

COURSE CURRICULUM FOR B.Sc. (HONOURS) GEOLOGY

AS PER NATIONAL EDUCATION POLICY (NEP) 2020



**DEPARTMENT OF GEOLOGY
JAGANNATH BAROOAH COLLEGE (AUTONOMOUS)
JORHAT (ASSAM)**

(Approved by Board of Studies on 22th March, 2023

And

Academic Council on 6th May, 2023)

PREAMBLE

The main objective of the four-year geology degree programme is to create skilled professionals who can serve society, plan for optimal use of earth resources and at the same time protect the Earth. This curriculum is structured based on the NEP 2020 requirements, which include the fundamentals, key ideas, and practical aspects of geology. It aspires to enable students to explore and understand the Earth by employing a learning outcome-based curriculum. It prepares students for academic and industrial prospects by encouraging them to inculcate critical thinking, analytical abilities, and interdisciplinary knowledge. In addition, it includes guidance on maintaining physical and emotional well-being and promoting social justice and sustainability.

PROGRAMME OUTCOMES (POs)

The Four-Year Undergraduate Programme (FYUGP), in geology is designed to fulfill the following objectives.

- Students are expected to understand the basics of geology, its scope, and its various branches, gain insights into fundamental aspects of the Earth and planetary systems and their changes over time. They will also learn the key geological concepts of mineralogy, petrology, structural geology, plate tectonics, stratigraphy, geochemistry, palaeontology, and various mineral exploration methods, as well as the origin and distribution of economic minerals and energy resources.
- They are also expected to gain understanding of environmental issues related to the planet Earth. They will also gain understanding about different form and processes of landforms evolution, sources of natural resources, including hydrocarbons, groundwater, and ores.
- Students will be able to participate in geological fieldwork to observe actual geological exposures, features etc., learn data collection techniques, measurements, and interpretation skills. This is expected to enhance their knowledge on geologic field mapping.

COMMON NEP, 2020 STRUCTURES OF J.B. COLLEGE (AUTONOMOUS)

Programme offered by the Department: B Sc (Hons)

Types of Course offered by the Department

1. Major Course
2. Minor Course
3. Multidisciplinary
4. Skill Enhancement Course (SEC)
5. Internship/Community Engagement
6. Dissertation/ Thesis

Credit Distribution of different courses

Semester	Major	Minor	Multi-Disciplinary	SEC	Intern	Dissertation /Thesis
1	4	4	3	3		
2	4	4	3	3		
3	4+4+4	4	3	3		
4	4+4+4+4	4			2	
5	4+4+4+4	4			2	
6	4+4+4+4+2	4				
7	4+4+4+4	4				2
8	4+4	4				10
Total	94	32	09	09	04	12

Semester wise Distribution of Course and Credit in Geology

Sem.	Major Course (Credit)	Minor Course (Credit)	Multi-Disciplinary Course (Credit)	SEC (Credit)
1	Fundamentals of Earth System Science I (4)	Fundamentals of Earth System Science I (4)	Introduction to Earth Sciences (3)	Laboratory Techniques-soil, water, and survey (3)
2	Fundamentals of Earth System Science II (4)	Fundamentals of Earth System Science II (4)	Introduction to Earth Sciences (3)	Laboratory Techniques-soil, water, and survey (3)
3	Mineral Science (4) Structural Geology & Tectonics (4) Elements of Geochemistry (4)	Rocks and Minerals (4)	Introduction to Earth Sciences (3)	Laboratory Techniques-soil, water, and survey (3)
4	Igneous Petrology (4) Sedimentary Petrology (4) Paleontology (4) Earth Climate and Environment (4)	Historical Geology (4)		
5	Metamorphic Petrology (4) Stratigraphy (4) Hydrology and Oceanography (4) Economic Geology (4)	Earth Resources (4)		
6	Engineering Geology (4) Fuel Geology (4) Remote Sensing and GIS (4) Geomorphology (4) Geological Field Work (2)	Climate and Environmental Geology (4)		

