KARNATAK UNIVERSITY, DHARWAD
ACADEMIC (S&T) SECTION

ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಧಾರವಾಡ
ವಿದ್ಯಾಮಂಡಳ (ಎಸ್&ಟಿ) ವಿಭಾಗ

ಸ್ವಾತಂತ್ರ್ಯದ ಅಮೃತ ಮಹೋತ್ಸವ

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NAAC Accredited
'A' Grade 2014

website: kud.ac.in

No. KU/Aca(S&T)/JS/MGJ(Gen)/2024-25/612   Date: 27 JUL 2024

ಅಧಿಸೂಚನೆ

ವಿಷಯ: ಸರಕಾರದ ಆದೇಶ ದಿನಾಂಕ: 08.05.2024 ಅನುಸಾರ 2024–25ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಎಲ್ಲ ಸ್ನಾತಕ ಪದವಿಗಳಿಗೆ NEP ಅಡಿಯಲ್ಲಿ ಪ್ರೋಗ್ರಾಂ ವಿನ್ಯಾಸ (Curriculum Structure)ದಂತೆ ಪರಿಷ್ಕೃತ ಪಠ್ಯಕ್ರಮದ ಅನುಷ್ಠಾನ ಕುರಿತು.

ಉಲ್ಲೇಖ: 1. ಸರ್ಕಾರದ ಪ್ರಧಾನ ಕಾರ್ಯದರ್ಶಿಗಳು, ಉನ್ನತ ಶಿಕ್ಷಣ ಇಲಾಖೆ ಇವರ ಆದೇಶ ಸಂಖ್ಯೆ: ಇಡಿ 166 ಯುಎನ್‌ಇ 2023, ದಿ: 08.05.2024.
2. ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ನಿರ್ಣಯಗಳ ಸಂ:2, 3, 4, 5, 6, 7, 8 & 9, ದಿ:16.07.2024.
3. ಮಾನ್ಯ ಕುಲಪತಿಗಳ ಅನುಮೋದನೆ ದಿನಾಂಕ: 27/07/2024

ಮೇಲ್ಕಾಣಿಸಿದ ವಿಷಯ ಹಾಗೂ ಉಲ್ಲೇಖಗಳನ್ವಯ, ಉಲ್ಲೇಖ–01ರ ಸರಕಾರ ಆದೇಶಾನುಸಾರ 2024–25ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಅನ್ವಯವಾಗುವಂತೆ, ಈ ಕೆಳಗಿನ ಎಲ್ಲ ಸ್ನಾತಕ ಪದವಿಗಳ NEP ಅಡಿಯ ಪ್ರೋಗ್ರಾಂ ವಿನ್ಯಾಸ (Curriculum Structure)ದಂತೆ ಪರಿಷ್ಕೃತ ಪಠ್ಯಕ್ರಮ ರಚನೆ ಕುರಿತಾಗಿ ಸಂಬಂಧಿಸಿದ ಅಭ್ಯಾಸಸೂಚಿ ಮಂಡಳಿ ಹಾಗೂ ನಿಖಾಯಗಳ ಶಿಫಾರಸ್ಸನಂತೆ ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ಅನುಮೋದಿತ ಪದವಿಗಳ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲ www.kud.ac.in ದಲ್ಲಿ ಭಿತ್ತರಿಸಲಾಗಿದೆ. ಸದರ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲದಿಂದ ಡೌನಲೋಡ ಮಾಡಿಕೊಳ್ಳಲು ಸೂಚಿಸುತ್ತ ವಿದ್ಯಾರ್ಥಿಗಳು ಹಾಗೂ ಸಂಬಂಧಿಸಿದ ಎಲ್ಲ ಬೋಧಕರ ಗಮನಕ್ಕೆ ತಂದು ಅದರಂತೆ ಕಾರ್ಯಪ್ರವೃತ್ತರಾಗಲು ಕ.ವಿ.ವಿ.ಯ ಎಲ್ಲ ಅಧೀನ ಹಾಗೂ ಸಂಲಗ್ನ ಮಹಾವಿದ್ಯಾಲಯಗಳ ಪ್ರಾಚಾರ್ಯರುಗಳಿಗೆ ಸೂಚಿಸಲಾಗಿದೆ.

ಅ.ಸಂ.	ಪದವಿ				ಸೆಮಿಸ್ಟರ್
1	1	B.A	8	BTTM	1 ರಿಂದ 6ನೇ ಸೆಮಿಸ್ಟರ್
	2	BSW	9	B.Sc	
	3	B.Sc. (H.M)	10	BCA	
	4	B.Com	11	B.Com (CS)	
	5	B.Com (E-Commerce Operation)	12	B.Com (Retail Operations)	
	6	B.Com (Banking Financial Services & Insurance)	13	B.Com (Logistics)	
	7	BBA	14	BBA (Logistics Management)	
2	1	B.Sc (Data Science)	2	B.Sc (Artificial Intellgence & Machinery Learning)	1 ಮತ್ತು 2ನೇ ಸೆಮಿಸ್ಟರ್
3	1	BASLP	3	BPA	1 ರಿಂದ 8ನೇ ಸೆಮಿಸ್ಟರ್
	2	BVA	4	B.Sc. Pulp & Paper	

A. Channappa
ಕುಲಸಚಿವರು.

ಅಡಕ: ಮೇಲಿನಂತೆ

ಗೆ,
ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯದ ವ್ಯಾಪ್ತಿಯಲ್ಲಿ ಬರುವ ಎಲ್ಲ ಅಧೀನ ಹಾಗೂ ಸಂಲಗ್ನ ಮಹಾವಿದ್ಯಾಲಯಗಳ ಪ್ರಾಚಾರ್ಯರುಗಳಿಗೆ. (ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲ ಹಾಗೂ ಮಿಂಚಂಚೆ ಮೂಲಕ ಬಿತ್ತರಿಸಲಾಗುವುದು)

ಪ್ರತಿ:
1. ಕುಲಪತಿಗಳ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು / ಕುಲಸಚಿವರ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು / ಕುಲಸಚಿವರು (ಮೌಲ್ಯಮಾಪನ) ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
2. ಅಧೀಕ್ಷಕರು, ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆ / ಗೌಪ್ಯ / ಜಿ.ಎ.ಡಿ. / ವಿದ್ಯಾಂಡಳ (ಪಿ.ಜಿ.ಪಿಎಚ್.ಡಿ) ವಿಭಾಗ, ಸಂಬಂಧಿಸಿದ ಕೋರ್ಸುಗಳ ವಿಭಾಗಗಳು ಪರೀಕ್ಷಾ ವಿಭಾಗ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
3. ನಿರ್ದೇಶಕರು, ಕಾಲೇಜು ಅಭಿವೃದ್ಧಿ / ವಿದ್ಯಾರ್ಥಿ ಕಲ್ಯಾಣ ವಿಭಾಗ / , ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
4. ನೋಡಲ್ ಅಧಿಕಾರಿಗಳು, ಯು.ಯು.ಸಿ.ಎಂ.ಎಸ್. ಘಟಕ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
5. ಎನ್.ಇ.ಪಿ. ನೋಡಲ್ ಅಧಿಕಾರಿಗಳು, ಸಿ.ಡಿ.ಸಿ. ವಿಭಾಗ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.

KARNATAK UNIVERSITY, DHARWAD

B.Sc. GEOLOGY

SYLLABUS

With Effect From 2024-25

DISCIPLINE SPECIFIC CORE COURSE (DSC) FOR SEM I -VI,

SKILL ENHANCEMENT COURSE (SEC) FOR SEM IV / V / VI

and

ELECTIVE COURSES FOR SEM V AND VI

AS PER NEP (Revised):2024

Karnatak University, Dharwad

B.Sc. in GEOLOGY

Effective from 2024-25

Sem.	Type of Course	Theory/ Practical	Course Code	Course Title	Instruction hour/ week	Total hours / sem	Duration Of Exam	Marks			Credits
								Formative	Summative	Total	
I	DSC-1	Theory	C1GEG1T1	General Geology and Physical Geology	04hrs	60	03hrs	20	80	100	04
	DSC-2	Practical	C1GEG1P1	Maps, Soil and Field Visit	04hrs	56	03hrs	10	40	50	02
II	DSC-3	Theory	C2GEG1T1	Crystallography, Mineralogy and Optical Mineralogy	04hrs	60	03hrs	20	80	100	04
	DSC-4	Practical	C2GEG1P1	Crystallography, Mineralogy and Optical Mineralogy	04hrs	56	03hrs	10	40	50	02
III	DSC-5	Theory	C3GEG1T1	Igneous and Metamorphic Petrology and Economic Geology	04hrs	60	03hrs	20	80	100	04
	DSC-6	Practical	C3GEG1P1	Igneous and Metamorphic Petrology and Economic Geology	04hrs	56	03hrs	10	40	50	02
1V	DSC-7	Theory	C4GEG1T1	Sedimentology, Principles of Stratigraphy and Palaeontology	04hrs	60	03hrs	20	80	100	04
	DSC-8	Practical	C4GEG1P1	Sedimentology, Principles of Stratigraphy and Palaeontology	04hrs	56	03hrs	10	40	50	02
*V	DSC-9A	Theory	C5GEG2T1	Structural Geology and Hydrogeology	04hrs	60	03hrs	20	80	100	04
	DSC-10A	Practical	C5GEG2P1	Structural Geology and Hydrogeology	04hrs	56	03hrs	10	40	50	02
	DSC-9B	Theory	C5GEG2T2	Geochemistry and Mining Geology	04hrs	60	03hrs	20	80	100	04
	DSC-10B	Practical	C5GEG2P2	Geochemistry and Mining Geology	04hrs	56	03hrs	10	40	50	02
*VI	DSC-11A	Theory	C6GEG2T1	Remote Sensing, GIS & GNSS	04hrs	60	03hrs	20	80	100	04
	DSC-12A	Practical	C6GEG2P1	Remote Sensing, GIS & GNSS	04hrs	56	03hrs	10	40	50	02
	DSC-11B	Theory	C6GEG2T2	Mineral Exploration and Mineral Processing	04hrs	60	03hrs	20	80	100	04
	DSC-12B	Practical	C6GEG2P2	Mineral Exploration and Mineral Processing	04hrs	56	03hrs	10	40	50	02
V	EC-1	Theory	C5GEG5T1	Disaster Management	03hrs	45	03hrs	20	80	100	03
VI	EC-2	Theory	C6GEG5T1	Gemmology and Medical Geology	03hrs	45	03hrs	20	80	100	03
IV/V/VI **	Skill	Practical	C0GEG6P1	Geo-exploration and Surveying	04hrs	56	03hrs	10	40	50	02

*student shall either DSC 9A and DSC10A or DSC 9B and DSC10B in 5th semester. Similarly, DSC 11A and DSC12A or DSC 11B and DSC12B in 6th semester.

