SYLLABUS

DIBRUGARH UNIVERSITY

FYUGP

GEOLOGY

(Recommended by B.O.S. in GEOLOGY, D.U. in its meetings held on 18.11.2022 & 10.02.2023)

PREAMBLE

The prime objective of this four years degree course in Geology of Dibrugarh University is to generate efficient and skilled human resources who can serve the society at larger extent and play a major role in preserving the Mother Planet. This model curriculum for Bachelor of Science in Geology is prepared following the guidelines of NEP 2020 includes basic foundation, core and the theoretical as well as applied components of the geology course. It aims at to empower the graduate students to explore and understand various aspects of the Planet Earth. A Learning Outcome-based Curriculum Framework (LOCF) is approached so that the students can experience the prime objectives of the course, engage themselves in the programme of their choice, acquire advance knowledge and perform better at examination level. This undergraduate curriculum is expected to prepare the students academia, industry employability. The student will unfold decisive thinking, analytical and interdisciplinary skills which can be applied to various scientific and environmental contexts and gain a deeper appreciation in the subject. This course is also designed to counselling the undergraduate students for maintaining the physical and mental well-being, emotional stability, stress management and social justice and sustainability.

INTRODUCTION

The Under Graduate (UG) syllabus of Geology in light of New Education Policy (NEP), 2020 consists of Major (Core) disciplines, Minor disciplines, Multi-Disciplinary Generic Elective Courses (MDGEC), Ability Enhancement Courses (AEC), Value Added Courses (VAC), Skill Enhancement Courses (SEC), Environmental Education (EE), YOGA, Community Based Engagement (NCC/NSS/Adult Education/Student Mentoring/NGO/Govt. Institutions, etc.), Digital and Technological Solutions/Digital Fluency (DTS/DF), Geological Fieldwork, Internship, Project, Research Ethics and Methodology, Research Project (Development of Project/Research Proposal, Review of related literature), Dissertation Project Work and Discipline Specific Electives (DSE).

The UG degree programme offers certificates, diplomas and degrees as follows:

UG Certificate: Students who opt to exit after completion of the first year (Two Semesters) and have secured 44 credits will be awarded a UG certificate. These students are allowed to re-enter within three years and complete the degree programme within the stipulated maximum period of seven years.

Certificate course consists of two Major disciplines, two Minor disciplines, two MDGEC, two AEC, two VAC, two SEC, YOGA and Environmental Education with emphasis on community-based activities.

UG Diploma: Students who opt to exit after completion of the second year (Four Semesters) and have secured 88 credits will be awarded the UG diploma. These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period of seven years.

Diploma course consists of six Major disciplines, four Minor disciplines, three MDGEC, three AEC, two VAC, three SEC, YOGA, Environmental Education with emphasis on community-based activities and Digital and Technological Solutions/Digital Fluency and Community engagement.

3-year UG Degree: Students who wish to undergo a 3-year (Six Semesters) UG programme will be awarded UG Degree in the Major discipline after successful completion of three years, securing 132 credits.

3-year UG degree course consists of fourteen Major disciplines, six Minor disciplines, three MDGEC, three AEC, two VAC, three SEC, YOGA, Environmental Education with emphasis on community- based activities, Digital and Technological Solutions/Digital Fluency, Community engagement, Internship and Project.

4-year UG Degree (Honours with Research): Students who secure 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year (Two Semesters). They should do a research project or dissertation under the guidance of a faculty member of the University/College. The research project/dissertation will be in the major discipline. The students who secure 176 credits, including 12 credits from a research project/dissertation, are awarded UG Degree (Honours with Research).

4-year UG degree course consists of twenty Major disciplines, eight Minor disciplines, three MDGEC, three AEC, two VAC, three SEC, YOGA, Environmental Education with emphasis on community-based activities, Digital and Technological Solutions/Digital Fluency, Community engagement, Internship, Project, Research Ethics and Methodology, Research Project or one DSE and Dissertation or two DSE.

UG Degree Programmes with Single Major: A student has to secure a minimum of 50% credits from the major discipline for the 3-year/4-year UG degree to be awarded a single major.

UG Degree Programmes with Double Major: A student has to secure a minimum of 40% credits from the second major discipline for the 3-year/4-year UG degree to be awarded a double major.

Interdisciplinary UG Programmes: The credits for core courses shall be distributed among the constituent disciplines/subjects so as to get core competence in the interdisciplinary programme.

Multidisciplinary UG Programmes: In the case of students pursuing a multidisciplinary programme of study, the credits to core courses will be distributed among the broad disciplines such as Earth and Energy Sciences, Life sciences, Physical Sciences, Mathematical and Computer Sciences, Social Sciences, Humanities, etc..

The statutory bodies of the Universities and Colleges such as the Board of Studies and Academic Council will decide on the list of courses under major category and credit distribution for double major, interdisciplinary and multidisciplinary programmes.

AIM

The aims of Four Year Under-Graduate Programme (FYUGP) in Geology are:

1. To know the fundamentals of Geology, its scope and its various branches.
2. To introduce fundamental aspects of Earth and Planetary system and its related changes with time. This course will mainly emphasize to provide knowledge on the Mineralogy, Petrology, Structural Geology and Plate Tectonics, Stratigraphy, Paleontology,various mineral exploration methods etc.
3. To introduce about the different sources of natural resources such as hydrocarbons, ground water and ores.
4. To associate the naturally occurring landforms with erosive and depositional action of the rivers, wind and glaciers.

5. Students will be able to understand scientific methodologies and by applying the methodsfinding solutions to selected problems in different fields of Geology.

GRADUATE ATTRIBUTES OF THE FYUGP IN GEOLOGY

Graduate attributes include both disciplinary knowledge related to the particular discipline and generic attributes that the graduates of all the disciplines of study should acquire and demonstrate.

Graduate attributes of the FYUGP in Geology are:

Disciplinary Knowledge: The graduates should have the ability to demonstrate the attribute of comprehensive knowledge and understanding of the discipline of Geology.

CommunicationSkills

Capability to express various Geological ideas clearly through computational methods, graphical methods, examples and their graphical representations; ability to use Geology effectively as a precise language of communication in other fields; ability to pay close attention, read texts and research papers critically, and communicate complicated information clearly and concisely to a variety of organisations and audiences.

MoralandEthicalAwareness/Reasoning

Ability to recognise ethical issues that are pertinent to one's work and pledge not to engage in unethical behavior such as plagiarism, copyright and infringement of intellectual property rights; ability to appreciate recent developments in various fields and one's research with honesty and integrity in all aspects.

MulticulturalCompetence

Ability to corelate and compare recent developments in various branches of Geology in a variety of organizations worldwide; ability to collaborate research in various fields of geology with otherresearchersfromavarietyofcommunitiesandorganisations;abilitytoeffectivelyparticipateinamulticultural group or society and interact politely with diverse groups, and the acquisition of knowledge of the values and beliefs of multiple cultures, and a global viewpoint to honour diversity.

Information/DigitalLiteracy

Ability to access, asses and utilize Information and Communications Technology (ICT) tools. Ability to understand, read and write programming language/packages/modules (MATLAB; C) for computation, simulation, graphs and solutions.

ReflectiveThinking

An understanding of how a researcher or an investigator influences and shapes the information one creates; ability to formulate appropriate questions pertaining to the ideas in various branches of Geology in order to propose new solutions using the domain knowledge of Geology; ability to interpret the findings and use them to solve a variety of problems found in numerous fields of Geology and real-life.

