
			Hydrogeology and Groundwater Exploration-Practical	2	1
		OR			
		SEC-5 B	Fuel Geology	3	3
			Fuel Geology-Practical	2	1

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
		SEC-6 A	Field Geology and Surveying	**3**	**3**
			Field Geology and Surveying-Practical	**2**	**1**
		OR			
		SEC-6 B	Precambrian Geology	**3**	**3**
			Precambrian Geology-Practical	**2**	**1**
	VIII	**19**	Stratigraphy and Indian Geology	**3**	**3**
			Stratigraphy and Indian Geology-Practical	**2**	**1**
		20	Sedimentary Petrology and Sedimentology	**3**	**3**
			Sedimentary Petrology and Sedimentology-Practical	**2**	**1**
		21	Geochemistry and Isotope Geology	**3**	**3**
			Geochemistry and Isotope Geology-Practical	**2**	**1**
		Skill Enhancement Courses			
		SEC-7 A	Watershed Management	**3**	**3**
			Watershed Management-Practical	**2**	**1**
		OR			
		SEC-7 B	Disaster Management	**3**	**3**
			Disaster Management-Practical	**2**	**1**
		SEC-8 A	Quaternary Geology	**3**	**3**
			Quaternary Geology-Practical	**2**	**1**
		OR			
		SEC-8 B	Sedimentary Basins of India	**3**	**3**
			Sedimentary Basins of India-Practical	**2**	**1**

Note: In the III Year (during the V and VI Semesters), students are required to select a pair of electives from one of the **Two** specified domains. **For example: if set 'A' is chosen, courses 12 to 15 to be chosen as 12 A, 13 A, 14 A and 15 A.** To ensure in-depth understanding and skill development in the chosen domain, students must continue with the same domain electives in both the V and VI Semesters.

SEMESTER - I

COURSE 1: EARTH AND ATMOSPHERIC SCIENCES

Theory **Credits: 3** **3 hrs/week**

Course Objectives

1. To understand the structure of the universe, the solar system, and the theories regarding the origin and motion of Earth.
2. To gain knowledge about the Earth's internal structure, methods of age determination, and the significance of the Geological Time Scale.
3. To study the processes responsible for the evolution of continents, oceans, and associated geodynamic phenomena.
4. To familiarize students with geographical coordinate systems and the dynamics of the atmosphere.
5. To understand the global climatic systems, types of air masses, and classification of natural regions of the world.

Course Outcomes

At the end of the Course, the Students will be able to

1. Explain the formation of Earth, apply Kepler's Laws to planetary motion, and interpret the effects of Earth's movements on day-to-day life.
2. Identify the layers of the Earth, describe techniques of age dating, and relate major events of Earth's history to the Phanerozoic Era.
3. Explain continental drift and paleomagnetism, recognize the significance of ice ages, and analyze the origin of rift valleys.
4. Locate places using latitude and longitude, interpret IST, and analyze atmospheric circulation patterns including monsoons, jet streams, and El Niño–La Niña events.
5. Distinguish between different air masses, cyclonic systems, and classify natural regions based on their climate and vegetation characteristics.

UNIT I: Exploring the Universe and the Earth

- Exploring the Universe – The Solar System
- Theories on the origin of the Earth
- Planetary motion: Kepler's Laws
- Earth as a Planet – its Shape, Size and Density
- Movements and their effects

UNIT II: Earth's Structure and Geological Time

- Interior of the Earth
- Age of the Earth
- Geological Time Scale (GTS) – Phanerozoic Era

UNIT III: Evolution of Continents and Ocean Basins

- Introduction to Evolution of Continents and Ocean Basins and their permanence
- Theories of Paleo-Magnetism
- Ice Ages and their Periodicity
- Rift Valleys – characteristics and origin