** Student shall study Skill of this subject either in 4th / 5th / 6th but not in all the semester.

1. PREAMBLE

The Karnatak University resolved to introduce Revised NEPsyllabus from the Academic Year 2024-25 onwards in tune with directives of the University Grants Commission to implement uniform grading system in universities. The primary aim of revised syllabus is to facilitate mobility of students across institutions within the country and abroad. The draft syllabus was modified by incorporating suggestions from participants in the workshop.

The objective of any programme at Higher Education Institute is to prepare their students for the society at large. The Karnatak University envisages all its programmes in the best interest of their students and in this endeavour it offers a new vision to all its Under-Graduate Courses.

The new curriculum of B.Sc. Geology offers through innovative classroom teaching with ICT tools, models and demonstrations, a conceptual background to the geological processes which generally operate at time scales ranging from days to billions of years and their products. Intensive field training exposes the students to the geological processes that operate in nature and their relevance to natural resource exploration, understanding natural hazards and environmental changes.

The programme addresses current environmental issues of societal relevance, such as climate change providing a deep time understanding of climate change in the geological past. Sustainable development of natural resources keeping a balance between economics and environment is what a geology graduate student is expected to learn.

The programme also provides a basic understanding of geo-heritage sites and their protection and preservation for posterity. As a whole, the students are expected to understand the nature of lithosphere, hydrosphere, atmosphere, and biosphere interactions and their final products from a deep time perspective. The Karnatak University hopes the learning outcome based approach of the programme B.Sc. Geology will help students in making an informed decision regarding the goals that they wish to pursue in further education and life, at large.

2. INTRODUCTION TO PROGRAMME

The objective of any programme at Higher Education Institute is to prepare students for the society at large. Keeping this in view, a Learning Outcome-based Curriculum Framework is adopted in B.Sc. Geology course. The learning outcome based curriculum has adopted to strengthen student’s experiences as they engage themselves in the programme of their choice. Being a fast economically developing country with increasing population, the nation is faced with innumerable problems related to depleting natural resources, acute shortage of energy, natural disasters and many types of environmental hazards. Two-third of Indian subcontinent lies in the seismic zones of moderate to severe intensity. Solution and management of many of these problems can be met by understanding the earth more intensively and extensively, which could be achieved by pursuing the course in Geology. It is an exciting course related to natural science and has both fundamental as well as applied utility especially in the large ticket infrastructure projects. The course aims at inculcation of values and knowledge within students that will make them well-being responsible citizen and encourage in critical thinking with skills of employability.

3. NATURE AND EXTENT OF THE PROGRAMME IN B.SC. GEOLOGY

After the successful completion of B.Sc. course pupil are eligible for admission to courses M. Sc./ M. Tech /M. Sc. Tech. in Geology, Applied Geology, Remote Sensing, Geo-informatics, Environmental science, Petroleum geology and Mining Engineering at various universities of India and abroad. They are also eligible for admission to B. Ed. at various universities. Geology is one of the optional subjects for civil services, Forest Services and similar examinations. PG degree in Geology, make them eligible for UPSC examination to enter Geological Survey of India (GSI) and the Central Ground water Board (CGWB). Para-military forces are also in constant need of Geologists. Experienced and well educated Geologists can also apply for top positions in the government, industry and education sector.

4. AIMS OF BACHELOR DEGREE PROGRAMME IN B. Sc. GEOLOGY

Through innovative classroom teaching with through ICT tools models and demonstrations, students develop an ability of perceiving the geological processes which generally operate at time scales ranging from days to billions of years with the fundamental premise that the present is the key to past. It prepares students to develop their logical thinking and communication skills with the science based imaginative perception. Ethical societal context of applied geology in economic as well as environmental context is the fundamental balance which a geology graduate student is expected to acquire. Propagating their thoughts through presentations and participation in various related societies enhance their cultural- social-national centric thought.

5. GRADUATE ATTRIBUTES IN B. Sc. GEOLOGY

Geology is everywhere in our daily lives and finds its potential application in various fundamental spheres of life including exploration and management of mineral and energy resources, ground water and surface water, land use and environment hazards viz. floods, landslides and seismicity, volcanoes and tsunamis, environmental protection by monitoring waste disposal sites including nuclear waste etc. Understanding our Earth has never been more important. Because Earth science is so intertwined with our daily lives, our discipline evolves as the years go by; responding to the needs of what society compels us to understand.

These diverse needs require a strong understanding of the basic concepts and principles of Earth science. Although the times change and the applications vary, understanding the basic composition of geologic materials their origins and how the planet acts as a physical and chemical system is imperative in understanding Earth. Everything from climate change, to the abundance of groundwater, to the frequency of large storms and earthquakes, to the location and cost of extracting rare elements from Earth is relevant. It is a simple fact that as the complexity of these challenges increases, the need for well-educated geologists to provide scientific data and advice in extracting, conserving and managing earth's natural resources will assume more and more importance.

6. QUALIFICATION DESCRIPTORS FOR GRADUATES B. Sc. GEOLOGY

Bachelor's degree in Geology will be awarded to students who will have:

1. Systematic understanding of key aspects of the subject, including acquisition of coherent and detailed knowledge.

2. Ability to employ the established techniques of analysis in the discipline in order to resolve problems.

3. Devise arguments and ideas to solve problems, which are in the forefront of the subject.

4. Describe and comment on recent topics of research and advancement in the subject.

5. Apply the methods and techniques to extend their knowledge to initiate and carry out projects, to address questions to achieve a solution.

6. Communicate information, ideas, problems and solutions to both professionals and non-professionals.

7. PROGRAMME LEARNING OUTCOMES IN B. Sc. GEOLOGY

Through innovative classroom teaching with through ICT tools models and demonstrations, students develop an ability of perceiving the geological processes which generally operate at time scales ranging from days to billions of years with the fundamental premise that the present is the key to past. It prepares students to develop their logical thinking and communication skills with the science based imaginative perception. Ethical societal context of applied geology in economic as well as environmental context is the fundamental balance, which a geology graduate student is expected to acquire. Propagating their thoughts through presentations and participation in various related societies enhance their cultural- social-national centric thought.

POS:1 To understand the nature and origin of various component of earth system including planetary objects, its origin, its components and operative processes in past and present.

POS:2 To acquire theoretical framework for understanding the nature of geological material including rocks, minerals and fossils.

POS:3 To integrate observations and theory for describing natural geological process in past and present as well to understand the time scales of geological processes.

POS:4 To apply the knowledge of the material and processes in mineral and energy exploration, oceanography, soil and water resource.

POS:5 To apply the knowledge gained through fieldwork for greater understanding of earth and related phenomena.

8. OTHER FEATURES

1. **Intake capacity / number of students**: As per University Norms
2. **Teacher's qualifications**: As prescribed by norms.
3. Workload details should be as per Apex body/UGC/State Govt/Universitynorms.
4. **Library:** List of books has been mentioned paper wise in the syllabi.
5. **Specific Equipment's**: Necessary to run the Course.

Rocks and minerals specimens, fossil specimens, petrological microscopes, field equipment's, maps, charts, models, Aerial photographs, satellite imageries, stereoscopes, slide projector, OHP/LCD, Computers and necessary software's and operating systems etc.

9. LABORATORYSAFETY MEASURES:

General Safety Rules for Laboratory Work:

List of Equipment's neededfor Laboratory Safety

- **a.** Fire extinguisher
- **b.** First Aid Kit
- **c.** Good earthling and insulated wirings for electrical supply
- **d.** Standard operated procedure manuals for instrument, map, specimens etc.

Instructions for Safety in Laboratory

- **a.** Any injury while handling rocks and mineral must be reported to teacher in charge of practically immediately.
- **b.** In case of fire, switch off all electric connections.
- **c.** Make your workplace clean before leaving the laboratory.
- **d.** Know the place of fire extinguisher, first aid box.
- **e.** Do not use cell phones in laboratory.

DO's

1. Always wear shoes in the laboratory.
2. Maintain separate record book for practical work.
3. Maintain silence, cleanliness and discipline in the laboratory.
4. Handle the laboratory equipment, rock, and mineral specimens carefully.
5. Follow the standard operation procedure of instrument.

DON'T

1. Don't take apparatus out of laboratory.
2. Don't eat or drink any food in laboratory.

3. Don’t enter or leave the laboratory without permission.

Lab Record:

1. It should be duly certified by the concerned Teacher and Head of the Department. A student should record all practicals in the laboratory journal prescribed by the Institution/College.

2. Each batch should consists of students as per the university norms for the regular practical classes and examination for all classes.

Study Tour/Fieldwork:

1. During II semester students should be taken to the areas of Geological importance to acquaint with the field occurrences of the minerals, rocks and Geological features for 5 days in the month of January.

2. During IV semester students should be taken to field mapping for about 7 days. They should prepare Geological Map, collect rocks, mineral samples, and submit the field/Tour report at the time of practical examination in IV semester that will be evaluated by the examiner.

3. During VI semester students should Geological Study Tour/fieldwork in selected areas as specified in Major papersfor about 05 to 07 days under guidance is compulsory during 5th/6th Semester. Submission of fieldwork report along with specimens collected is also compulsory.

Field project: Related to geology like Well inventory, Resistivity survey in the area or any other work related to geology.

10. GUIDELINES FOR FIELD WORK

1. During study tour, more emphasis be given to field relations of rocks, collection of specimens, their labeling and mapping.

2. Students are advised to carry field equipment’s–viz. hammers, clinometers/Brunton compass, magnifying lens, tape, maps/toposheet, field notebooks, writing and drawing material as well as haversack for collection of specimens.

3. Field notes should be taken under the guidance of teacher in-charge incorporating photographs, sketches and measurement of different features.

4. Strict discipline and safety measures must be followed under the guidance of teacher in-charge.

5. Preparation of the study tour report and its presentation along with field collection at the time of practical examination is compulsory.

B.Sc. Semester–I

Discipline Specific Course (DSC)-GEOLOGY

Course Title: GENERAL GEOLOGY AND PHYSICAL GEOLOGY

Course Code:C1GEG1T1

Type of Course	Theory/ Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-1	**Theory**	**04**	**04**	**60 hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1 Understand the significance of various branches of Geology; describe characteristics of earth and its origin in relation to the Solar System.

CO2 Understand and comprehend the connectivity and dynamics of atmosphere, lithosphere, and hydrosphere of the Earth.

CO3 A thorough understanding of Geology, its various branches and overall scope of Earth Science will be possible through this course.