Cooperation/Team Work

During field work ability to collaborate with diverse teams in an effective and respectful manner; capacity to cooperate withpeoplefromvaried backgrounds in theinterests of acommon goal.

ResearchRelatedSkills

To formulate appropriate questions, problems, and hypotheses by analysing and interpreting the ideas from various branches of Geology; ability to demonstrate the results, theories, techniques and proofs using the concepts of various fields of Geology; ability to develop methodology and design research proposals.

ProblemSolving

To work independently and do in-depth study to find ways that Geology is used in various industries and in daily life to improve job possibilities in a wide range of fields and academic study; ability to use innovative, imaginative, lateral thinking, interpersonal skills, and emotional intelligence; ability to tackle various challenges in both familiar and unfamiliar circumstances, then apply what they've learned to actual scenarios.

CriticalThinking

Capability to analyse and synthesise theoretical and applied problems, as well as acquire knowledge andskills through logical reasoning, analytical thinking and evaluations; ability to find gaps and logical faults in arguments; inculcate a healthy attitude to be a lifelong learner.

LEARNING OUTCOMES

1. Students will understand the genesis of Geology and its importance.
2. The students will gain fair knowledge of understanding of the subject concerned and also recent trends developed in the subject.
3. The University expects maximum involvement of the student fraternity in utilising the benefits of such a flexible yet rigorous curriculum framework at the undergraduate level and reaping the benefits of it through enrichment of their skills in their area of interest which will eventually help them in gaining employment, entrepreneurship, start-ups and various other ways of a dignified life and living as a global citizen with contemporary global demands.
4. Students, after completing this course, are expected to be well prepared to pursue future studies and research in the field of Geology. The Pursuit of higher studies in the subject will help in the academic upliftment of the subject and society as a whole.
5. Further, the students will be benefited in preparing for the various competitive examinations.
6. The course will impart life skills such as communication, cooperation, teamwork, and resilience.

TEACHING LEARNING PROCESS

The programme allows to use varied pedagogical methods and techniques both within

classroom and beyond.

1. Lecture
2. Tutorial
3. Power point presentation
4. Documentary film on related topic
5. Project Work/Dissertation
6. Group Discussion and debate
7. Seminars/workshops/conferences
8. Field visits and Report/Excursions
9. Mentor/Mentee

TEACHING LEANING TOOLS

1. Projector
2. Smart Television for Documentary related topic
3. LCD Monitor
4. WLAN
5. White/Green/Black Board
6. Fieldwork

ASSESSMENT

1. Home assignment
2. Project Report
3. Class Presentation: Oral/Poster/Power point
4. Group Discussions
5. In semester examinations
6. End Semester examinations
7. Field work

DRAFT STRUCTURE OF FOUR YEAR UNDER GRADUATE PROGRAMMES (FYUGP) INGEOLOGY FOR DIBRUGARH UNIVERSITY AND ITS AFFILIATED COLLEGES (ASPERNEP-2020 GUIDELINES)

Year	Semester	Course	Title of the Paper and Paper Code	Total Credit
Year 01	1st Semester	Major	Earth System Science	4
		Minor	Earth and Climate	4
		MDGEC	(Any one) Minerals, Rocks and Ore Disaster Preparedness	3
		AEC	AEC Language: MIL/ Regional Language	4
		VAC	Value Added Course 1: Understanding India	2
		VAC	Value Added Course 2: Health and Wellness	2
		SEC	Basic Field Training	3
	Total22			
	2nd Semester	Major	Mineralogy and Crystallography	4
		Minor	Introduction to Geophysics	4
		MDGEC	(Any one) Earthquake Studies Brahmaputra Studies	3
		AEC	English Language and Communication Skills	4
		VAC	Value Added Course 1: Environmental Science	2
		VAC	Value Added Course 2: Yoga Education	2
		SEC	Geological Mapping	3
	Total22			
The students on exit shall be awarded Undergraduate Certificate (in the Field of Study/Discipline) after securing the requisite 44 Credits in Semester 1 and 2 provided they secure 4 credits in work based vocational courses offered during summer term or internship / Apprenticeship in addition to 6 credits from skill-based courses earned during 1st and 2nd Semester				
Year 02	3rd Semester	Major	Palaeontology	4
		Major	Structural Geology and Tectonics	4
		Minor	Evolution of Life through Time	4
		MDGEC	(Any one) Climate Change Past and Present Geo-Heritage and Geo-tourism	3
		VAC	Digital and Technological Solutions / Digital Fluency	2
		AEC	Communicative English / Mathematical Ability	2
		SEC	Surveying Techniques and GIS	3
	Total			**22**

Abbreviations Used:

- **C = Major**
- **GEC = Generic Elective Course / Multi-Disciplinary Course**
- **AEC = Ability Enhancement Course**
- **SEC = Skill Enhancement Course**
- **VAC = Value Added Course**

B.SC. IN GEOLOGY PROGRAMME (NEP)
DETAILED SYLLABUS OF 1st SEMESTER

Course Title **: Earth System Science**
Course Code **: GEOC1**
Nature of Course **: Major (Core)**
Total Credits **:** 04 credits
Distribution of Marks **:** 80 (End-Sem.) (60T+20P) + 20 (In-Sem.)

COURSE OBJECTIVES: *Earth system science programme aims to explore, understand, communicate and teach the earth as a planet, its complex processes, past and future evolution and interaction with society. In short language, it provides integrated understanding of the earth system. It also deals with complex interaction among lithosphere, biosphere and atmosphere*.

UNITS	CONTENTS	L	T	P	Total Hours
I (15 Marks)	**Universe and the Solar System** Formation and evolution of the Universe, meteorites and asteroids; theories of origin of the earth, brief geological history and age of earth.	**12**			**12**
II (20 Marks)	**Earth System** Planet Earth, moon, planetary properties, orbital and rotational characteristics of the earth, physical characteristics; atmosphere, hydrosphere, lithosphere, biosphere and cryosphere; gravitational and magnetic field of the earth, Interior of the Earth: core, mantle and crust.	**15**			**15**
III (25 Marks)	**Introduction to Geology** Various branches of geology and its interdisciplinary and multidisciplinary perspectives Minerals and rocks: concept of native elements, mineraloids, rock forming minerals. Brief introduction to rocks: igneous, metamorphic and sedimentary rocks, the rock cycle Rock weathering; Soil: formation, soil profile and soil types. Brief idea about different geomorphic processes and their products. Geomorphic divisions of Indian subcontinent. Concept of plate tectonics, origin of oceans, continents, mountains and rift valleys. Earthquake and earthquake belts. Volcanoes- types, products and their distribution. Earth's heat budget, land-air-sea interactions; atmospheric and ocean circulation, Coriolis effect, concepts of eustasy. Stratigraphy and historical geology – basic principles; Introduction to the geology of India.	**18**			**18**
Unit IV Practical (20 Marks)	Identification of minerals and rock in hand specimen Identification of mega fossils Identification of structural models **Note book**			**15**	**30**
	Total				**75**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(20 Marks)**

- **One Internal Examination -** **10 Marks**

- **Others (Any one) - 10 Marks**
  - **Group Discussion**
  - **Seminar presentation on any of the relevant topics**
  - **Debate**

LEARNING OUTCOMES:

On completion of this Course, a student will be able to develop a scientific understanding of the entire Earth system on a global scale by describing how its component parts and their interactions have evolved, how they function, and how they may be expected to continue to evolve on all timescales.