GEOLOGY COURSE STRUCTURE

Major Course

Semester	Course Code	Credit	Course Title	Course Type and Credit (Theory 3 + Practical 1)	Marks Distribution					Remarks
					T H	TH -IA	PR	PR- IA	Total	
1 st	GEOMJ-011	4	Fundamentals of Earth System Science I	Theory + Practical	60	15	20	05	100	
2 nd	GEOMJ-021	4	Fundamentals of Earth System Science II	Theory + Practical	60	15	20	05	100	
3 rd	GEOMJ-031	4	Mineral Science	Theory + Practical	60	15	20	05	100	
	GEOMJ-032	4	Structural Geology & Tectonics	Theory + Practical	60	15	20	05	100	
	GEOMJ-033	4	Elements of Geochemistry	Theory + Practical	60	15	20	05	100	
4 th	GEOMJ-041	4	Igneous Petrology	Theory + Practical	60	15	20	05	100	
	GEOMJ-042	4	Sedimentary Petrology	Theory + Practical	60	15	20	05	100	
	GEOMJ-043	4	Paleontology							
	GEOMJ-044	4	Earth Climate and Environment	Theory + Practical	60	15	20	05	100	
5 th	GEOMJ-051	4	Metamorphic Petrology	Theory + Practical	60	15	20	05	100	
	GEOMJ-052	4	Stratigraphic Principles and Indian Stratigraphy	Theory + Practical	60	15	20	05	100	
	GEOMJ-053	4	Hydrogeology and Oceanography	Theory + Practical	60	15	20	05	100	
	GEOMJ-054	4	Economic Geology	Theory + Practical	60	15	20	05	100	
6 th	GEOMJ-061	4	Geomorphology	Theory + Practical	60	15	20	05	100	
	GEOMJ-062	4	Remote Sensing and GIS	Theory + Practical	60	15	20	05	100	
	GEOMJ-063	4	Fuel Geology	Theory + Practical	60	15	20	05	100	
	GEOMJ-064	4	Engineering Geology	Theory + Practical	60	15	20	05	100	
	GEOMJ-065	2	Field Work				40	10	50	

Minor Course

1 st	GEOMI-011	4	Fundamentals of Earth System Science I	Theory + Practical	60	15	20	05	100	
2 nd	GEOMI-012	4	Fundamentals of Earth System Science II	Theory + Practical	60	15	20	05	100	
3 rd	GEOMI-013	4	Rocks and Minerals	Theory + Practical	60	15	20	05	100	
4 th	GEOMI-014	4	Historical Geology	Theory + Practical	60	15	20	05	100	
5 th	GEOMI-015	4	Earth Resource	Theory + Practical	60	15	20	05	100	
6 th	GEOMI-016	4	Climate and Environmental Geology	Theory + Practical	60	15	20	05	100	

Multidisciplinary Course

1 st	GEOMU-011	3	Introduction to Earth Science	Theory	60	15			75	
2 nd	GEOMU-012	3	Introduction to Earth Science	Theory	60	15			75	
3 rd	GEOMU-013	3	Introduction to Earth Science	Theory	60	15			75	

Skill Enhancement Course (SEC)

1 st	GEOSK-011	3	Laboratory Techniques - soil, water and survey (3)	Practical			60	15	75	
2 nd	GEOSK-012	3	Laboratory Techniques - soil, water and survey (3)	Practical			60	15	75	
3 rd	GEOSK-013	3	Laboratory Techniques - soil, water and survey (3)	Practical			60	15	75	

Syllabus for Geology Major and Minor Course
(Same syllabus for Major and Minor Course for Semester I and II)

Semester-I

COURSE TITLE: FUNDAMENTALS OF EARTH SYSTEM SCIENCE-I

Course Code: GEOMJ-011/GEOMI-011

Credits: 04 (Theory- 03 + Practical- 01)

No. of Classes: 60(T-45+ P-15)

Marks: Total 100

Theory: 75 (End Semester: 60 and Internal Assessment: 15)

Practical: 25 (End Semester: 20 and Internal Assessment: 05)