CO4 Understand and explain endogenic processes, the theories and hypothesis of plate tectonics, Continental drift and Sea-floor spreading; ideas of plate boundaries, plate movements and associated geological features.

CO5 Understand and explain Mountains and types, volcanoes, their classification, products and global distribution.

CO6 Earthquakes, types, causes, effects; elastic rebound theory, seismic waves, scale of measures and seismic belts of world.

CO7 Understand the various field methods in Geology, the principles and accessories

UNIT-I	**GENERAL GEOLOGY**	**15 hrs**

Introduction: Geology and its perspectives. Pure and applied branches of Geology: scope and applications. The universe and solar system: Origin of the universe – Big-bang theory. Solar system- Members of solar system – planets (Terrestrial and gaseous planets), satellite, comets, asteroids, meteorite. Earth in the solar system. Size, shape, mass, and density of the earth.

Origin of the Earth – Gaseous hypothesis, Nebular hypothesis, Planetesimal hypothesis, Tidal hypothesis, Supernova hypothesis, Interstellar or dust or meteoric hypothesis. Evolution of earth: Age of the Earth: Geochronology; Absolute and relative methods; (a) Relative Methods-Sedimentation, Salinity method, varve chronology, Rate of cooling of earth. (a) Radiometric dating, atomic energy, decay scheme, half-life method, K-Ar; Rb-Sr; U-Pb, Pb-Pb methods Age of the earth. A brief introduction on the Earth's system-Atmosphere, Lithosphere, Hydrosphere and Biosphere.

Earth's internal structures and its composition. Evidence for the Earth's composition and mineralogy-1. Seismic data, 2. Density studies, 3. Meteorites. Earth's internal layers-Crust, mantle and core. Lithosphere, asthenosphere, mesosphere and barysphere.

UNIT-II	**GEOMORPHOLOGY**	**15 hrs**

Introduction: Basic concepts of Geomorphology, Definition and scope, geomorphic agents. Geomorphic processes: endogenetic (epigene) and exogenetic (hypogene). Weathering-physical, chemical, biological. Soil-Definition, Formation, Types of soils. Soil Profile.

Rivers and fluvial landforms: - Introduction, Development of rivers-Drainage system and patterns. Stages of rivers-Davi's concept; youth, mature, old. Geological actions: Erosion - hydraulic action, abrasion, attrition, solution. Erosional landforms-Potholes, V shaped valleys, gorges and canyons, waterfalls and types, river meanders, ox-bow lakes, river terraces, structural benches. Transportation - suspension, solution. Deposition and depositional landforms-alluvial fans and cones, flood plains, natural levees, deltas, channel deposits.

Wind and Aeolian landforms: Types of wind-Breeze, Gale, Tempest and Cyclone. Geological action of wind: Wind erosion-Deflation, abrasion, attrition. Erosional features - mushroom rocks, yardangs, Hamda, ventifacts, pedestal rocks, zeugen, milletseed and sands. Transportation - suspension, saltation, traction. Deposition and depositional landforms - Sand dunes and types, Loess.

Glaciers and glacial landforms: Types of glaciers-Mountain or valley glaciers, Piedmont glaciers, continental ice-sheets or ice caps. Geological action of glaciers.

UNIT-III	GEODYNOMICS-I	15 hrs

Introduction to Geodynamics. Origin of oceans, continents and mountains. Concepts and theories of isostasy. Concept of palaeomagnetism, application of palaeomagnetism. Continental drift. Sea floor spreading. Concept of plate tectonics. Nature and types of plate margins, Mid-oceanic ridges and trenches. Origin and distribution of Island arcs.

Earthquakes: definition, Elements of an earthquake, types of earthquake waves, scale based on intensity and magnitude, seismographs and seismometers, causes and prediction of earthquake, Effects of earthquake, Seismic zones of India.

Volcanoes: A typical volcano parts, volcanic activity, types of volcanoes, composition of lava, distribution of volcanoes. Products of a volcano. Volcanic landforms; depressed landforms: Volcanic cone (Cinder Cone), volcanic craters, Calderas (Caldera Lake). Landforms due to the accumulation of lava: Volcanic Mountains, Volcanic plateaus, Volcanic plains, Volcanic necks.

UNIT-IV	GEODYNOMICS-II	15 hrs

Groundwater: Meaning and components of groundwater. Geological action of groundwater: Erosion and erosional landforms (lapis, solution holes and associated features, poljes, caves and caverns: valleys of karst topography, natural bridges). Transportation; solution. Depositional work; concretions, stalactites and stalagmites.

Plate Tectonics: Historical development of the concept of continental drift and plate tectonics. Plates and plate boundaries. Plate tectonics: mountain belts and rift valleys

Oceans and Coastal landforms: Topography of ocean floor – continental slope, shelf, abyssal zone, mid-oceanic ridges, trenches, transform faults and island arcs.

Books Recommended

1. Duff, P. M. D., & Duff, D. (Eds.). (1993). Holmes' principles of physical geology. Taylor & Francis.
2. Gross, M. G. (1977). Oceanography: A view of the earth.
3. Brian, J. S., Barbara, W.M., 2010. The Blue Planet: An Introduction to Earth System Science, 3rd Edition, Wiley.
4. Ernst, W.G., 2000. Earth Systems: Processes and Issues, Cambridge University Press.

5. Sarah, E., Cornell, I., Prentice, C., Joanna, I.H., Catherine, J.D., 2012. Understanding the Earth System Global Change Science for Application, Academic Press.
6. Jacobson, M., Charlson, R., Rodhe, H., Orians, G., 2000.Earth System Science: From Biogeochemical Cycles to Global Changes, Elsevier.
7. Ehlers, E., Krafft, T., 2006. Earth System Science in the Anthropocene, Springer.
8. Arthur Holmes; Principles of Geology
9. Physical Geology – Longwell & Flient
10. General Geology – Radhakrishnan. Y
11. Geomorphology –Thornbury
12. Geomorphology –Davies
13. Physical Geography Today – Muller & Oberlander

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Internal Assessment Test-1	05
Internal Assessment Test-2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–I
Discipline Specific Course (DSC)

Course Title:MAPS, SOIL AND FIELD VISIT (Practical)
Course Code:C1GEG1P1

Type of Course	Theory/ Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-2	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**10**	**40**	**50**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: Understand the applications of geological field instruments, toposheets and maps.

CO2: Determine slope of terrain, latitude and longitude, distance between places in toposheets.

CO3: Preparation of LU/LC maps

Sem – I	**Paper Title:MAPS, SOIL AND FIELD VISIT**	56 Hrs. (4/Week)
1.	Introduction to maps. Study of maps. Types of maps. Types of scale.	1 practical
2.	Reading topographical maps of the Survey of India; Detailed study of topographic sheets	2 practical
3.	Preparation of topographical map	1 practical
4.	Identification of drainage patterns	2 practical
5.	Preparation of LU/LC maps.	2 practical
6.	Study of soil profile and determination of soil texture	2 practical
7.	Study of major geomorphic features and their relationships with outcrops through physiographic models and using lens stereoscope and mirror stereoscope.	3 practical
8.	Field visit to a place of geological/geomorphological interest.	1 practical

B.Sc. Semester-II

Discipline Specific Course (DSC)-GEOLOGY

Course Title: CRYSTALLOGRAPHY, MINERALOGY AND OPTICAL MINERALOGY

Course Code:C2GEG1T1

Type of Course	Theory/ Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-3	**Theory**	**04**	**04**	**60hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: Understand the elements of crystallography, the morphology and symmetry elements of crystals.

CO2: The laws of crystallography, working principle of Goniometer; describe the classification of crystals into systems and classes.

CO3: Explain crystal notations, indices, and the types of crystal forms.

CO4: Understand and describe the symmetry, simple forms and combinations of the different crystal classes of the six crystal systems.

CO5: Understand and explain the various aspects of twinning and imperfections in crystals such as the elements of twinning, the twin laws.

CO6: Describe and illustrate the symmetry elements and identify and describe the crystal models of Normal classes of the six crystal systems.

CO7: Understand basic ideas of Mineralogy regarding its scope and aim; and describe the important physical properties of minerals.

UNIT-I	CRYSTALLOGRAPHY	15hrs

Introduction. Definition of a crystal. Elementary ideas about crystal structure (crystalline, cryptocrystalline, and amorphous). Crystal elements; faces, edges and Solid angle. Euler's formula. Interfacial angles and its measurement (Contact Goniometer and its use). Crystallographic axes; classification of crystals based on geometrical constants.

Laws of crystallography; the law of constancy of interfacial angles, the law of symmetry; Plane, axis and center of symmetry, Grade of symmetry- classification of crystals based on grade of symmetry. The law of rational indices- crystallographic parameters and crystallographic notation; Weiss notation, Miller's Indices. Crystal form and types of forms.

UNIT-II	CRYSTALLOGRAPHY	15hrs

Study of forms of normal classes (Holohedral) - Isometric, Tetragonal, Hexagonal, Orthorhombic, Monoclinic, Triclinic.

Cubic System: Symmetry elements - forms and representative mineral of the normal, pyritohedral, tetrahedral and plagiohedral classes. **Tetragonal system:** Symmetry element and forms of normal, hemimorphic, tripyramidal, pyramidal hemimorphic, sphenoidal and trapezohedral classes. **Hexagonal system:** Symmetry elements and forms. **A**. Hexagonal division: normal, hemimorphic, tripyramidal, and trapezohedral classes with type minerals. **B.** Rhombohedral division: rhombohedral, rhombohedral-hemimorphic, trirhombohedral, and trapezohedral classes. **Orthorhombic system:** study of the symmetry element and forms of the normal, hemimorphic, and sphenoidal classes with type minerals.**Monoclinic**

system:study of the symmetry elements and forms of the normal class. **Triclinic system:** Study of the symmetry elements and forms of the normal class.

UNIT-III	MINERALOGY	15hrs

Introduction. Definition of a mineral. Formation of minerals. Physical properties of minerals. Characters depending upon the state of aggregation; habit, form. Characters depending upon cohesion and elasticity; cleavage, fracture, hardness, tenacity. Characters depending upon light; colour, streak, luster, diaphaneity, iridescence, Opalescence, Luminescence, Fluorescence, Tarnish. Characters depending upon electricity (conductivity, pyro, piezo) and magnetism (para and diamagnetism).

Specific gravity and methods of determining specific gravity; Walker's steel yard. Chemical Mineralogy; Bonding of molecules – Ionic, Covalent, Metallic, Vander Walls. Isomorphism, Polymorphism and Pseudomorphism.