SUGGESTED READINGS

1. Brian J. Skinner, B. J. & Porter, S. C.: (2012). The Blue Planet: An Introduction to Earth System Science. John Wiley & Sons. Inc.
2. Thompson G.R.R., Turk J. (1997) Introduction to Physical Geology. Brooks Cole.
3. Tarbuck, E. J. &Lutgens, F. K. (1998). Earth: An Introduction to Physical Geology. Pearson
4. Charles, C. P., Carlson, D., &Mcgeary, D. (2009) Physical Geology. McGraw-Hill Higher Education
5. Duff, P. M. D., & Duff, D. (Eds.). (1993). Holmes' principles of physical geology. Taylor & Francis.
6. Emiliani, C. (1992). Planet earth: cosmology, geology, and the evolution of life and environment. Cambridge University Press.

Course Title : **Earth and Climate**
Course Code : **MINGEO1**
Nature of Course : **Minor**
Total Credits : 4 credits
Distribution of Marks : 80 (End-Sem.) (60T+20P) + 20 (In-Sem.)

Objectives: Aims in study of the earth, its heat budget, its climate, atmosphere and hydrosphere and their changes through time and it effects and responses produce by the biosphere.

UNITS	CONTENTS	L	T	P	Total Hours
I (16 Marks)	**Climate system: Forcing and Responses** Components of the climate system, Climate forcing, Climate controlling factors Climate system response, response rates and interactions within the climate system Feedbacks in climate system	**12**			**12**
II (22 Marks)	**Atmosphere – Hydrosphere** Layering of atmosphere and atmospheric Circulation Atmosphere and ocean interaction and its effect on climate, Heat transfer in ocean Global oceanic conveyor belt and its control on earth's climate, Surface and deep circulation Sea ice and glacial ice **Response of biosphere to Earth's climate** Climate Change: natural vs. anthropogenic effects Humans and climate change, Future perspectives, Brief introduction to archives of climate change, Archive based climate change data from the Indian continent	**15**			**15**
III (22 Marks)	**Orbital cyclicity and climate** Milankovitch cycles and variability in the climate Glacial-interglacial stages, The Last Glacial maximum (LGM), Pleistocene Glacial-Interglacial cycles, Younger Dryas, Marine isotope stages **Monsoon** Mechanism of monsoon Monsoonal variation through time Factors associated with monsoonal intensity Effects of monsoon	**18**			**18**
Unit IV	Study of distribution of major climatic regimes of India on map Distribution of major wind patterns on World map Preparation of paleogeographic maps (distribution of land				

Practical (20 Marks)	and sea) of India during specific geological time intervals Numerical exercises on interpretation of proxy records for paleoclimate Note Book Viva Voce			**15**	**30**
	Total				**75**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: (20 Marks)

- **One Internal Examination - 10 Marks**
- **Others (Any one) - 10 Marks**
  - **Group Discussion**
  - **Seminar presentation on any of the relevant topics**
  - **Debate**

LEARNING OUTCOMES:

On completion of this Course, a student will be able to develop a scientific understanding of the entire Earth's climate system, heat budget of the earth, inter relationships among atmosphere, hydrosphere and biosphere, orbital cyclicity and on different components of Monsoon.

SUGGESTEDREADINGS:

1. Rudiman, W.F., 2001.Earth's climate: past and future. Edition2, Freeman Publisher.
2. Rohli,R.V., and Vega,A.J.,2007.Climatology.JonesandBarlatt
3. Lutgens, F., Tarbuck, E., and Tasa, D., 2009. The Atmosphere: An Introduction to Meteorology.Pearson Publisher
4. Aguado,E.,and Burt,J.,2009.Understanding weather

Course Title : **Minerals, Rocks and Ores**
Course Code : **GECGEO1A**
Nature of Course : **Multi-Disciplinary Generic Elective**
Total Credits : 3 credits
Distribution of Marks : 80 (End-Sem.) + 20 (In-Sem.)

COURSE OBJECTIVES:

- The course will provide an introduction to mineralogy, petrology, and related ore deposits
- Basic principles of mineralogy and microscopy will be built upon to describe and interpret igneous, metamorphic, and economically important rocks and minerals.

UNITS	CONTENTS	L	T	P	Total Hours
I (20 Marks)	**Minerals** Definition and different categories of minerals and classification; Common rock forming minerals of Igneous, Sedimentary and Metamorphic rocks. Physical properties of minerals: characters depending on light, senses, heat, magnetism, electricity and radioactivity; Macroscopic identification of Minerals. Minerals used in the industry.	**12**			**12**
II (20 Marks)	**Rocks** The three groups of rocks: Igneous rocks: intrusive and extrusive rocks-their forms with examples. Classification and description of Igneous Rocks. Sedimentary Rocks: classification and description.clastic and non-clastic, Sedimentary rocks and natural resources. Metamorphic Rocks: metamorphism, naming of metamorphic rocks; Types of metamorphic rocks.	**15**			**15**
III (20 Marks)	**Ores** Definition of ore, ore minerals and average crustal composition; Economic deposit.Ore minerals in human concerns. Metallic and non-metallic ore minerals, gemstones.	**12**			**12**
IV (20 Marks)	Use of rocks, minerals and ores in different mineral industries, refractory, ceramic,cement, fertilizer, chemical industries etc.	**06**			**06**
	Total				**45**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(20 Marks)**

- **One Internal Examination -** **10 Marks**
- **Others (Any one) -** **10 Marks**
  - **Group Discussion**
  - **Seminar presentation on any of the relevant topics**
  - **Debate**

LEARNING OUTCOMES:

On completion of this Course, a student will be able to identify and describe common rock-forming and economically significant minerals, as well as igneous, sedimentary and metamorphic rocks, using the properties of the rock. A student will also be able to know the significant uses of those minerals and rocks.

SUGGESTED READINGS

1. Alexander, P.O. 2009 A Handbook of Minerals, Crystals, Rocks and Ores. New India Pub. Agency, New Delhi.
2. Ehlers & Blatt. (1999). Petrology, Igneous, Sedimentary, Metamorphic. CBS.
3. Winter. (2015). Principles of Igneous and Metamorphic Petrology. Pearson Education India
4. Perkins, D. (2015). Mineralogy. Pearson Education India.
5. Earth Materials- Introduction to Mineralogy and Petrology, Cornelis Klein and Anthony Philpotts,
6. Understanding Earth (Sixth Edition), John Grotzinger and Thomas H. Jordan, 2010, W.H. Freeman andcompany, New York

Course Title : **Disaster Preparedness**
Course Code : **GECGEO1B**
Nature of Course : **Multi-Disciplinary Generic Elective**
Total Credits : 3 credits
Distribution of Marks : 80 (End-Sem.) + 20 (In-Sem.)

COURSE OBJECTIVES: The primary objective of offering the course of disaster preparedness is to understand the various aspects associated in the event of a disaster. Preparing for an imminent disaster encompasses large number of factors that need attention of an individual and the community as a whole. A detail analysis of these factors only can help us to prevent loss of life and property through a robust scheme of preparedness.