***Learning Objective:** To acquire a holistic understanding of dynamics of the planet Earth, its spheres and interior.*

***Learning Outcome:** At the end of the course the student will have knowledge and understanding of the planet Earth as integral part of the universe, the dynamism affecting every aspect of the planet Earth including the interrelationship among atmosphere, lithosphere, and hydrosphere. The students will also learn about Earth's internal zonation, the physical and chemical characters of each zone, its magnetic field and the global geodynamic processes.*

THEORY:

Unit 1: Holistic understanding of the planet Earth

Marks: 10

No of Classes: 07

Introduction to various branches of Earth Sciences and its relation to other branches of science. Origin of the Universe, Solar System and its planets. The terrestrial and jovian planets. Meteorites and Asteroids

Unit 2: Earth and its Spheres

Marks: 15

No of Classes: 10

Earth in the solar system - size, shape, mass, density, rotational and revolution parameters, and its age.

Geosphere (Atmosphere, Hydrosphere, Cryosphere, Lithosphere): Origin and composition,

Biosphere: Components

Pedosphere: Soil and soil profile

Unit 3: Interior of the earth

Marks: 12

No of Classes: 08

Understanding the mechanical layering of the Earth through seismic waves.

Formation and elemental composition of crust, mantle, and core

Geomagnetism: Causes of Earth's magnetism, Earth's magnetic field- changes and effects

Unit 4: Geodynamics

Marks: 15

No of Classes: 12

Heat-flow pattern in the Earth

Concept of plate tectonics, sea-floor spreading, continental drift and isostasy.

Geodynamic elements of Earth- mid oceanic ridges, trenches, transform faults and island arcs

Origin of ocean basins, continents, mountains, and rift valleys

Earthquake and earthquake belts
Volcanoes- types, products, and their distribution.
Introduction to Neotectonics

Unit 5: Understanding the past from stratigraphic records

Marks: 08

No of Classes:08

Nature of stratigraphic records

The concept of time in geological studies. Geologic Time and Standard Geological time scale.

Uniformitarianism, catastrophism and neptunism

PRACTICALS:

Marks: 20

No of Classes: 15

Identification of topographic features with the help of physiographic models.

Study of topographic maps and physiographic description of an area

Identification of soil types.

Identification of horizons of soil profile.

Plotting of earthquake and volcanic belt on world map.

Preparation of Heat flow pattern.

SUGGESTED READINGS:

1. Jacobson, Michael C; Charlson, Robert J.; Rodhe, Henning; Orians, Gordon H. (Eds) (2000): Earth System Science from Biogeochemical Cycles to Global Change, Elsevier Academic Press.
2. Skinner, Brian J. and Porter, Stephen C. (1995): The Blue Planet, An Introduction to Earth System Science, John Wiley & Sons, Inc.
3. Condie, Kent C. (1976): Plate Tectonics and Crustal Evolution, Butterworth-Heinemann.
4. Frisch, Wolfgang; Meschede, Martin; Blakey, Ronald (2011): Plate Tectonics Continental Drift and Mountain Building, Springer, Berlin.
5. Nesar, Laura (2023): Introduction to Earth Science, Virginia Tech University
6. Kolay, A.K. (2021): Soil Geology, Atlantic Publishers & Distributors Pvt. Ltd
7. Duff, P. M. D., & Duff, D. (Eds.). (1993). *Holmes' principles of physical geology*. Taylor & Francis.
8. Emiliani, C. (1992). *Planet earth: cosmology, geology, and the evolution of life and environment*. Cambridge University Press.
9. Gross, M. G. (1977). *Oceanography: A view of the earth*.

Semester-II

COURSE TITLE: FUNDAMENTALS OF EARTH SYSTEM SCIENCE-II

Course Code: GEOMJ-021/GEOMI-021

Credits: 04 (Theory- 03 + Practical- 01)

No. of Classes: 60(T-45 + P-15)

Marks: Total 100

Theory: 75 (End Semester: 60 and Internal Assessment: 15)

Practical: 25 (End Semester: 20 and Internal Assessment: 05)

***Learning Objective:** To gain knowledge on the fundamental concepts of geochemistry, mineralogy, petrology, structural geology, plate tectonics, and paleontology.*

***Learning Outcome:** At the end of the course the student will have knowledge and understanding of distribution and abundance of earth elements and basic concept of minerals and rocks. Students will also have basic idea about geological structures. Students will also learn about fossil records.*

Unit 1: Introduction to Geochemistry

Marks: 10

No of Classes:08

Cosmic and terrestrial abundance of elements.