Study of chemical composition and diagnostic physical properties of the following minerals: Feldspars; Plagioclase, Orthoclase, Microcline. Pyroxene; Augite, Diopside and Hypersthene. Amphibole: Actinolite and Hornblende. Garnet; Pyrope and Grossular. Mica; Muscovite and Biotite. Olivine.

Study of chemical composition and diagnostic physical properties of the following minerals: Quartz, Calcite, Chlorite, Andalusite, Enstatite, Kyanite, Sillimanite, Topaz and Zircon.

UNIT-IV	OPTICAL MINERALOGY	15hrs

Nature of light, nomenclature of wave theory, Ordinary and polarized light, isotropic and anisotropic minerals, their wave surfaces and wave fronts, Reflection and refraction of light, Refractive index, critical angle, total internal reflection, Double refraction (Uniaxial, Biaxial minerals).

Nicol Prism its construction and working. Behaviour of light under crossed Nicol's with mineral section.

Optical properties under microscope: Petrological microscope- its parts and functioning.Optical properties of minerals: Mica plate, Gypsum plate and Quartz wedge (construction and use). Pleochroism (Dichroism, Trichroism), Interference colours, Michael Levy's chart. Order of Interference colour. Extinction- Straight, inclined, undulose and symmetrical extinctions. Extinction angle.

Study of optical properties of the following minerals: Quartz, Orthoclase, Microcline, Plagioclase. Hypersthene, Hornblende, Garnet, Muscovite, Biotite, Olivine, Kyanite, Sillimanite, Calcite and Augite.

Books Recommended

1. James D Dana. A Textbook of Mineralogy, John Wiley and Sons
2. Verma, P K (2010), Optical mineralogy. Ane books Pvt. Ltd. Buerger, Elementary crystallography
3. Ram S. Sharma and Anurag Sharma (2013) Crystallography and Mineralogy -
4. Concepts and Methods. Text Book Series, Geological Society of India, Bangalore
5. Dana, E.S. and Ford, W.E., (2002) A textbook of Mineralogy (Reprints).
6. Flint, Y., (1975) Essential of crystallography, Mir Publishers.
7. Phillips, F.C., (1963) An introduction to crystallography. Wiley, New York.
8. Berry, L.G., Mason, B. and Dietrich, R.V., (1982) Mineralogy. CBS Publ.
9. Read, H.H., (1968) Rutley's Element of Mineralogy (Rev. Ed.). Thomas Murby and Co.

10. Berry and Mason, (1961) Mineralogy. W.H. Freeman & Co.
11. Kerr, B.F., (1995) Optical Mineralogy 5th Ed. McGraw Hill, New York.
12. Deer, Howie and Zussman (1996) Introduction to Rock forming Minerals, Pearson
13. Wahlstrom E.E. (1971) Optical crystallography, John Wiley and sons.
14. R.N. Hota (2012) Practical approach to Mineralogy and Crystallography, CBS Publications & Distributions.
15. Perkin D. (2010) Mineralogy, Pearson.

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Internal Assessment Test-1	05
Internal Assessment Test-2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–II

Discipline Specific Course (DSC)-GEOLOGY

Course Title: CRYSTALLOGRAPHY, MINERALOGY AND OPTICAL MINERALOGY-(PRACTICAL)

Course Code:C2GEG1P1

Type of Course	Theory/ Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-4	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**10**	**40**	**50**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1 Determine and explain the various physical properties of minerals

CO2 Understand the basic concepts and principles of Optical Mineralogy; describe the parts and uses of Petrological microscope and optical accessories and explain pleochroism, birefringence and indicatrix.

CO3 Understand and describe classification of minerals and silicate structures.

CO4 Understand and explain systematically the physical, chemical and optical properties of silicate and non-silicate minerals.

CO5 Describe the megascopic properties of minerals and identify different minerals.

CO6 Determine and describe the various optical properties of important minerals under the petrological microscope.

List of the Expedients, each will have 4rs / Week (Minimum 12 experiments)

Sem – II	**CRYSTALLOGRAPHY, MINERALOGY AND OPTICAL MINERALOGY**	56 Hrs. (4/Week)
1.	Study of crystals based on geometrical constants. Measurement of interfacial angle using contact goniometer and Verification of Euler's theorem	1 practical
2.	Study of holohedral forms of six crystal system	4 practicals
3.	Study of Physical properties of rock forming minerals (list-given below)	4 practicals
4.	Study of Physical properties of rock ore minerals (list-given below)	2practicals
5.	Study of the optical properties of important rock forming minerals using polarizing microscope: Quartz, Plagioclase, Orthoclase, Microcline, Biotite, Hornblende, Augite, Hypersthene, Olivine, Garnet, Calcite.	2 practical
6.	Visit to field to study the mode of occurrence of minerals.	1 practical

List of rock or ore minerals

Non-silicates				Native elements
Non-Metallic minerals		Metallic minerals		
Sulphates	Barite, Gypsum	Sulphides	Chalcopyrite, Galena, Realgar, Orpiment, Spalerite, Cinnabar, Pyrite, Stibnite	
Oxides	Corundum	Oxides	Haematite, Magnetite, Pyrolusite, Chromite, Bauxite, Psilomelane	
Carbonates	Dolomite, Calcite, Magnesite	Carbonates	Malachite, Azurite	
Phosphates	Monazite	Halides	Rock salt (Halite), Fluorite	

*Silicates	**Group**	**Mineral Name**

Nesosilicates		Olivine Group	Olivine
		Garnet Group	Garnet
		Al_2SiO_5 Group	Andalusite, Sillimanite, Kyanite, Staurolite
		Zircon Group	Zircon
Sorosilicates		Epidote Group	-
Cyclosilicates		Beryl Group	Beryl
		Tourmaline	Tourmaline
Inosilicates	Single Chain Silicates	Pyroxene Group	Augite, Hypersthene
	Double Chain Silicates	Amphibole Group	Actinolite, Hornblende
Phyllosilicates		Serpentine Group	Serpentine, Asbestos
		Clay Minerals Group	Talc, Kaolin
		Mica Group	Muscovite, Biotite, Phlogopite, Vemiculite
Tectosilicates		Quartz Group	Quartz
		Feldspar Group	Orthoclase, Plagioclase, Microcline
		Feldspathoid Group	Nepheline, Sodalite
		Zeolite Group	Zeolite

B.Sc. Semester–III

Discipline Specific Course (DSC)-GEOLOGY

Course Title: IGNEOUS AND METAMORPHIC PETROLOGY AND ECONOMIC GEOLOGY

Course Code: C3GEG1T1

Type of Course	Theory/ Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours/Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-5	**Theory**	**04**	**04**	**60 hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: Understand the basic concept of rock cycle, origin of igneous rocks from magma, the Bowen’s reaction series.

CO2: Explain the important binary systems, the petro-tectonic settings and diversity of igneous rocks in relation to various processes.

CO3: Understand, classify and explain the forms of intrusive and extrusive igneous rocks and the different igneous structures and textures.

CO4: Understand, classify and describe the different modes of classification of igneous rocks and explain CIPW norm and normative minerals.

CO5: Understand and explain systematically the texture, mineralogy, classification, occurrence and origin of granites and basalts.

CO6: Describe the brief petrographic character of common igneous rocks.

CO7: Understand the concept of metamorphism and metamorphic rocks; explain the origin of metamorphic rocks, the factors, limits and types of metamorphism.

CO8: Categorize and describes the metamorphic grade concept, metamorphic mineral zone concept and metamorphic facies concept.

CO9: Understand history of development of Economic Geology, the terminologies associated with the subject and the classification schemes of economic mineral deposits.

CO10: Understand and explain the various processes of formation of ore mineral deposits.

UNIT-I	IGNEOUS PETROLOGY	15hrs

Definition of Petrology - Earth zones. Composition and constitution of magmas - Primary and Parental Magmas. Forms of Intrusive igneous rocks: Concordant forms - Sill, Laccolith, Lopolith and Phacolith, Discordant forms - Dykes, Cone Sheets, Volcanic neck, Ring dyke, Batholiths, Stocks, Bosses and Psymaliths. Forms of Extrusive igneous rocks: Lava flows, Pyroclastic deposits - Agglomerate, Lapilli, volcanic ash and volcanic froth.

Crystallization of Unicomponent magma: Augite system. Crystallization of binary magma: Diopside-Anorthite system – simple eutectic. Albite – Anorthite system – solid solution series. Forsterite-Silica system-incongruent melting. Crystallization of a ternary system: Diopside - Anorthite – Albite.

Bowen's Reaction Series. Mechanism and processes of magmatic differentiation. Magmatic Differentiation: Fractional Crystallization, Liquid immiscibility, Assimilation –Effects of different types of magmas on different types of rocks.

UNIT-II	IGNEOUS PETROLOGY	15hrs

Structures vesicular and Amygdaloidal structures - block lava - Ropy lava - pillow structure - flow structure -sheet joints- mural jointing - columnar jointing - rift and grain.

Textures: Definition and description-Crystallinity: crystallites and microlites-Devitrification - Granularity -shapes of crystals, mutual relations. Equigranular textures: Allotriomorphic, Hypidiomorphic, Panidiomorphic.

Inequigranular Textures: Porphyritic and Intergrowth texture - Trachytic texture, Intergrowth texture, Directive textures and Overgrowth textures. Reaction textures - Micro Structures.

Classification: Bases of classification-Megascopic classification, classification based on colour index, based on the proportion of Alkali to plagioclase feldspars. Based on silica saturation, based on alumina saturation. A short account of CIPW classification, Normative minerals, salic and femic groups - mention of the main divisions, classes, orders, sub-orders, ranges and sub-ranges only.

UNIT-III	METAMORPHIC PETROLOGY	15hrs

Metamorphism: definition and scope. Agents and kinds of metamorphism. Metamorphic zones and grades. Concept of metamorphic facies and its applications. Textures and structures of metamorphic rocks. Outline of crystalloblastic series and its applications. Metasomatism and metasomatic processes. Pneumatolytic and injection metamorphism. Contact or Thermal metamorphism of pelitic sediments and calcareous rocks. Cataclastic metamorphism and its products.

UNIT-IV	ECONOMIC GEOLOGY	15hrs

Definition and Scope of Economic Geology. Concepts of: Ore, gangue, tenor, grade, host rock, and economic value. Brief outline of factors controlling the generation of materials of a Mineral Deposit. Outline of Lindgren and Bateman's scheme of classification of mineral Deposits. Controls of ore deposit localization.

Processes of Ore Formation I: - Magmatic Concentration – Oxidation and Supergene Enrichment - Sublimation – Residual and Mechanical Concentration – Metamorphic – Metasomatism – Evaporation.