UNIT IV: Geographical Coordinates and Atmosphere

- Concepts of Latitudes and Longitudes
- Mathematical location of places on the globe
- Indian Standard Time (IST)
- Atmosphere – Circulation
- Planetary and local winds: Jet streams, Monsoons, EL-Niño and La Niña phenomena, Inter Tropical Convergence Zone (ITCZ)

UNIT V: Climatic Systems and Natural Regions

- The Air Masses – Cyclones and Anti-Cyclones
- Major Natural Regions of the World:
    - Hot-Wet Equatorial
    - Tropical Monsoon and Marine
    - Savannas
    - Hot and Mid Latitude Deserts
    - Mediterranean
    - Steppes
    - China Type
    - British Type
    - Siberian
    - Laurentian
    - Polar

Text Books:

1. Physical Geology - A.N. Strahler , 1980
2. Environmental Geosciences - A.N. Strahler and A.H. Strahler, 1973
3. An Introduction to Earth and Environment - A.K. Sinha, 1990

Reference Books:

1. Elements of Meteorology - Albert Miller and Jack C. Thompson
2. Basic Physical Geology - E. S. Robinson , 1982
3. Certificate Physical and Human Geography- Goh Cheng Leong

SEMESTER - I

COURSE 1: EARTH AND ATMOSPHERIC SCIENCES

Practical **Credits: 1** **2 hrs/week**

- Study of topographic maps and interpretation of physical features.
- Identification of major landforms using satellite images.
- Plotting latitude, longitude, great circles and small circles on a globe.
- Preparation of simple climatic diagrams (temperature–rainfall).
- Calculation of Earth's density and gravity anomalies (exercise-based).
- Demonstration of plate boundaries and tectonic features on world maps.

SEMESTER - I

COURSE 2: PHYSICAL GEOLOGY AND GEOMORPHOLOGY

Theory **Credits: 3** **3 hrs/week**

Course Objectives

1. To introduce students to the fundamental concepts, scope, and principles of geomorphology.
2. To understand the classification, evolution, and development of various landforms and drainage patterns.
3. To study earth movements, tectonic theories, and their role in shaping landforms.
4. To analyze the role of endogenic and exogenic forces in geomorphic processes.
5. To learn the origin, classification, and distribution of rocks and their significance in geomorphology.

Course Outcome

At the end of the course, the students will be able to:

1. Explain the principles, scope, and fundamental concepts of geomorphology.
2. Identify, classify, and interpret different landforms, drainage systems, and geomorphic cycles.
3. Analyze tectonic processes such as continental drift, isostasy, and plate tectonics, and assess their impact on landforms.
4. Evaluate the influence of endogenic and exogenic processes in the formation of erosional and depositional landforms.
5. Demonstrate knowledge of the origin, classification, and distribution of rocks and relate them to geomorphic processes and landform evolution.

UNIT I: Introduction to Geomorphology and Rocks

- Nature, definition, scope, fundamental concepts and Principles in Geomorphology
- Geomorphic classification of Land forms
- Evolution of various Land Forms
- Drainage Pattern
- Geomorphic Cycle and their interpretation
- Rocks – Origin, Classification, Distribution

UNIT II: Earth Movements and Tectonics

- Earth Movements – Epirogenic and Orogenic movements
- Theories of Continental Drift
- Isostacy and Plate tectonics

UNIT III: Endogenic Forces

- Earthquakes
- Volcanoes and their distribution

UNIT IV: Geomorphic Agents and Climate

- Geomorphic agents and processes – Weathering, Erosion, Mass wasting
- Cycles of erosion – Concept
- Land forms of Sea

- Marine deposits
- Coral reefs
- Lacustrine deposits
- Earth's Heat Budget and Global Climate Change

UNIT V: Exogenic Processes and Landforms

- Geomorphic processes – Erosional and Depositional Land forms made by:
- Fluvial processes
- Glacial processes
- Aeolian processes
- Karst topography
- Seas and Oceans