Basic geochemical environment, mobility of elements and association of elements

Geochemical cycle and Residence time.

Radiogenic isotopes.

Unit 2: Introduction to Mineralogy

Marks: 12

No of Classes:10

Minerals-Definitions, Physical properties of minerals

Chemical bonding in minerals, Silicate structures

Nature of light and principles of optical mineralogy

Unit 3: Introduction to Petrology

Marks: 15

No of Classes:15

Rocks- Definitions and types, Basics of rock formation and rock cycle

Magma and lava. Extrusive and intrusive igneous rock

Formation of sediment and sedimentary rocks

Metamorphism of rocks

Unit 4: Basics of Structural Geology

Marks: 15

No of Classes:07

Deformation of Rocks, concept of Stress and Strain

Concept of planar and linear structures features.

Dip, strike, plunge

Common geological structures: Fold, Fault, Joints

Unit 5: Introduction to Paleontology

Marks: 08

No of Classes:05

Definition, branches, scope, and application of paleontology

Modes of preservation of fossils

Condition for fossilization

PRACTICALS:

Marks: 20

No of Classes: 15

Preparation of geochemical contour map

Study of physical properties of minerals in hand specimen

Differentiating igneous, sedimentary and metamorphic rocks in hand specimens

Use of clinometer, determination of strike, dip, plunge, rake, and pitch

Identification of mode of preservation of fossils.

SUGGESTED READINGS:

1. Klein, C., Dutrow, B., Dwight, J., & Klein, C. (2007). The 23rd Edition of the Manual of Mineral Science (after James D. Dana). J. Wiley & Sons.
2. Kerr, P. F. (1959). Optical Mineralogy. McGraw-Hill.
3. Verma, P. K. (2010). Optical Mineralogy (Four Colour). Ane Books Pvt Ltd.
4. Deer, W. A., Howie, R. A., & Zussman, J. (1992). An introduction to the rock-forming minerals (Vol. 696). London: Longman.
5. Mason, B. (1986) Principles of Geochemistry. 3rd Edition, Wiley New York.
6. Rollinson, H. (2007) Using geochemical data – evaluation, presentation, and interpretation. 2nd Edition. Publisher Longman Scientific & Technical.
7. Walther, J. V. (2009). Essentials of geochemistry. Jones& Bartlett Publishers.
8. Albarède, F. (2003). Geochemistry: an introduction. Cambridge University Press.
9. Raup, D. M., Stanley, S. M., Freeman, W. H. (1971) Principles of Paleontology
10. Shukla, A. C., & Misra, S. P. (1975). Essentials of paleobotany. Vikas Publisher
11. Neser, Laura (2023): Introduction to Earth Science, Virginia Tech University
12. Misra, Kula C (2016): Introduction to Geochemistry Principles And Applications, Wiley India

Syllabus for Multidisciplinary Course
Same syllabus will be followed in Semester I, II and III

COURSE TITLE: INTRODUCTION TO EARTH SCIENCE

Course Code: GEOMU– 011/021/031

Credits: 03(only Theory)

No. of Classes: 45

Marks: Total: 75 (End Semester: 60 and Internal Assessment: 15)

Learning Objective: To give a fundamental understanding of the processes involved in the planet earth and common natural resources.

Learning Outcome: At the end of the course the student will have basic knowledge and understanding on earth system, its dynamics, and resources.

Unit 1:Earth as a Planet

Marks:12

No of Classes:10

Origin of the Universe, Solar System, and its planets

Earth in the solar system - size, shape, mass, density, rotational and revolution parameters, and its age.

Introduction to Geosphere

Unit 2: Minerals and Rocks

Marks:12

No of Classes:7

Minerals-Definition, important physical properties, important rock forming minerals.