Processes of Ore Formation II: Hydrothermal: Cavity filling deposits and Replacement deposits. Outline of ore shoots. Contact Metasomatism – Sedimentation. Mineralogy, association, mode of occurrence and distribution in India of the minerals used in the following Industries: abrasives – refractory – cement – glass – ceramics – fertilizer – paints and pigment.

Books Recommended

1. Tyrell, G.W. (1958). Principles of Petrology. B.I. Publications. New Delhi.
2. Haung, W.T. (1962). Petrology. McGraw Hill. New York.
3. Winter, J. D.(2010).Principles of Igneous and Metamorphic Petrology. PHI. New Delhi.
4. Williams, H. et al. (1982). Petrography. CBS. New Delhi.
5. McBirney, A.R. (1993). Igneous Petrology. CBS. New Delhi.
6. Best, M.G. (2005). Igneous Petrology. Wiley. New Delhi.
7. Best, M.G. (2003). Igneous and Metamorphic Petrology. Wiley. New Delhi.
8. Hatch, F.H. et al. Petrology of the Igneous Rocks. CBS. Delhi.
9. Hyndman, D.W. (1985). Petrology of the Igneous and Metamorphic Rocks. McGraw Hill. New York.

10. Middlemost, E.A.K. (1985). Magmas and Magmatic Rocks. Longman. UK.
11. Winkler, H.G.F. (1970). Petrology of the Metamorphic Rocks. Springer. New Delhi.
12. Turner, F.J. (1968). Metamorphic Petrology. McGraw Hill. New York
13. Bateman, A.M. & M. L. Jensen.(1981). Economic Mineral Deposits. 3rd ed. Wiley. New York
14. Edwards, R. & K. Atkinson. (1986). Ore Deposit Geology. Chapman & Hall. UK.
15. Krishnan, M.S. (1951). Mineral Resources of Madras. Memoir V.80. Geol. Surv. Ind. Kolkata.
16. Park, C.F. & M. A. MacDiarmid.(1970). Ore Deposits. Freeman. New York.
17. Prasad, U. (2003). Economic Mineral Deposits. CBS. Delhi.
18. Banerjee, D.K. (1998). Mineral Resources of India. World Press. Kolkata.
19. Deb, S. (1985). Industrial Minerals and Rocks of India. Oxford & IBH. Delhi.

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Internal Assessment Test-1	05
Internal Assessment Test-2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester– III

Discipline Specific Course (DSC)

Course Title: **IGNEOUS AND METAMORPHIC PETROLOGY AND ECONOMIC GEOLOGY**

Course Code: **C3GEG1P1**

Type of Course	Theory/ Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-6	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**10**	**40**	**50**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: Understand and describe the megascopic and microscopic properties of important igneous rocks.

CO2: Understand and describe the megascopic and microscopic properties of important metamorphic rocks.

CO3: Understand and describe the megascopic properties and identify important ore and industrial minerals.

List of the Expedients, each will have 4rs / Week (Minimum 12 experiments)

IGNEOUS AND METAMORPHIC PETROLOGY AND ECONOMIC GEOLOGY

Megascopic identification of the following Igneous rocks:	Practicals
Granite, Graphic granite, Pegmatite, Aplite, Schorl Rock, Granite Porphyry, Syenite, Syenite porphyry, Diorite, Gabbro, Anorthosite, Dunite, Pyroxenite, Dolerite, Dolerite Porphyry, Basalt, Trachyte, Rhyolite, Obsidian, Pumice, Scoria.	2 Practicals
Megascopic identification of the following Metamorphic rocks: Slate, Phyllite, Schists, Gneisses, Quartzite, Marble, Amphibolite, Ecologite, Leptynite, Charnockite, Khondalite, and Basic Granulite.	2 Practicals
Microscopic identification and description of the following Igneous rocks: Mica Granite, Hornblende Granite, Tourmaline Granite, Graphic Granite, Mica Syenite, Hornblende Syenite, NephelineSyenite, Diorite, Gabbro, Norite, Dunite, Peridotite, Granite - porphyry. Syenite - porphyry, Diorite - porphyry, dolerite, Anorthosite, Trachyte, Andesite, Basalt, Volcanic Breccia,	3 Practicals
Microscopic identification and description of the following Metamorphic rocks: Slate, Chlorite Schist, Mica Schist, Kyanite Schist, Staurolite Schist, Garnetiferous Schist, Glaucophane Schist, Granulite, Charnockite, Ecologite Amphibolite, Leptynite, Khondalite, Cordierite, Gneiss, Garnet - Sillimanite Gneiss, Calc Granulite.	3 Practicals
ECONOMIC GEOLOGY: **Megascopic identification and description, Indian occurrences and uses of the following ore and industrial Minerals:** Realgar, Orpiment, Stibnite, Molybdenite, Galena, Sphalerite, Cinnabar, Bornite, Chalcophyrite, Pyrite, Arsenopyrite, Barite, Gypsum, Cuprite, Zincite, Corundum, Hematite, Ilmenite, Magnetite, Chromite, Cassiterite, Rutile, Pyrolusite, Psilomelane, Goethite, Limonite, Bauxite, Calcite, Dolomite, Magnesite, Siderite, Aragonite, Cerussite, Azurite, Malachite, Chrysocolla, Halite, Fluorite, Phosphatic Nodule, Monazite, Graphite, Coal and its varieties.	2 Practicals

B.Sc. Semester–IV

Discipline Specific Course (DSC)-GEOLOGY

Course Title: SEEDIMENTARY PETROLOGY, PRINCIPLES OF STRATIGRAPHY AND PALAEONTOLOGY

Course Code: C4GEG1T1

Type of Course	Theory/ Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-7	**Theory**	**04**	**04**	**60hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: Understand and explain the basic concept of origin of sedimentary rocks, their classification, textures and structures.

CO2: Understand, classify and explain the categorization of sedimentary rocks, describe the characteristics.

CO3: Classification of important sedimentary rocks like sandstone, limestone and acquire ideas of chemical and biochemical sedimentary rocks.

CO4: Understand and describe the basic principles of Stratigraphy and breaks in stratigraphic successions.

CO5: Understand and describe the physiographic and geological divisions of India and acquire knowledge about cratons and mobile belts.

CO6: Understand and describe the Early Precambrian and Late Precambrian formations of India

CO7: Understand and describe the important Palaeozoic, Mesozoic and Cenozoic formations of India.

CO8: Understand and describe the stratigraphy of Karnataka and explain the characteristics of the Precambrian terrain of Karnataka.

CO9: Understand and explain significance of palaeontology, the conditions and methods of fossilization, classification and nomenclature of fossils and the basic principles of Taxonomy, Systematics and Binomial nomenclature.

CO10: Understand and explain the morphology, classification,geological history and stratigraphic importance of Phylum Protozoa, Phylum Coelenterata- Class Anthozoa, Phylum Brachiopoda and Phylum Mollusca.

CO11: Understand and describe the morphology, classification, geological history and stratigraphic importance of the PhylaArthropoda, Echinodermata and Hemichordata.

CO12: Describe the characteristics of important plant fossils.

UNIT-I	SEDIMENTARY PETROLOGY	15hrs

Introduction, definition and Sedimentary process-disintegration & decomposition of rocks - transportation - deposition - diagenesis. A broad classification of sedimentary rocks into residual, mechanical, chemical and organic groups. Structures of sedimentary rocks. Mechanical, chemical and organic structures. Textures of sedimentary rocks - clastic and non - clastic textures. Residual deposits-terra rossa, clay, laterite, bauxite, and soils. Mechanical deposits-rudaceous, arenaceous and argillaceous groups. Heavy minerals in sand and sandstones. A descriptive study of Conglomerate, Breccia, Sandstones and Shales. Chemical deposits-siliceous, carbonaceous, ferruginous and salt deposits. Organic deposits-calcareous, siliceous, phosphatic, ferruginous and carbonaceous deposts. A breief study of Flinit, Chert, Siderite, Gypsum, Rock Salt, Caliche. Guano and Kiesellgher. Descriptive study of different types of calcareous and carbonaceous deposits.

UNIT-II	PRINCIPLES OF STRATIGRAPHY	15hrs

Principles of stratigraphy: Definition and scope of Stratigraphy. Principles and laws of Stratigraphy. Methods of Stratigraphic Correlation. Stratigraphic Nomenclature: Litho-stratigraphy, Bio-stratigraphy and Chrono-stratigraphy. Geological Time Scale and Standard Geological divisions. Physiographic divisions of India: Peninsular India, Indo-gangetic alluvial plains and Extra Peninsular India. Study of Archaean Group: Dharwar system of Karnataka-mineral riches. Study of the following geological formations of India: Proterozoic Group: Cuddapah System; Delhi System; Vindhyan System; Kurnool System. Paleozoic Group: Paleozoic of Spiti; Permo-Carboniferous of Salt Range.

UNIT-III	PRINCIPLES OF STRATIGRAPHY	15 hrs

Study of the following geological formations of India: Gondwana Group: Classification, lithology, deposits, fossil content, and climate - economic importance. Triassic of Spiti; Jurassic of Kutch; Cretaceous of Trichinopoly and Narmada valley. Study of the following geological formations of India: Deccan Traps: distribution – structure - Lameta beds-Inter-trappean and Infra-trappean beds - Bagh beds; Tertiary Group : Eocene of Assam, Cuddalore sandstone of Tamil Nadu and Quilon beds of Kerala; Siwalik System; outline of Pleistocene Ice Ages in India. Karewa formation; Recent: Placer deposits of Tamil Nadu. Rise of Himalaya.

UNIT-IV	PALAEONTOLOGY	15 hrs

Definition of Palaeontology, Definition of fossils-nature and modes of preservation of fossils: Body fossils and; unaltered hard parts, altered hard parts: Petrifaction, permineralisation, carbonisation, recrystallization and silicification. Trace fossils - mould, casts, tracks, trails, borings; Uses of fossils - stratigraphic indicators - climatic indicators- indicators of palaeo-geography - indicators of evolution and migration of life forms - indicators of new deposits of coal and petroleum - life through ages.

Phylum Arthropoda - Class -Trilobita - General morphology: classification - geological history. Phylum coelentrata - class Anthozoa - zoological features - General morphology: classification - tabulate corals - Rugose corals geological distribution- stratigraphic importance. Sub phylum Hemichordata - class Graptozoa: order Dendroidea and Graptoloidea - general morphology, classification, geological distribution and stratigraphic importance.

Phylum Mollusca -Class Pelecypoda -General characters - ornamentation, classification, geological history. Class Gasteropoda: General morphology, shell forms - types of coiling - Dextral and sinistral - ornamentation, classification and geological history. Class Cephalopoda: General morphology, (Nautilitic, Goniotitic, Ceratitic and Ammonitic)-shell forms- ornamentation - classification, geological history - morphology of a Belemnite shell.