UNITS	CONTENTS	L	T	P	Total Hours
I (20 Marks)	Definition: hazard, vulnerability, risk, emergency and disaster. Types of disaster: natural and anthropogenic. Overview of disaster scenarios.	**12**			**12**
II (20 Marks)	Disaster management. Disaster preparedness: pre-disaster, during -disaster and post disaster preparedness. Community planning: Critical infra-structure and key resources; key sectors: schools and colleges, hospitals, fire, police, rescue.	**13**			**13**
III (20 Marks)	Emergency management: prepare, protect, respond, recover, mitigate. Infrastructure damage; Evacuation/ displaced persons; economic impact; recovery time line.	**10**			**10**
IV (20 Marks)	Multi-hazard scenario in NE India: earthquake, landslide, flood and erosion, cyclone, industrial hazard, tornado, lightning, cloud burst. Disaster early warning system – floods, landslides, cyclones and earthquakes.	**10**			**10**
	Total	**45**			**45**

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (20 Marks)

- **One Internal Examination - 10 Marks**
- **Others (Any one) - 10 Marks**
  - **Group Discussion**
  - **Seminar presentation on any of the relevant topics**
  - **Debate**

LEARNING OUTCOMES:

On completion of this Course, a student will be able to develop his basic conceptual understanding about disaster, disaster management and about disaster preparedness.

SUGGESTED READINGS

- Disaster Management and Preparedness by L R Collins, Taylor and Francies Group
- Case Studies in Disaster Response and Emergency Management byN. A.Valcik and C E Tracy, ASPA
- Disaster preparedness by R Brouhard and Crystal Kline, Mike Sanders
- Disaster preparedness Handbook: A Guide for families by A T Bradley, Skyhorse Publishing
- National Disaster Management Authority (NDMA) publications

Course Title : **Basic Field Training**
Course Code : **SEC121**
Nature of Course : **Skill Enhancement**
Total Credits : 3 credits
Distribution of Marks : 80 (End-Sem.) + 20 (In-Sem.)

COURSE OBJECTIVES: *The purpose of basic field mapping is the skill enhancement to enable us the basic field techniques and procedures.*

UNITS	CONTENTS	L	T	P	Total Hours
I (20 Marks)	Orientation of topographic maps in field, marking location in toposheets, concept of bearing; Topographic distance, height and pace approximation	**12**			**12**
II (25 Marks)	Identification of rock types in field; structures and texture of rocks, Use of various field tools	**08**			**08**
III (15 Marks)	Basic field measurement techniques, preparation of vertical profile.	**10**			**10**
IV (20 Marks)	Field Work				**30**
	Total				**60**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(20 Marks)**

- **One Internal Examination -** **10 Marks**
- **Others (Any one)** **-** **10 Marks**
  - **Group Discussion**
  - **Seminar presentation on any of the relevant topics**
  - **Debate**

LEARNING OUTCOMES:

On completion of this Course, a student will be able to develop the basic knowledge of geological field work techniques. He/she will be able to identify different rock types along with various structures developed on rocks in the field.

SUGGESTED READINGS

- Mathur, S.M (2001). Guide to Field Geology. Prentice Hall India Learning Private Limited.
- Gokhale, N.W. (2009). A Guide to Field Geology. CBS.
- Lahee, F.H. 1916. Field Geology.
- Compton, R.R, 1985. Geology in the Field.

B.SC. IN GEOLOGY PROGRAMME (NEP)
DETAILED SYLLABUS OF 2nd SEMESTER

Course Title **: Mineralogy and Crystallography**
Course Code **: GEOC2**
Nature of Course **: Major (Core)**
Total Credits **:** 04 credits
Distribution of Marks **:** 80 (End-Sem.) (60T+20P) + 20 (In-Sem.)

COURSE OBJECTIVES: *Minerals are the basic building blocks of the solid Earth materials and also used as raw materials for mineral based industries. This requires a fundamental knowledge in mineral genesis, associations and occurrence to understand the mineralogical processes. This course is designed to gain basic principles and concepts behind the arrangement of atoms to form crystal structures and how this is reflected in the external form, chemical composition and mineral properties.*

UNITS	CONTENTS	L	T	P	Total Hours
I (25 Marks)	**Crystallography** Crystal, Characteristics of crystal: Faces, Edges, Solid angle, Zone and Zone axis. Crystal symmetry: Planes, Axes and centre of symmetry. Faces, Intercepts and Symbols: Unit face, Parameters, Axial ratio, Miller indices. Fundamental laws of crystallography, crystal habits. Seven crystal system: Cubic, Tetragonal, Hexagonal, Trigonal, Orthorhombic, Monoclinic and Triclinic. Study of elements of symmetry and forms of the holosymmetric class of each crystal system. Crystal aggregates and twinned crystals. Twin laws, types of twins.	**20**			**20**
II (23 Marks)	**Mineralogy** Definition of mineral, Classification and physical properties of minerals, Isomorphism, Polymorphism and Pseudomorphism, Atomic substitution. Crystal structures of Silicate minerals. Common rock forming mineral Groups and their Structural formula, Physical and optical properties, mode of occurrence.	**18**			**18**
III (12 Marks)	**Optical Mineralogy** Nature of light, ordinary and plane polarized light.	**07**			**07**
IV Practical (20 Marks)	Identification of crystal models Study of crystals and symmetry elements of given crystal models Study and identification of rock forming minerals in hand specimens Note Book Viva-voce			**15**	**30**
	Total				**75**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(20 Marks)**

- **One Internal Examination - 10 Marks**
- **Others (Any one) - 10 Marks**
  - **Group Discussion**
  - **Seminar presentation on any of the relevant topics**
  - **Debate**

LEARNING OUTCOMES: *The learning outcome of the course is to demonstrate understanding of the distinction between light velocity, vibration direction, propagation direction and wavelength and interaction of light with isotropic and anisotropic minerals special to understand basic principles of analytical techniques and be able to use this knowledge to simple mineral phase identification., and to identify an unknown mineral based on optical properties and optical techniques.*

SUGGESTED READINGS:

1. Perkins, D. (2015). Mineralogy. Pearson Education India.
2. Klein, C., Dutrow, B., Dwight, J., & Klein, C. (2007). The 23rdEdition of the Manual of MineralScience (after James D. Dana). J. Wiley & Sons.
3. Deer, W. A., Howie, R. A., &Zussman, J. (1992). An introduction to the rockformingminerals (Vol. 696). London: Longman.
4. Gribble, C. D. (2005). Rutley's Elements of Mineralogy. CBS.
5. Mason & Berry (2004). Mineralogy. CBS.
6. Rabindra, H. N. (2012). Practical Approach to Crystallography and Mineralogy. CBS.
7. Sands, D. E. (1994). Introduction to Crystallography. Dover Publications Inc.
8. Schwarzenbach, D. (1997). Crystallography. Willey

Course Title : **Introduction to Geophysics**
Course Code : **MINGEO2**
Nature of Course : **Minor**
Total Credits : **0**4 credits
Distribution of Marks : 80 (End-Sem.) (60T+20P) + 20 (In-Sem.)

COURSE OBJECTIVES: *Use of the physics in understanding the geodynamic features of the earth. Aims to study different types of the geophysical methods, integrated geophysical methods its anomalies and application*.