Text Books / Reference Books

1. Text Book of Geomorphology - A.L.Bloom
2. Principles of Geomorphology -W.S. Thornbury
3. A text Book of Geomorphology - P.Dayal
4. Indian Geomorphology - H.S. Sharma

SEMESTER - I

COURSE 2: PHYSICAL GEOLOGY AND GEOMORPHOLOGY

Practical **Credits: 1** **2 hrs/week**

- Identification of geomorphic features from topographic sheets and/or aerial photographs.
- Drainage pattern analysis and preparation of longitudinal river profiles.
- Morphometric analysis of a drainage basin.
- Study of erosional and depositional landforms.
- Simple exercises on earthquake distribution maps and volcanic provinces.

SEMESTER - II

COURSE 3: FUNDAMENTALS OF CRYSTALLOGRAPHY AND MINERALOGY

Theory **Credits: 3** **3 hrs/week**

Course Objectives

1. To understand the fundamental principles of crystallography and symmetry, including crystal classes and twin laws.
2. To study the structures, properties, and occurrences of important silicate and non-silicate mineral groups.
3. To analyze physical, chemical, and optical properties of rock-forming minerals for identification and classification.
4. To develop knowledge of optical mineralogy, including the behavior of light in minerals and the use of petrological microscopes.
5. To acquire practical skills in thin section preparation and application of optical techniques for mineral identification.

Course Outcomes

At the end of the course, the students will be able to:

1. Explain the elements of crystallography, crystal symmetry, Hermann–Mauguin symbols, and crystal irregularities.
2. Classify and describe the structures and properties of silicate minerals such as quartz, feldspars, feldspathoids, and zeolites.
3. Analyze the physical, chemical, and optical characters of mineral groups including olivine, pyroxenes, amphiboles, micas, garnets, and alumino-silicates.
4. Demonstrate understanding of optical principles such as refraction, interference, polarization, extinction, and pleochroism using petrological microscopes.
5. Apply optical mineralogy techniques (e.g., Berek compensator, gypsum plate, quartz wedge, mica plate) to determine mineral properties in thin sections.

Unit I

- Elements of Crystallography
- Derivation of 32 Crystal classes and Hermann–Mauguin symbols
- Twin laws and twin crystals
- X-ray crystallography and irregularities in crystals
- Etch figures

Unit II

- Structures of silicates
- Isomorphism and polymorphism
- Physical, chemical, and optical properties, mode of occurrence of the following mineral groups:
    - Quartz
    - Feldspars
    - Feldspathoids
    - Zeolites

Unit III

- Physical, chemical, and optical characters and mode of occurrence of the following mineral groups:
    - Olivine
    - Pyroxene
    - Amphibole
    - Mica
    - Garnet
    - Aluminium silicates

Unit IV

- Nature of light rays and their propagation
- Internal reflection
- Double refraction
- Interference and polarization
- Nicol prism and polaroids
- Petrological microscope – parts and their functions
- Preparation of thin section of minerals and rocks

Unit V

- Snell's Law – Critical angle – Total reflection
- Pleochroism
- Extinction
- Determination of retardation with Berek compensator
- Optic axial angle
- Uniaxial and biaxial minerals
- Gypsum plate
- Quartz wedge
- Mica plate

Text Books / Reference Books

1. A Text Book of Mineralogy by E.S.Dana
2. Elements of Crystallography by F.A.Wade and R.B.Matrox.
3. Elements of Mineralogy by Rutleys
4. Optical mineralogy by Paul F.F. Kerr
5. Mineral Optics by Philips W.R.
6. Elements of Optical Mineralogy by Winchell A.N.

SEMESTER - II

COURSE 3: FUNDAMENTALS OF CRYSTALLOGRAPHY AND MINERALOGY

Practical **Credits: 1** **2 hrs/week**

- Study of symmetry elements in crystal models (cubic, tetragonal, hexagonal, orthorhombic, monoclinic, and triclinic).
- Drawing of stereographic projections of crystals.
- Study of physical properties of minerals in hand specimens
- Optical properties of minerals under petrological microscope
- Preparation of thin sections (demonstration).