Phylum Brachiopoda - General morphology -Brachial skeleton - morphometric details, ornamentation, classification, geological history. Phylum Echinodermata: Class Echinoidea: General morphology, corona (Ambulacra, inter ambulacra) - peristome - regular and irregular echinoids - classification - geological history. Phylum protozoa - Order: Foraminifera: General morphology - dimorphism - classification, geological history and stratigraphic importance. Class Crustacea - Sub class: Ostracoda - morphology - classification and geological history.

General classification of plant kingdom - plant fossils from India - A brief account of the following plant fossils: -Glossopteris, Gangamopteris, Ptilophyllum, Calamites, Lepididendron and Sigillaria.

Books Recommended

1. Tyrrel, G.W- Principles of petrology, Asia Publishing House.
2. Huang, W.T.-Petrology, MC Graw Hill
3. Pettijhon, F.J.-Sedimentary Rocks, Harper & Bros.
4. Harker, A. -Petrology for Students, Cambridge,
5. Krishnan M.S. (2003) - Geology of India and Burma, 6th Edition, CBS.
6. Wadia D.N. (1953) - Geology of India, TATA McGraw - Hill.
7. Ravindrakumar K.R. - Stratigraphy of India.
8. Lemon R.Y (1990) - Principles of Stratigraphy, Merrill Publishing Co.
9. Pascoe, E.H.(1968) - A manual of the Geology India and Burma, Govt of India Publications.
10. Gregory, J.W. and Barret B.H- General stratigsraphyMathuen.
11. Henry woods: Invertebrate palaeontolgy - Cambridge.
12. Arnold, C.A.,: An introduction to Palaeobotany., MC-Graw
13. Jain, P.C., and Anatharaman, M.S.: An introduction to Paleontology, Vishal Publications.
14. Raup, D.M. and Stanely, M.S.: Principles of Palaeontology, CBS Publishers.
15. Moore , R.C., Laliker , C.G.&Fishcher, A.G.: Invertebrate Fossils , Harper brothers
16. Shrock. R.R. and Twenhofel , W.H - 1953 : Principles of invertebrate Palaeontology,
17. Amold publication Easton - Invertebrate Paleontology

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Internal Assessment Test-1	05
Internal Assessment Test-2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–IV

Discipline Specific Course (DSC)-GEOLOGY

Course Title: **SEDIMENTOLOGY, STRATIGRAPHY AND PALAEONTOLOGY (PRACTICAL)**

Course Code: **C4GEG1P1**

Type of Course	Theory/Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-8	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**10**	**40**	**50**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: Describe the principles of Stratigraphy. This knowledge is useful for field geology, mineral exploration, oil exploration, and tectonics.

CO2: Describe the principles of Indian Geology. Describe geological formations to understand the distribution of geological formations in India

CO3: Identify fossils and describe geological time scale.

CO4: Identify different types of molluscan fossils; understand about Hemichordata and their significance.

CO5: Identify about plant fossils and significance of Paleobotany

List of the Expedients, each will have 4rs / Week (Minimum 12 experiments)

Sl. No	Content	Practicals
	Indian Stratigraphy:	
1	Preparation of Lithostratigraphic maps of India showing distribution of important geological formations.	**1**
2	Dharwar Province (Group), Cuddapah Super Group, Vindhyan Super Group, Jurassic of Kutch, Cretaceous of Trichinopoly, Gondwana Super Group, Deccan Traps.	**2**
	Palaeontology	
3	Identification of fossils based on morphological characters. Fixing the biological position and range in time of the following classes of fossils:	
4	Brachiopods: Lingula, Spirifer, Productus, Terebratula, Syringothyris, Rhynchonella, Pentamerus, Atrypa and Athyris	**2**
5	Lamellibrachia: Arca, Cardita, Exogyra, Gryphea, Ostrea, Pecten, Trigonia, Venus and Glycemeris	**2**
6	Gastropods: Turritella, Cerithium, Turbo, Trochus, Natica, Conus, Fusus, Physa, Busycon, Voluta, Murex, Bellerophon, Helix, Cyprea and Euomphalus.	**2**
7	Cephalopods: Orthoceras, Nautilus, Goniatites, Ceratites, Acanthoceras, Schloenbachia, Scaphites, Perisphinctes, Turrilites, Baculites, Belemnites.	**2**
8	Trilobites: Paradoxides, Calymene, Olenellus, Olenus, Asaphus, Trinucleus and Phacops.	**1**
9	Echinoids: Echinus, Cidaris, Hemicidaris, Micraster, Holaster, Hemiaster, Stigmatophygus.	**2**
10	Plant fossils: Glossopteris, Gangamoptris, Ptilophyllum, Lepidodentron, Sigillaria, Stigmaria, Calamites.	**1**

B.Sc. Semester–V

Discipline Specific Course (DSC)-GEOLOGY

Student shall select DSC 9A & 10 A or 9B & 10 B for 06 credits only

Course Title: STRUCTURAL GEOLOGY AND HYDROGEOLOGY

Course Code: C5GEG2T1

Type of Course	Theory/ Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-9A	**Theory**	**04**	**04**	**60hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: Understand and describe the basic terminologies in Structural Geology, the Rule of V's and characteristics of primary and secondary structures.

CO2: Understand and describe rock deformation, concepts and applications of stereographic projection in Structural Geology, and geological mapping techniques and procedures.

CO3: Understand and describe the folds, faults and joints with reference to their origin, terminologies, classification and geological significance.

CO4: Understand groundwater in relation to hydrological cycle and explain hydrometeorology and its significance.

CO5: Understand and describe the occurrence of groundwater, the properties of aquifers and their types; define and explain the Darcy's law governing groundwater movement and flow directions.

CO6: Understand and describe the groundwater investigation techniques and pumping tests for determination of aquifer parameters.

CO7: Understand Physical and chemical properties of water and water quality.

UNIT-I	**STRUCTURAL GEOLOGY**	**15 hrs**

Introduction: Structural forms of rocks: Primary structural forms and Secondary structural forms. Concept of brittle and ductile formations. Forces: compression, tension, torsion and share. Contour and types: Topography and geological map. Elementary idea of bed, strike, dip, and its types. Brunton compass and its uses.

Primary structural forms-sedimentary and igneous rocks: stratification, current or cross bedding, graded bedding, ripple marks, mud cracks and rain prints, flow layers, primary joints, vesicular and amygdaloidal structures and pillow structure.

Lineation foliation and unconformities: Description and origin of foliations axial plane cleavage and tectonic significance. Description and origin of lineation and relationship with the major structures. Unconformity types- Para, disconformity, nonconformity, angular unconformity and regional unconformities.

UNIT-II	**STRUCTURAL GEOLOGY**	**15 hrs**

Secondary structural firms: **A) Cohesive dislocations-** Distortion bedding and folds.**Folds:** Definitions-Parts of folds: axis, axial planes, limb, plunge, crest and trough. **Mechanism of folding**: Buckling, Bending, Flexural slip and flow folding. **Types of folds**: Symmetrical and asymmetrical, anticline, syncline, anticlinorium, synclinorium, overturned fold, recumbent fold. Isoclinal, chevron, fanfold, monocline and drag fold. Denudational structures-Outlier and Inlier.

B) Disruptive dislocations-Joint and faults. **Joints:** Definition, Dip, Strike. Joint plane, block join, joint set, joint system. **Classification: 1) Geometrical-** Dip, strike, oblique and bedding joints. **2) Genetic-** Columnar**,** mural sheets joints, master joints, Importance of joints.

Faults: Definition, elements of fault, fault plane, dip, strike, hade, heave, throw, hanging and footwalls. **Classification: 1) Geometrical:** a) Based on attitude of fault as compared to the adjacent beds. Dip, Strike, Diagonal and Bedding faults. b) Based on Apparent movement: Normal and Reverse faults. **2) Genetic classification:** Thrust faults, over thrust and under thrust. Gravity Faults- Step fault, Ridge fault and Trough fault. Criteria for recognition of faults in the field.

UNIT-III	HYDROGEOLOGY	15 hrs

Introduction and basic concepts. Scope of hydrogeology and its societal relevance. Hydrologic cycle. Precipitation, evapo-transpiration., run-off, infiltration and subsurface movement of water. Rock properties affecting groundwater-specific yield, specific retention, permeability, porosity, openings in rocks and types of openings. Vertical distribution of subsurface groundwater- zone of aeration and zone of saturation and water table.

Types of aquifer confined and unconfined: Artesian aquifer, Perched, leaky and semi confined aquifers. Darcy's law and its validity, hydraulic head and groundwater flow directions. Intrinsic permeability and hydraulic conductivity. Groundwater flow rates and flow direction: laminar and turbulent groundwater flow.

UNIT-IV	HYDROGEOLOGY	15 hrs

Groundwater chemistry: Physical and chemical properties of water and water quality.

Introduction to methods of interpreting groundwater quality data using standard graphical plots, Sea water intrusion in coastal aquifers, Groundwater management, surface and subsurface water interaction. Groundwater fluctuation, Basic concepts of water balance studies, Issues related to groundwater resource development and management, Rainwater harvesting and artificial recharge of groundwater.

Books Recommended

References to Structural geology

1. Davis, G. R 1984 Structural Geology of Rocks and Regions;John wily
2. Billings, M. P 1987 Structural Geology;4th edition prentice hall
3. Park, R. G 2004 Foundation of Structural Geology;Chapman and hall
4. Pollard, D. D 2005 Fundamental of Structural Geology;Cambridge University press
5. Raagan, D. M 2009 Structural Geology and Introduction to Geometrical Techniques 4th edition Cambridge University press
6. Laahi, S. H 1962 Field Geology McGraw hill
7. Hills, E. S 1961 Elements of Structural Geology; Asia publishing house
8. Hobs means and Williams 1976, An Outline of Structural Geology John wily
9. John Roberts 1982 Introduction to Geological Maps and Structures; Pergamon press
10. R. J Twist and E M Moore 2007 Structural Geology 2nd edition freeman and company

References to Hydrogeology

11. Tod DK 1980 Groundwater Hydrology John wily and sons
12. Davis SN and Devastrjm 1966 Hydrogeology John wily and sons New York
13. Raghunath H.M 2007 Groundwater New age; International publishers Delhi
14. Current KR 1987 Groundwater assessment development and management; Tata

McGraw hill
15. Ramkrishnan S 1998 Groundwater kg graph arts Chennai
16. C W Fetter 2005 Applied hydrogen second edition CBS and distributors New Delhi.