UNITS	CONTENTS	L	T	P	Total Hours
I (20 Marks)	**Geology and Geophysics:** Interrelationship between geology and geophysics, Role of geological and geophysical data in explaining geodynamical features of the earth. **General and Exploration geophysics:** Different types of geophysical methods - gravity, magnetic, electrical and seismic; their principles and applications. Concepts and Usage of corrections in geophysical data	**15**			**15**
II (25 Marks)	**Geophysical field operations:** Different types of surveys, grid and route surveys, profiling and sounding techniques, Scales of survey, Presentation of geophysical data **Application of Geophysical methods:** Regional geophysics, oil and gas geophysics, ore geophysics, groundwater geophysics, engineering geophysics	**18**			**18**
III (15 Marks)	**Geophysical anomalies:** Correction to measured quantities, geophysical, anomaly, regional and residual (local) anomalies, factors controlling anomaly, and depth of exploration **Integrated geophysical methods:** Ambiguities in geophysical interpretation, planning and execution of geophysical surveys	**12**			**12**
VII Practical (20 Marks)	**A**nomaly and background- Graphical method Study and interpretation of seismic reflector geometry Problems on gravity anomaly Note Book Viva Voce			**15**	**30**
	Total				**75**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(20 Marks)**

- **One Internal Examination** - **10 Marks**
- **Others (Any one)** - **10 Marks**
  - **Group Discussion**
  - **Seminar presentation on any of the relevant topics**
  - **Debate**

LEARNING OUTCOMES: Students, after completing this course, are expected to be well prepared to pursue future studies and research in the field of geodynamic features of the earth. Further, the students will be benefited in preparing for the various competitive examinations.

SUGGESTEDREADINGS:

1. Outlines of Geophysical Prospecting –A manual for geologists by Ramachandra Rao, M.B.,Prasaranga,University of Mysore, Mysore,1975.
2. Exploration Geophysics - An Outline by Bhimasarikaram V.L.S., Association of Exploration
3. Geophysicists,Osmania University, Hyderabad,1990.
4. Dobrin, M.B. (1984) An introduction to Geophysical Prospecting. McGraw-Hill, New Delhi.
5. Telford, W. M., Geldart, L. P., & Sheriff, R. E. (1990). *Applied geophysics* (Vol. 1). Cambridge university press.
6. Lowrie,W.(2007).Fundamentals of geophysics.Cambridge University Press.

Course Title : **Earthquake Studies**
Course Code : **GECGEO2A**
Nature of Course : **Multi-Disciplinary Generic Elective**
Total Credits : 03 credits
Distribution of Marks : 80 (End-Sem.) + 20 (In-Sem.)

COURSE OBJECTIVES: *The course is designed to provide students the basic concepts of earthquakes, along with some practice in analyzing seismological database.*

UNITS	CONTENTS	L	T	P	Total Hours
I (20 Marks)	Theory of elasticity, Generalized Hooke's law, Different types of elastic waves	**11**			**11**
II (20 Marks)	Earthquakes: Causes and effects, Various magnitude and intensity scales, Elastic rebound theory.	**11**			**11**
III (25 Marks)	Classification of earthquakes, Seismometers, Analysis of seismograms, Seismic networks and arrays, Earthquake prediction and forecasting, basics of paleoseismology.	**14**			**14**
IV (15 Marks)	Seismicity and seismo tectonics of India, Seismic hazard map of India.	**09**			**09**
	Total				**45**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(20 Marks)**

- **One Internal Examination** - **10 Marks**
- **Others (Any one)** - **10 Marks**
  - **Group Discussion**
  - **Seminar presentation on any of the relevant topics**
  - **Debate**

LEARNING OUTCOMES: The Northeast region lies in the zone V of seismic zonation map of India. It has great experienced two great earthquakes: one of 1897 and another great earthquake of 1950. Therefore, the understanding of the earthquake is very important. Hence, this course in introduced in the Multi-Disciplinary Generic Course.

SUGGESTED READINGS:

1. Shearer, P.M. (2009). *Introduction to Seismology*. Cambridge University Press.
2. Lowrie, W. (2007). *Fundamentals of Geophysics*. Cambridge University Press.
3. Scholz, C.H. (2002). *The Mechanics of Earthquakes and Faulting*. Cambridge University Press.
4. Bullen, K.E. and Bolt, B.A. (1985). *An Introduction to the Theory of Seismology*. Cambridge University Press.
5. Gubbins, D. (1990). *Seismology and Plate Tectonics*. Cambridge University Press.

Course Title : **Brahmaputra studies**
Course Code : **GECGEO2B**
Nature of Course : **Multi-Disciplinary Generic Elective**
Total Credits : 03 credits
Distribution of Marks : 80 (End-Sem.) + 20 (In-Sem.)

COURSE OBJECTIVES: *The Brahmaputra Studies is aimed to acquaint the students with the multi-dimensional perspectives associated with the Brahmaputra basin. The inter-disciplinary approach will equip the students with an understanding of the Brahmaputra valley, the drainage system associated with this region, issues of flood, erosion, development, flood control measures and the technologies, issue of dams and related debates, geopolitics and socio-economic issues associated with the Brahmaputra as a trans-boundary river, the riverine communities, cultures and economy, Civilization in Brahmaputra Valley.*

UNITS	CONTENTS	L	T	P	Total Hours
I (20 Marks)	**Geological background of the Brahmaputra Basin** The Brahmaputra River basin. Fluvial style, major tributaries of Brahmaputra River; Geological set up. Fluvial landforms in Brahmaputra valley.	**11**			**11**
II (25 Marks)	**Drainage system and landforms of the Brahmaputra basin** Channel characteristics of the Brahmaputra River and some of its major tributaries; Evolution and erosion of the large river islands (Majuli,Dibru-Saikhoa Island). Flood and erosion across the valley.	**14**			**14**
III (20 Marks)	**Hazard and socio-economic and trans-boundary issues** Socio-economic aspects related to flood and erosion; The origin of the Brahmaputra Basin and record of civilization in Brahmaputra valley.	**11**			**11**
IV (15 Marks)	Dams and debates, transboundary issues, geopolitics associated with the Brahmaputra River. Technology of Embankment, Porcupines and geo-tubes, Impact and Issues related with Flood Control technologies	**09**			**09**
	Total				**45**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(20 Marks)**

- **One Internal Examination** - **10 Marks**
- **Others (Any one)** - **10 Marks**
  - **Group Discussion**
  - **Seminar presentation on any of the relevant topics**
  - **Debate**

LEARNING OUTCOMES: The major part of Assam lies in the flood plain of Brahmaputra River and its tributaries. People residing in these floodplains have regular interaction with the fluvial process of these rivers and their livelihood is to some extend depends on it. Therefore, understanding of the river system, development of big civil engineering project like dams, embankment etc. for harness the power and development of the river valley is important.

SUGGESTED READINGS

1. André Robert (2003). *River Processes-An Introduction to Fluvial Dynamics.* Published by Arnold, London (http://www.arnoldpublishers.com) Distributed in the USA by Oxford University press.
2. Arup Kumar Dutta (2001). *The Brahmaputra*. Published by National Book Trust, India, 2001. (p.237)[[**ISBN-13:** 978-8123735443]

3. Arupjyoti Saikia (2019). The Unquiet River – a biography of the Brahmaputra. Oxford University Press. (p.620)[**ISBN-13:** 978-0199468119]
4. John S. Bridge (2003). *Rivers and Floodplains – Forms, Processes, and Sedimentary record*, Blackwell Publishing
5. *Large Rivers-Geomorphology and Management*, Edited by Avijit Gupta (2007), John Wiley & Sons, Ltd.
6. 'The Brahmaputra Basin Water Resources' Editors: Singh, Vijay., Sharma, Nayan., Ojha, C. Shekhar P., Springer, 2004 (p. 613) [**ISBN-13:** 978-1402017377]
7. 'Neo-Thinking on Ganges-Brahmaputra Basin Geomorphology' by Editors: Balai Chandra Das, Sandipan Ghosh, Aznarul Islam, Md. Ismail, Springer, 2016 (p.177)**[ASIN:** B01ACZ6U7E]
8. Sarma, J.N. (2022) "An Account of the Brahmaputra:the outsized braided river"

Course Title : **Geological Mapping (3-5 days field work)**
Course Code : **SEC221**
Nature of Course : **Skill Enhancement**
Total Credits : 03 credits
Distribution of Marks : 80 (End-Sem.) + 20 (In-Sem.)