Rocks – Definition and types. Commonly occurred rocks and their uses

Unit 3:Soil and Water

Marks:10

No of Classes:8

Definition of soil, soil profile. Soil types of India. Soil erosion

Water- Surface and ground water, their use and management

Unit 4: Geohazards

Marks: 13

No of Classes:10

Dynamic Earth Process- Plate Tectonics

Hazards, Risks & Disasters.

Geo Hazards: Causes, effect and mitigation of earthquake, landslide,flood and bank erosion,

Urban Floods

Disaster Management.

Unit 5:Earth Resources

Marks: 13

No of Classes:10

Occurrence and types of Coal

Occurrence of Petroleum

Economic minerals and their uses. Important economic minerals of India

Geothermal energy

SUGGESTED READINGS:

1. Mukerjee, P. K. (2013): A Textbook of Geology, World Press,
2. Mahapatra, G. B (2019): A Textbook of Geology, CBS Publishers & Distributors
3. Mahapatra, G. B (2018): A Textbook of Physical Geology, CBS Publishers & Distributors
4. Bangar, K. M (2021): Principals Of Engineering Geology, Standard Publishers Distributors, New Delhi
5. Bangar, K. M (2019): General and Engineering Geology, Standard Publishers Distributors, New Delhi
6. Prasad, Umeshwar (2019): Economic Geology: Economic Mineral Deposit, CBS Publishers & Distributors.
7. Lutgens, Frederick K. and Tarbuck, Edward J. (2012): **Essentials of Geology**, Prentice Hall

COURSE TITLE: LABORATORY TECHNIQUES: SOIL, WATER AND SURVEY

Course Code: GEOSK-011/021/031

Credits: 03 (only Practical)

No. of Classes: 45

Total Marks: 75 (End Semester: 60 and Internal Assessment: 15)

***Learning Objective:** To develop important surveying skills and identify soil and water qualities.*

***Learning Outcome:** At the end of the course the student will know the basic properties of soil and water and learn how to find the qualities of soil and water. Students also learn simple methods of measurement of length, area, and height on the earth surface.*

Unit 1: Basics of land surveying

Class:20

Marks: 30

Land surveying tools

Map reading, Topographic maps and satellite imageries

Contouring, Digitization of the map data

Use of compass and determination of bearing

Length and height measurement – actual value and approximation

Pacing and height approximation in the field

Location of field point on the map and map point in the field

Unit 1:Basics of Soil and Water Testing**Class: 25****Marks: 30**

Sampling and Bathymetry

Engineering properties of soil,

Different tools used for analysis of soil

Determination of soil properties

Classification of soil based on identified properties

Soil profile study

Occurrence of surface and ground water

Physical, chemical, and dynamic properties of surface and groundwater

Evaluation of water quality

Water testing tools and methods

Water table contouring and determination of flow-lines

SUGGESTED READINGS:

1. Meyers, Robert A (2001): Encyclopedia of Physical Science and Technology, measurements techniques and instrumentation, Elsevier Science Ltd.
2. Barnes, John W. and Lisle, Richard J. (2004): Basic Geological Mapping, John Wiley & Sons Ltd, West Sussex, England.
3. Khambalkar, Priyadarshani A; Yadav, Shashi S; Singh, Akhilesh; Trivedi, S K & Narendra Gurjar, S (2022): Practical Manual on Soil Testing, I B P S S Publication.
4. Maharaj, Dr. D.K. (2017):aboratory Manual For Soil Testing, S.K. Kataria & Sons
5. Singh, P (2017): Practical Manual Of Water Analysis, Agri Biovet Press.
6. Khanna, D. R and Bhutani, R (20211): Laboratory Manual of Water and Wasteland Analysis, Daya Publishing House, New Delhi.
7. Moorberg, Colby. J. AND Crouse, David. A.(2021): Soils Laboratory Manual, New Prairie Press, Manhattan.
8. Singh, Ummed and Praharaj, C S (2017): Practical Manual, Chemical Analysis of Soil and Plant Samples, ICAR-Indian Institute of Pulses Research, Kanpur, Uttar Pradesh (India)-208 024