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Internal Assessment Test-1	05
Internal Assessment Test-2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–V

Discipline Specific Course (DSC)-GEOLOGY

Course Title: STRUCTURAL GEOLOGY AND HYDROGEOLOGY (Practical)

Course Code: C5GEG2P1

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-10A	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**10**	**40**	**50**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: Understand and illustrate the important structural features and attitude of beds; Rule of V's, draw and carry out the procedures of analysis of geological maps with different structural features.

CO2: Study of Brunton Compass and its uses.

CO3: Preparation of cross-section profile from geological map.

CO4: Work out problems related to true and apparent dip.

CO5: Physical criteria of water quality and Chemical analyses of groundwater and units used. TDS and hardness of ground water. Biological analysis of groundwater.

List of the Expedients, each will have 4rs / Week (Minimum 12 experiments)

STRUCTURAL GEOLOGY	**Practicals**
1. Study of Brunton compass identification of different types of folds bar faults joints and unconformity from block models	2 Practicals
2. Exercise on structural maps preparation of cross section profile from geological map	6 Practicals
a) Horizontal and incline strata with and without intrusion	
b) Inclined start with faults with and without intrusion	
c) Map showing combined features such as fault folds unconformity and intrusions; unconformities without intrusions	
d) Completion of outcrops	
e) Solving strike and dip problems	
HYDROGEOLOGY (WATER ANALYSIS)	
1. Collection and preservation of water samples from open well tap and bore well river water treatment plant wastewater treatment plant and proper labelling of samples	1 Practical
2. Selection of parameters to be determined	1 Practical
A. pH, electrical conductance and hardness of water	1 Practical
B. Estimation of calcium magnesium carbonates and bicarbonates chemical oxygen demand and biological oxygen demand	1 Practical

B.Sc. Semester–V

Discipline Specific Course (DSC)-GEOLOGY

Student shall select DSC 9B & 10 B or DSC 9A & 10 A for 06 credits only

Course Title: GEOCHEMISTRY MINING GEOLOGY

Course Code: C5GEG2T2

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-9B	**Theory**	**04**	**04**	**60hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: To understand basic concepts of geochemistry.

CO2: To explain age and origin of universe and earth.

CO3: To understand geochemical elements, principles of crystal chemistry etc.

CO4: To explain mining terminologies and methods of mining.

CO5: To understand Geological parameters for mine planning and designing

CO6: To understand concepts of mineral economics and its importance in national development.

UNIT-I	GEOCHEMISTRY	15 hrs

Basic concepts and Scope of Geochemistry. Age, origin and composition of the universe, Age and Origin of solar system, Geochemical evolution of Earth, Structure and Composition of earth. Geochemical classification of elements: Lithophile, Siderophile, Chalcophile, Atmophile elements. Biochemical classification of elements. Geochemical cycles: Nitrogen, Oxygen, Carbon, Water, Phosphorus, Sulfur etc.

UNIT-II	GEOCHEMISTRY	15 hrs

Geochemistry- Geochemistry- Elements, Atoms, and Chemical Bonds, States of matter, Principles of crystal Chemistry, Isomorphism and Polymorphism. Principles of Geothermobarometry. Energy, and Fundamental Thermodynamic Concepts, Laws of Thermodynamics, Fundamental variables of thermodynamics, System and Surroundings: Open, closed and isolated systems. Enthalpy, Entropy, Heat capacity and free energy, concept of equilibrium and equilibrium constant. Gibbs phase rule: Degree of freedom, Components and Phase, application to mineralogical system -H_2O; Al_2SiO_5; Forsterite-Fayalite; Albite-Anorthite; Albite-Orthoclase; Forsterite-Quartz and Diopside-Anorthite. Fundamentals of isotope geochemistry.

UNIT-III	MINING GEOLOGY	15 hrs

Introduction, mining terminologies, Classification of mining methods–Alluvial mining methods, open-cast mining methods, Quarrying, Underground mining methods – Open stopes, stoping with supports. Geological parameters for mine planning and designing. Drilling: methods and types of drilling and their uses. Mine safety, mine ventilation, Mining hazards, advantages and disadvantages of surface and subsurface mining. Impact of mining and mineral processing on environment and human health.

UNIT-IV	MINING GEOLOGY	15 hrs

Mineral Economics: Concept of mineral economics and its importance in national development and economy. Resource scenario of India. Production, demand, supply and substitution of natural resources in global context. Structure and organization of mineral industry, valuation of mineral property.

Mineral deposits – Meaning, specialties. Mining laws in India, Concept of mineral resources and its estimation, classification of mineral resources, Indian and International mineral legislation, National mineral policy. Mineral Conservation: Introduction, Growth and awareness. Methods of conservation. Limitations and scope of conservation.

Books Recommended

1. William M. White, (2013). Geochemistry, Wiley-Blackwell
2. Krauskopf, K. B. and D. K. Bird. (1995). Introduction to Geochemistry. New York: McGraw- hill.
3. Brain Mason. Principles of Geochemistry.
4. Rankama and Sahama. Geochemistry
5. Henderson. Rare earth element Geochemistry
6. Young. Elements of Mining Geology
7. Lewis. Elements of Mining
8. Shevyekov. Mining of mineral deposits
9. Stoces. Introduction of mining.
10. Arogyaswamy. Principles of Mining Geology
11. K KChatterjee. An Introduction to Mineral Economics
12. Sinha R.K & Sharma N L, Oxford & IBH. Mineral Economics

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Internal Assessment Test-1	05
Internal Assessment Test-2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester– V
Discipline Specific Course (DSC)-GEOLOGY

Course Title: **GEOCHEMISTRY AND MINING GEOLOGY (Practical)**

Course Code: **C5GEG2P2**

Type of Course	Theory/ Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-10B	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**10**	**40**	**50**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: To describe plotting the geochemical data using discriminant diagrams.

CO2: To estimate P-T diagrams using mineral pairs

CO3: Geochemical variation diagrams and its interpretations

List of the Expedients, each will have 4rs / Week (Minimum 12 experiments)

Contents	Practicals
1. Plotting the Geochemical data using suitable discriminant diagrams and interpretation of data.	2 Practicals
2. Models of P-T estimation using suitable mineral pairs.	2 Practicals
3. Construction of P-T diagrams	1 Practical
4. Geochemical variation diagrams and its interpretations: bivariate and trivariate plots to delineate the control of different compositional variables:	2 Practicals
5. Harker variation diagram, AFM diagram, MgO diagram.	2 Practicals
6. Chemical variation diagrams based on major elements: the alkali-lime index, iron enrichment index, aluminum saturation index and alkalinity index diagrams.	3 Practicals

B.Sc. Semester–VI
Discipline Specific Course (DSC)-GEOLOGY
Student shall select DSC 11B & 12 B or DSC 11A & 12A for 06 credits only

Course Title:REMOTE SENSING, GIS AND GNSS
Course Code:**C6GEG2T1**

Type of Course	Theory/ Practical	Credits	Instruction hour/week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-11A	**Theory**	**04**	**04**	**60hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcomes (COs): At the end of the course students, will be able to:

CO1: Understand basic of remote sensing, working and duties of satellite.

CO2: To understand about the Basic principles of Remote Sensing, Aerial remote sensing, optical remote sensing, Thermal Remote Sensing and application of Remote Sensing.

CO3: Understand fundamentals of GIS Systems, Geoinformation, Maps, Databases

CO4:become aware of Reference surfaces for mapping, Coordinate Systems

CO5: Direct and indirect spatial data capture, accuracy and positioning, data checks and repairs, interpolating discrete and continuous data

CO6: Relate to classification of analytical GIS capabilities. Vector and Raster overlay operators. Proximity and Buffer modeling, GIS applications and advances.

CO7: Working of GPS, acquiring knowledge of satellites of Indian constellation and advances made by IIRS.

CO8: To understand fundamental concepts of GNSS system elements and signals.

UNIT-I	REMOTE SENSING	15 hrs

Remote Sensing: Definition, History, scope and limitations of Remote Sensing in Geology. Electromagnetic spectrum – definition and components. Energy sources and radiation - outline of interaction of electromagnetic spectrum with atmosphere and earth surface features - spectral signatures – atmospheric windows.

Types of remote sensing: based on 1) Energy sources: active and passive. 2) Platforms: aerial and satellite and 3) Sensors: optical, thermal, and microwaves. 4) RADAR. Remote sensing techniques: Optical, thermal and hyperspectral remote sensing.

Types of satellites: geosynchronous and sun synchronous satellites, Types of satellite orbits, Types of sensors, data types and products of remote sensing satellites.A short account of LANDSAT, SPOT and India Remote Sensing satellites. Indian Space Missions.

UNIT-II	GEOGRAPHICAL INFORMATION SYSTEM (GIS)	15 hrs

Introduction to Geographical Information System (GIS). Fundamentals: Functions and Components of GIS. GIS Applications in earth system sciences. Earth's shape and size: Ellipsoid, Oblate spheroid and Geoids

Coordinate System- Geographical Coordinate System and Projected Coordinate System (UTM). Data and Information. Spatial data: Vector (Point, Line and Polygon), Raster (Grid and Image) and Triangulated Irregular Network (TIN); Non-spatial data: attribute data.

UNIT-III	GEOGRAPHICAL INFORMATION SYSTEM (GIS)	15 hrs

Digital elevation model (DEM) and Digital Terrain Model (DTM). Maps and Spatial Information, Map layout: Essential parts in map layout. Map Projection: Properties of Map

Projections, Types - Cylindrical, Conical and Azimuthal projections.

Datum: types, Characteristics and significance of datum. Data Models: Vector data models and Raster data models. Data Conversions; Vector to Raster and Raster to Vector, applications and limitations of the data conversion. Data quality and errors.

Digital Image Processing, Spatial and non-spatial data analysis. Map Algebra: Overlay Analysis-Union and Intersect. Proximity Analysis- Buffer Analysis and Surface Analysis-Hillshade, slope analysis and viewshade.

UNIT-IV	**GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS)**	**15 hrs**

Introduction to Global Navigation Satellite System (GNSS); Fundamental concepts. Classification of GNSS receivers. History, Satellite Navigations constellations. GNSS system elements and signals. GNSS measurements and accuracy of GNSS.

GPS systems, Indian Regional Navigation Satellite System (IRNSS) and Navigation with Indian Constillation (NavIC) systems.

Atmospheric Effects on GPS Signal, and Applications of GPS. GPS Errors. Types of GPS: Differential GPS (DGPS) & Real-time Kinematic (RTK) GPS. Surveying with GPS, GPS Data Processing, GIS and GPS data integration, Navigation with GPS.