COURSE OBJECTIVES: *Geological mapping deals with use of the different instruments and techniques in the field and enhance the skill of understanding the earth through measurement, plotting, sketching, correlating etc.*

UNITS	CONTENTS	L	T	P	Total Hours
I (25 Marks)	Geological mapping, Identification and field documentation of primary (scalars and vectors) and secondary structures (linear and planar); Stratigraphic correlation	**12**			**12**
II (15 Marks)	Trend, plunge, Rake/Pitch	**08**			**08**
III (20 Marks)	Stereo plots of linear and planar structures, Orientation analyses	**10**			**10**
IV (20 Marks)	Field work				**30**
	Total				**60**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(20 Marks)**

- **One Internal Examination -** **10 Marks**
- **Others (Any one) -** **10 Marks**
  - **Group Discussion**
  - **Seminar presentation on any of the relevant topics**
  - **Debate**

LEARNING OUTCOMES: On completion of this Course, a student will be able to develop a sound knowledge on various mapping techniques in geology. Further they will be benefited with advance skills of identification as well as documentation of different structures in the field.

SUGGESTED READINGS:

1. Lahee, F.H. 1916. Field Geology.
2. Compton, R.R, 1985. Geology in the Field.
3. Barnes, J.W. 4th Edition, Basic Geological Mapping.
4. Mathur, S.M (2001). Guide to Field Geology. Prentice Hall India Learning Private Limited.
5. Gokhale, N.W. (2009). A Guide to Field Geology. CBS.

B.SC. IN GEOLOGY PROGRAMME (NEP)
DETAILED SYLLABUS OF 3rd SEMESTER

Course Title **: Palaeontology**
Course Code **: GEOC3**
Nature of Course **: Major (Core)**
Total Credits **:** 04 credits
Distribution of Marks **:** 80 (End-Sem.) (60T+20P) + 20 (In-Sem.)

COURSE OBJECTIVES: *Palaeontology deals with identification, classification and taxonomic description of past life forms as fossils. It aids in there construction of palaeoenvironment, palaeoclimate, palaeoecology ,palaeoceanography and palaeobiogeography. It is an important tool applied for hydrocarbon exploration*.

UNITS	CONTENTS	L	T	P	Total Hours
I (15 Marks)	**Introduction to Palaeontology, Fossil Nomenclature and Taxonomy** Palaeontology: definition, branches, scopes and applications. Fossil: definition and types. Process of fossilization. Conditions and modes of preservation. Fossil: Nomenclature, Type specimens, Concept of species, Taxonomy, Taxonomic hierarchy, Binomial system of nomenclature, Naming of genera and species. General principles of Palaeontology: Phylogenetic and Phenetic classification Theory of organic evolution interpreted from fossil records.	**12**			**12**
II (18Marks)	**Vertebrate and Invertebrate Fossils** General idea of vertebrate fossils: Origin of vertebrates and their evolution. Mesozoic reptiles with special reference to origin, diversity and extinction of dinosaurs. Evolution of horse and intercontinental migrations. Human evolution. Brief introduction to important invertebrate groups: Brachiopoda, Pelecypoda, Gastropoda, Cephalopoda, Trilobita, Echinoidea, Anthozoa and Foraminifera and their biostratigraphic significance.	**15**			**15**
III (12 Marks)	**Palaeobotany** General idea about Palaeobotany, Plant fossils and Palynology. Gondwana Floras of India.	**08**			**08**
IV (15 Marks)	**Applied Palaeontology** Biostratigraphy, Biozones and Correlation Application of Fossils for palaeoenvironment analysis, palaeoclimatic interpretation, reconstruction of palaeobiogeography and hydrocarbon exploration. Palaeoecology-fossils as a window to the evolution of ecosystems.	**10**			**10**
V (20	Study of fossils showing various modes of preservation. Study of diagnostic morphological characters, systematic			**15**	**30**

Marks)	position, stratigraphic position and age of various invertebrate, vertebrate and plant fossils. Note Book Viva Voce				
	Total				**75**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(20 Marks)**

- **One Internal Examination -** **10 Marks**
- **Others (Any one) -** **10 Marks**
  - **Group Discussion**
  - **Seminar presentation on any of the relevant topics**
  - **Debate**

LEARNING OUTCOMES: The course is mainly designed to prepare students for work in the geological and related service sector with a knowledge of mega and micropalaeontology in details. The skills acquired by the students will also provide a strong foundation for those wishing to undertake further studies in Palaeontology.

SUGGESTEDREADINGS:

1. Dasgupta A.An Introduction to Palaeontology,World Press.
2. Jain&Anantharaman (2016).Palaeontology,Palaeobiology.VishalPublishingCo.
3. Benton, M. (2014). Vertebrate Palaeontology 4thEdition.Wiley-Blackwell
4. Raup, D.M., Stanley,S. M.,Freeman, W. H.(1971)Principles of Paleontology
5. Clarkson, E. N. K. (2012) Invertebrate paleontology and evolution 4th Edition by Blackwell Publishing.
6. Benton, M.(2009).Vertebrate paleontology.JohnWiley&Sons.
7. Shukla,A.C., & Misra,S.P.(1975).Essentials of paleobotany.VikasPublisher
8. Shrock R. R. and Twenhofel W. H. Principles of Invertebrate Palaeontology, CBS Publishers & Distributors
9. Armstrong, H.A., &Brasier,M.D.(2005)Microfossils.Blackwell Publishing.
10. Kathal P.K.Applied Geological Micropalaeontology:Scientific Publishers,India
11. Nield E.W.and Tucker V.C.T. Palaeontology – An Introduction,Pergamon Press
12. Jain P.C.and Anantharaman M.S.Palaeontology(Palaeobiology)Evolution and Animal Distribution Vishal Publishing Co.

Course Title : **Structural Geology and Tectonics**
Course Code : **GEOC4**
Nature of Course : **Major (Core)**
Total Credits : 04 credits
Distribution of Marks : 80 (End-Sem.) (60T+20P) + 20 (In-Sem.)