SEMESTER - II

COURSE 4: IGNEOUS AND METAMORPHIC PETROLOGY

Theory **Credits: 3** **3 hrs/week**

Course Objectives

1. To introduce the fundamental concepts of igneous petrology, including the origin, composition, crystallization, and structures of igneous rocks.
2. To understand the crystallization processes of uni- and binary-component magmas and their role in petrogenesis of major igneous rock types.
3. To explain the agents, types, zones, and processes of metamorphism and their influence on rock transformation.
4. To study the structures, textures, and classification of metamorphic rocks for systematic identification.
5. To analyze metamorphic facies, grades, and petrography of important rock types with reference to their occurrences in India.

Course Outcomes

At the end of the course, the students will be able to:

1. Describe the origin, composition, crystallization processes, and textural features of igneous rocks.
2. Interpret binary magma crystallization, petrogenesis, and classify major igneous rock types and their field occurrences.
3. Explain the agents, types, and zones of metamorphism along with the role of metamorphic minerals.
4. Identify structures, textures, and classify different types of metamorphic rocks.
5. Apply the concept of metamorphic facies and petrography to study major metamorphic rocks and their occurrences in India.

UNIT I: Introduction to Igneous Petrology

- Introduction to igneous petrology
- Earth zones
- Origin, composition and constitution of magmas
- Formation of igneous rocks
- Crystallization of unicomponent systems
- Grain of igneous rocks
- Formation of glass

UNIT II: Crystallization and Petrogenesis of Igneous Rocks

- Crystallisation of Binary magmas – Eutectics – Mixed crystals
- Forms of intrusive igneous rocks: concordant and discordant forms
- Composite intrusions and multiple intrusions
- Forms, structures and textures of igneous rocks
- Petrogenesis of major igneous rock types:
    - Granites, Pegmatite, Basalts, Dolerite, Rhyolite
    - Ultramafic rocks, Carbonatites, Lamprophyres, Syenites, NephelineSyenites

UNIT III: Introduction to Metamorphism

- Introduction and definition of metamorphism
- Agents of metamorphism
- Types of metamorphism
- Zones of metamorphism
- Metamorphic minerals – stress and anti-stress minerals

UNIT IV: Structures, Textures and Classification of Metamorphic Rocks

- Structures of metamorphic rocks: cataclastic, maculose, schistose, granulose, gneissose
- Textures of metamorphic rocks: crystalloblastic, palimpsest, xenoblastic, idioblastic
- Classification of metamorphic rocks

UNIT V: Metamorphic Facies and Petrography of Rock Types

- Metamorphic zones and grades
- Concept of metamorphic facies
- Structures and textures of metamorphic rocks (revision/advanced context)
- Petrographic notes on important rock types and their occurrences in India:
    - Schists, Gneisses, Marble, Quartzite, Slate, Phyllites, Khondalite, Charnockite, Eclogites

Text Books / Reference Books

1.Philpotts, A., & Ague, J. (2009). Principles of igneous and metamorphic petrology.
2.Raymond, L. A. (2002). Petrology: the study of igneous, sedimentary, and metamorphic rocks.
3.Myron G. Best (2001). Igneous and Metamorphic Petrology,
4.Bose M.K. (1997). Igneous Petrology.
5.G W Tyrrell. (1926). Principles of Petrology. Springer
6.Winter,J.D.(2014).Principles of igneous and metamorphic petrology. Pearson.

SEMESTER - II

COURSE 4: IGNEOUS AND METAMORPHIC PETROLOGY

Practical **Credits: 1** **2 hrs/week**

- Megascopic identification of igneous rocks.
- Microscopic study of common igneous rocks.
- Megascopic identification of metamorphic rocks.
- Microscopic study of common metamorphic rocks.
- Plotting mineralogical classification of igneous rocks (Streckeisen diagram).