COURSE OBJECTIVES: *The primary objective of structural geology is to understand the history of deformation in rocks. The deformation of the lithosphere by tectonic forces can be learnt through this subject. Further, this subject helps us to understand the geodynamics in the regional and global scale. Structural control on ore localisation and landscape evolution are also learnt through this subject. Further, application of structural geology in engineering geology projects is huge.*

UNITS	CONTENTS	L	T	P	Total Hours
I (16 Marks)	**Structural Geology** **Geological Structures and Topography; Introduction to Rock Mechanics; Folds.** Relation of geological structures and topography. Outcrop patterns of different structures. Mechanical behaviour of rocks and their controlling factors. Concept of stress and strain. Stress at a point in a solid body. Types of stress and strain. Ductile and brittle behaviour of rocks; Stress-strain relationships; Mohr diagram for stress and strain. Theory of rock failures. Geometric, morphological and genetic classification of folds. Mechanics of folding and buckling. Superposed folds and fold interference patterns.	**10**	**02**		**12**
II (24 Marks)	**Faults and joints; Shear zones; Foliations, Lineation and Unconformities.** Joint, fracture and fault: Geometric and genetic classification of fractures and faults. Effects of faulting on the outcrops. Geologic/geomorphic criteria for recognition of faults. Mechanics of faulting. Joints: classification and origin. Relation of joints with major geological structures. Palaeostress analysis with fault slip data. Shear zones and their significance in crustal evolution. Shear/ fault zone rocks.Shear zone related folds. Classification and origin of foliations and lineations. Relationship with the major structures. Classification of unconformities. Distinguishing characteristics of fault and unconformity in the field.	**14**	**02**		**16**
III (20 Marks)	**TECTONICS** **Constitution of the Earth's Interior; Plate tectonics; Tectonics of India.** Theory of the Plate Tectonics, Plate Boundaries, Mechanics of Plate Movement, Significance of plate tectonics in Petroleum Exploration, Plate tectonics and vulcanicity, Plate Tectonics and unconformity, Island arc System. Major structural elements in Indian sub-continent. Structural framework of NE India with special emphasis on eastern Himalaya, Assam and Assam-Arakan Folded belt.	**15**	**02**		**17**
IV Practical	Preparation of cross sections and interpretations of			**15**	**30**

(20 Marks)	geological maps representing different structural settings and geological histories. Completion of outcrops in a map: three- point problems. Geometric solution of problems involving inclined strata Stereographic solution of problems involving inclined strata Paleostress analysis from fault slip data				
	Total				**75**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: (20 Marks)

- **One Internal Examination - 10 Marks**
- **Others (Any one) - 10 Marks**
  - **Group Discussion**
  - **Seminar presentation on any of the relevant topics**
  - **Debate**

LEARNING OUTCOMES: The outcome expected through the course is to produce students with sound knowledge of structural geology and its applicability in different sectors of the exploration and civil construction. Further, the course is also beneficial for students who may be engaged in the high-quality research in the subject and for those who may be engaged in the teaching profession.

SUGGESTEDREADINGS:

Structural Geology

1. Fossen, H. 2010. Structural Geology, Cambridge University Press, ISBN: 978-0-521-51664-8,
2. Pluijm, B. A. V.D., and Marshak, S, 2003. Earth Structure. Second Edition. W.W. Norton and Company. ISBN 0-393-92467-X.
3. Ramsay, J. G., 1967. Folding and fracturing of rocks. McGraw-Hill, New York
4. Ramsay, J.G., and Huber, M.I., 1983. The techniques of modern structural geology, Vol.1, Strain Analysis. Academic Press, pp.1-308.
5. Ghosh, S.K., 1993. Structural Geology: Fundamentals and Modern Developments, Pergamon Press, Oxford, p 598.
6. Passchier, C. W., and Trouw, R. A. J., 2005. Microtectonics, 2nd Edn., Springer Verlag, Berlin.
7. Pollard, D. D. (2005) Fundamental of Structural Geology. Cambridge University Press.
8. Ragan, D. M. (2009) Structural Geology: an introduction to geometrical techniques (4th Ed).Cambridge University Press (For Practical)

Tectonics

1. Kent C Condie 1989, Plate tectonics and crustal evolution, Pergamon Press plc
2. Gobal Tectonics 2009, Philip Kearey, Keith A. Klepeis and Frederick J Vine, Wiley-Blackwell 3rd Ed.
3. Arc-Continent Collision, 2010, Dennis brown Paul D Ryan (Eds), Springer.

Course Title : **Evolution of Life through Geological Time**
Course Code : **MINGEO3**
Nature of Course : **Minor**
Total Credits : 04 credits
Distribution of Marks : 80 (End-Sem.) (60T+20P) + 20 (In-Sem.)

COURSE OBJECTIVES: *Deals in the study of the life through geological time- their origin, evolution in the past up to the age of the humans*.

UNITS	CONTENTS	L	T	P	Total Hours
I (18 Marks)	**Life through ages; Geobiology** Fossils and chemical remains of ancient life. Geological Time Scale with emphasis on major bio-events. Fossilization processes and modes of fossil preservation. Exceptional preservation sites- age and fauna. Biosphere as a system, processes and products, Biogeochemical cycles, Abundance and diversity of microbes, extremophiles. Microbes-mineral interactions, microbial mats	**14**			**14**
II (18 Marks)	**Origin of life**; **Paleozoic Life** Possible life sustaining sites in the solar system, life sustaining elements and isotope records Archean life: Earth's oldest life, Transition from Archean to Proterozoic, the oxygen revolution and radiation of life Precambrian fossils – The garden of Ediacara. The Snow Ball Earth Hypothesis. The Cambrian Explosion. Biomineralization and skeletalization. Origin of vertebrates and radiation of fishes Origin of tetrapods - Life out of water. Early land plants and impact of land vegetation	**11**			**11**
III (24 Marks)	**Mesozoic and Cenozoic Life; The age of humans.** Life after the largest (P/T) mass extinction, life in the Jurassic seas. Origin of mammals. Rise and fall of dinosaurs. Origin of birds; and spread of flowering plants. Aftermath of end Cretaceous mass extinction- radiation of placental mammals Evolution of modern grasslands and co-evolution of hoofed grazers. Rise of modern plants and vegetation. Back to water - Evolution of Whales. Hominid dispersals and climate setting. Climate Change during the Phanerozoic - continental break-ups and collisions. Plate tectonics and its effects on climate and life. Effects of life on climate and geology	**20**			**20**
IV Practical (20 Marks)	Study of modes of fossil preservation Study of fossils from different stratigraphic levels Exercises related to major evolutionary trends in important groups of animals and plants Note Book			**15**	**30**

	Viva Voce				
	Total				**75**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: (20 Marks)

- **One Internal Examination - 10 Marks**
- **Others (Any one) - 10 Marks**
  - **Group Discussion**
  - **Seminar presentation on any of the relevant topics**
  - **Debate**

LEARNING OUTCOMES: The studying these courses under a syllabus of "Evolution of Life Through Time" will provide students with a comprehensive understanding of the history of life on Earth, the principles of evolution, and the interplay between life and the environment. They will develop critical thinking, analytical, and interdisciplinary skills that can be applied to various scientific and environmental contexts, and gain a deeper appreciation for the complexity and diversity of life on our planet.

SUGGESTEDREADINGS:

1. Stanley,S.M.,2008 Earth System History
2. Jonathan I. Lumine W.H.Freeman Earth-Evolution of a Habitable World, Cambridge University Press.
3. Canfield,D.E.&Konhauser,K.O.,2012Fundamentals of Geobiology Blackwell
4. Cowen,R.,2000History of Life,Blackwell
5. The Sixth Extinction: An Unnatural History by Elizabeth Kolbert.
6. The Ancestor's Tale: A Pilgrimage to the Dawn of Life by Richard Dawkins.
7. The Rise and Fall of the Dinosaurs: A New History of Their Lost World by Steve Brusatte.
8. Your Inner Fish: A Journey into the 3.5-Billion-Year History of the Human Body by Neil Shubin.
9. The Selfish Gene by Richard Dawkins.

Course Title : **Climate Change- Past & Present**
Course Code : **GECGEO3A**
Nature of Course : **Multi-Disciplinary Generic Elective**
Total Credits : 03 credits
Distribution of Marks : 80 (End-Sem.) + 20 (In-Sem.)

COURSE OBJECTIVES: *Climate change aims in the study of Earth's climate and their changes through time and its effects and responses produce by the biosphere. Climate change refers to long-term shifts in temperatures and weather patterns.*

UNITS	CONTENTS	L	T	P	Total Hours
I (15 Marks)	**Introduction to climate system** Components of climate system, Climate forcing, Climate system response, response rates and interactions within climate system, feedbacks in climate system, heat budget of earth.	**09**			**09**
II (20 Marks)	**Climatic Phenomenons** El Nino - Southern Oscillation (ENSO), Madden Julian Oscillation (MJO), Indian Ocean Dipole (IOD), Pacific Decadal Oscillation (PDO).	**11**			**11**
III (25 Marks)	**Understanding of past and present climate change** Brief introduction to archive and proxies of climate change, Climate change through geological time, Milankovitch cycle and variability in the climate; Glacial – interglacial stages, The Last Glacial Maximum (LGM), Pleistocene Glacial-Interglacial cycles, Younger Dryas, Marine Isotope stages; Global warming and greenhouse gas emission; The Anthropocene,.	**14**			**14**
IV (20 Marks)	**Climate risk and vulnerability** Global influence of climate change on extreme events and coastal vulnerability, influence of climate change on monsoon in Indian subcontinent and susceptibility measures for coastal vulnerability, brief introduction to climate prediction systems.	**11**			**11**
	Total				**45**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(20 Marks)**

- **One Internal Examination -** **10 Marks**
- **Others (Any one) -** **10 Marks**
  - **Group Discussion**
  - **Seminar presentation on any of the relevant topics**
  - **Debate**

LEARNING OUTCOMES: The course aims to achieve the following outcomes:

- Understand the different components of climate system and their mutual interaction.
- Understand the role of major climate phenomenon on climate variability.
- Impart the knowledge on past and present climate change and assess the role of natural vs. anthropogenic climate change.
- Develop critical understanding and analytical skills on climate risks and vulnerability.

SUGGESTED READINGS:

1. Rudimen, W. F., 2001. Earth's climate: Past and future. Freeman Publisher.
2. Donald Ahrens, C., & Henson, R., 2015. Meteorology today: An introduction to weather, climate and the environment.
3. Rohli, R. V. & Vega, A. J., 2007. Climatology. Jones and Barlatt.
4. Lutgens, F., Tarbuck, E., & Tasa, D., 2009. The atmosphere: an introduction to meteorology. Pearson Publisher.
5. General Climatology, H J Critchfield, Pearson

Course Title : **Geo-heritage and Geo-tourism**
Course Code : **GECGEO3B**
Nature of Course : **Multi-Disciplinary Generic Elective**
Total Credits : 03 credits
Distribution of Marks : 80 (End-Sem.) + 20 (In-Sem.)

COURSE OBJECTIVES: The primary objective of offering the course of Geotourism is to understand the various aspects of geoheritage sites and their tourism potential.

UNITS	CONTENTS	L	T	P	Total Hours
I (25 Marks)	Introduction and history of geoheritage concept, geoheritage resources, geosites, geodiversity, heritage stone. Geoparks: creation, management and outputs.	**14**			**14**
II (15 Marks)	Global geoheritage. National Geological Monuments: fossil parks, rock monuments, geological marvels, other monuments. National Geological Monuments in Northeast India.	**12**			**12**
III (20 Marks)	Definition of geotourism and modern geotourism, scope of geotourism, methods of geotourism, potentiality for a geotourism site.	**11**			**11**
IV (20 Marks)	The Geotourism Industry in the 21st Century: A futuristic approach; Geotrails.Visit to geotourism sites.	**08**			**08**
	Total				**45**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(20 Marks)**

- **One Internal Examination -** **10 Marks**
- **Others (Any one) -** **10 Marks**
  - **Group Discussion**
  - **Seminar presentation on any of the relevant topics**
  - **Debate**

LEARNING OUTCOMES: The exposition of the natural resources to crater the need of the society is damaging lots of the stratigraphic type section, fossil records, present in those sections, mode of occurrence of different economic deposits etc. Therefore, for preservation of different geological aspect in different geological important site for future generation is important. Further, different regions have different site of different geological importance. The preservation and development of these sites for geotourism is very important as each site contribute towards understanding of geological history of the area and also of regional scale.

SUGGESTED READINGS:

1. Geoheritage and Geotourism resources edited by N. Santangeolo and E. Valente
2. Principles of Geotourism by A. Chen, Y. Lu, Young C.Y.NG

Course Title : **Surveying Techniques and GIS**
Course Code : **SEC321**
Nature of Course : **Skill Enhancement**
Total Credits : 03 credits
Distribution of Marks : 80 (End-Sem.) (60T+20P) + 20 (In-Sem.)

COURSE OBJECTIVES: *This course is intended to impart knowledge on various field-based techniques of surveying, their principles, history and development, instrument and techniques and their applications.*

UNITS	CONTENTS	L	T	P	Total Hours
I (15 Marks)	**Principles of Surveying** History of development of surveying, applications of surveying in the field of planning and development, revenue collection, territorial demarcation, cartography, geography, exploration, geology and engineering. Great Trigonometric Survey of India, Indian surveying agencies. Concept of Geodetic and Plan Survey: Datum, Control Points, Horizontal and Vertical Controls, Geoid: topo surface, geodetic surface, ellipsoidal surface and its significance in maps, Azimuth and bearing. Triangulation and Traversing.	**08**			**08**
II (15 Marks)	**Surveying and Levelling** Compass, Chain and Plane Table Surveying. Electronic Distance Measurement System. Theodolite and Total Stations. Global Positioning System and its use in surveying. Level, Types of levels and Methods of Levelling: direct method, trigonometrical method, differential leveling, reciprocal method, barometric method Contouring from leveling: triangular intersection method, DEM and DTM.	**05**			**05**
III (10 Marks)	**Applications** Application of surveying in construction of dam, tunnel, road, bridge, building and artificial islands, Application of surveying in Geological Mapping and Sampling	**07**			**07**
IV (20 Marks)	**GIS** Coordinate systems: Cartesian Coordinate System, Geographic Coordinate system. Map Projection. Introduction and definitions of GIS, components, application areas of GIS, advantages and disadvantages of GIS Data formats, Raster data model and vector data model, Raster versus vector, Advantages and disadvantages of raster and vector.	**10**			**10**
V Practical (20 Marks)	Visual Image Interpretation Working with GIS Software. Note Book Viva Voce			**15**	**30**
	Total				**60**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: (20 Marks)

- **One Internal Examination - 10 Marks**
- **Others (Any one) - 10 Marks**
  - **Group Discussion**
  - **Seminar presentation on any of the relevant topics**
  - **Debate**

LEARNING OUTCOMES: At the end of the semester, the student will have basic knowledge of various field-based techniques of surveying. The course will provide insight on GIS, technical languages of GIS, practical understating of the GIS concept. They will have hands on knowledge on image processing, image interpretation, image classification; have hold on working with GIS software.

SUGGESTED READINGS:

1. Surveying and Leveling by N.N. Basak.
2. Surveying and Leveling by Rangawala