Books Recommended

1. Lillesand, T. M. & Kiefer, R.W., Remote Sensing and Image Interpretation,Wiley.2007.
2. Richards, J.A. and Jia, X., 1999. Remote Sensing Digital Image Analysis, Springer-Verlag.
3. Drury S. A. (1990), A Guide to Remote Sensing - Interpreting Images of Earth, Oxford Science Publications
4. C.P.Lo, Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems
5. Burrough and Rachel, Principles of Geoinformation systems,
6. Goodchild and Longley, Geographical information system and Science
7. P.S.Roy, Geographical Information Science
8. John E. Harmon & Steven J. Anderson., The design and implementation of Geographic Information Systems; John Wiley & Sons,2003.
9. Kang Tsung Chang., Introduction to Geographic Information Systems; Tata Mc Graw Hill Publishing Company Ltd, New Delhi, 2008
10. Hofmann W.B & Lichtenegger, H. Global Positioning System -Theory and Practice
11. Gunter Seeber. 2003, Satellite Geodesy Foundations-Methods and Applications
12. Curran, P.B. (1985). Principles of Remote Sensing. ELBS. London.
13. Drury, S.D. (1993). Image Interpretation in Geology. Allen & Unwin. London.
14. Sabins, F.F. (1974). Remote Sensing Principles and Interpretation. Freeman. New York.
15. Reddy, A. (2010). Principles of Remote Sensing and GIS. CBS. Delhi.

16. Guptha, R.P. (2003). Remote Sensing Geology. Springer. New Delhi.

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Internal Assessment Test-1	05
Internal Assessment Test-2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–VI
Discipline Specific Course (DSC)-GEOLOGY

Course Title: **REMOTE SENSING, GIS AND GNSS (Practical)**
Course Code: **C6GEG2P2**

Type of Course	Theory / Practical	Credits	Instruction hour/week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-12A	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**10**	**40**	**50**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: To understand Satellite Data Products and Maps types along with visual interpretation

CO2: Understand GIS and practical uses of the same

CO3: To understand Geo-Processing Tools: Clip, Union, Dissolve, Merge, Intersect and buffers solve the real world tasks

CO4: To understand GPS data collection and its application

List of the Expedients, each will have 4rs / Week (Minimum 12 experiments)

Contents	Practicals
1. Introduction to Satellite Data Products and Maps types. Basics of visual interpretation of satellite images	2 Practicals
2. Introduction to GIS Software and its Tools.	1 Practicals
3. Georeferencing (Image Rectification).	1 Practical
4. Digitization of Maps, Editing the Data.	1 Practical
5. Displaying the data: Classification of Spatial Data.	1 Practical
6. Spatial data Labeling and Creating Map Layout.	1 Practical
7. Geo-Processing Tools: Clip, Union, Dissolve, Merge, Intersect.	2 Practical
8. Buffer Analysis.	1 Practical
9. Introduction about GPS Device.	1 Practical
10. GPS Data Collection and Applications	2 Practical

B.Sc. Semester–VI

Discipline Specific Course (DSC)-GEOLOGY

Student shall select DSC 11B & 12 B or DSC 11A & 12A for 06 credits only

Course Title: MINERAL EXPLORATION AND MINERAL PROCESSING

Course Code: C6GEG2T2

Type of Course	Theory / Practical	Credits	Instruction hour/week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-11B	**Theory**	**04**	**04**	**60hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: To Explain mineral exploration

CO2: To understand importance of mineral resources

CO3: To Describe geological concepts in mineral exploration

CO4: Explain geological mapping and sampling, Geochemical surveys.

CO5: Subsurface exploration and drilling

CO6: Describe scope and necessity of Mineral Processing and Physical properties of Ores and their importance in Mineral Processing

CO7: To understand Gravity separation, Magnetic separation and Electrical separation.

CO8: Principles and factors affecting the filtration.

CO9: Tailing ponds, Design & construction, Types.

UNIT-I	MINERAL EXPLORATION	15 hrs

Introduction to mineral exploration: Introduction to mineral prospecting and exploration: Definition and scope, Classification of prospecting methods, Principles of Exploration: Geological, Geophysical and Geochemical Methods.Importance of mineral resources. Exploration of life cycle and stages. Geological concepts in mineral exploration: Rock types and their significance, Plate tectonics and mineralization.

UNIT-II	MINERAL EXPLORATION	15 hrs

Exploration methods and techniques: Surface geological exploration methods: Geological mapping and sampling, Geochemical surveys.

Subsurface exploration and drilling: Diamond drilling, Reverse circulation drilling, Core logging and sampling.

Geophysical methods in Mineral exploration: Electrical, Gravity, Magnetic, Seismic, Radioactive and electric well logging methods.

Mineral resource evaluation: Classification of mineral resources, Resource estimation methods. Economic evaluation of mineral deposits based on UNFC classification.Economic and technical considerations.

UNIT-III	MINERAL PROCESSING	15 hrs

Mineral Processing: Definition, scope and necessity of Mineral Processing. Physical properties of Ores and their importance in Mineral Processing.

Sampling: Definition, purpose, types of sampling and sample treatment.

Particle size: Definition and measurement of particle size, screening and sub-sieve sizing. Wet and dry sieving. Graphical representation of size analysis data and their applications. Industrial screens and their efficiency.

Liberation: Definition, importance, Methods of liberation and behavior of locked particles.

Methods of Separation: Gravity separation, Magnetic separation and Electrical separation.

Flotation: Introduction, Basic principles of flotation process, Mechanism of flotation process, Physical aspects of flotation, Equipment's: Mechanical and Froth flotation column, Micro flotation tests**,** Factors affecting flotation.

UNIT-IV	**MINERAL PROCESSING**	**15 hrs**

Dewatering and Drying: Flocculation and dispersion, principles of flocculation and dispersion phenomena. Different types of flocculants used in dewatering techniques, selective flocculation and their applications.Dewatering by gravity sedimentation and by using screens. Applications of dewatering processes in mineral industries.

Filtration: Principles and factors affecting the filtration, different types of industrial filters, cake filtration.

Centrifuging and drying: Centrifugal sedimentation, Different types of thermal dryers and their application.

Tailing Disposal: Tailing ponds, Design & construction, Types. Industrial applications and water reclamation.

Books Recommended

1. Principles of Mineral Dressing: A.M. Gaudin
2. Ore Processing: S.K. Jain
3. Mineral Processing Technology: B.A. Wills
4. Text Book of Ore Dressing: A.F. Taggart
5. Hand Book of Mineral Dressing: A.F. Taggart
6. Mineral Processing – Recent advances and future trends: S.P. Mehrotra& P. Sarkar
7. Laboratory Experiments in Mineral Processing: S. Venkatachalam&Degaleeson
8. Particle Size Measurement: T. Allen
9. Mineral Deposits of the Deep Ocean Floor – by Emery, K.O. and Skinner, Brian J(1977)
10. Geological prospecting and exploration – Kreiter, V.M.
11. Geochemistry in mineral exploration Rose, A.W Hawkes. H.E & Webb J.S. 1979.Academic press

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Internal Assessment Test-1	05
Internal Assessment Test-2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–VI
Discipline Specific Course (DSC)-GEOLOGY

Course Title: MINERAL EXPLORATION AND PROCESSING (Practical)
Course Code: C6GEG2P2

Type of Course	Theory / Practical	Credits	Instruction hour/week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-12B	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**10**	**40**	**50**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: Explain megascopic study of industrial minerals-Abrasives, Refractory, Ceramic, Fertilizer, Chemical minerals, Mineral pigments.

CO2: Describe calculation of mineral and ore reserves- average thickness of bed, assay value, assay width, specific gravity, tonnage, grade, volume and life of a mine.

List of the Expedients, each will have 4rs / Week (Minimum 12 experiments)

Contents	Practicals
Megascopic study of important economic minerals	3 Practicals
Megascopic study of industrial minerals – Abrasives, Refractory, Ceramic, Fertilizer, Chemical minerals, Mineral pigments.	3 Practicals
Microscopic study of important economic minerals.	2 Practicals
Mineral sampling and statistical calculations.	1 Practical
Calculation of mineral and ore reserves – average thickness of bed, assay value, assay width, specific gravity, tonnage, grade, volume and life of a mine.	3 Practicals

B.Sc. Semester– V
Elective Course (EC)-GEOLOGY
It is for other combination students

Course Title: **DISASTER MANAGEMENT**
Course Code: **C5GEG5T1**

Type of Course	Theory/ Practical	Credits	Instruction hour/week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
EC-1	**Theory**	**03**	**04**	**45hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: To understand the nature, cause and effects of disasters.

CO2: Comprehend the importance of Disaster Management and the need of awareness.

CO3: Acquire knowledge on disaster preparedness, recovery remedial measures and personal precautions.

CO4: Volunteer in pre and post disaster management service activities

UNIT-I	HAZARD AND DISASTER	15 hrs

Hazard and Disaster – Difference between Hazard and Disaster – Introduction of Disaster – Different types of Disasters – Natural: flood, cyclone, earthquake, landslide, land subsidence, cyclones, volcanoes, tsunami, famine and pandemic – Accidental : Terrorism, gas and radiations leaks, toxic waste disposals, Fire, Blasting, Chemical leakage, Rail, Aviation, Road, boat tragedies and nuclear pollution – Disaster Management Act 2005

Addl. Input: Hazard and Disaster, Difference between Hazard and Disaster.

UNIT-II	HAZARD AND DISASTER	15 hrs

Causes and immediate effects of Disasters-Disaster Management Cycle-Basic principles of Disasters Management : Prevention, Preparedness, Response and Recovery-Nature and concepts-Role of National Disaster Management Authority and Role of Government and non-governmental organizations in protecting human livestock and natural resources-Use of technology – Role of Citizens and Youth in the prevention.

Addl. Input: Disaster Management Cycle, Basic principles of Disasters Management: Prevention.

UNIT-III	HAZARD AND DISASTER	15 hrs

Post Disaster effects – short term – Reconstruction, Rehabilitation and Recovery – Role of volunteers and Safety Precautions – Long-term remedial and preventive measures – Collection, filing and storage of information. Awareness generation program, usage of GIS and Remote sensing techniques in disaster management.

Addl. Input: Reconstruction, Rehabilitation and Recovery.

Books Recommended

1. Disaster Management Guidelines, GOI-UND Disaster Risk Program (2009-2012).
2. Damon, P. Copola, (2006) Introduction to International Disaster Management, Butterworth Heineman.
3. Gupta A.K., Niar S.S and Chatterjee S. (2013) Disaster management and Risk Reduction, Role of Environmental Knowledge, Narosa Publishing House, Delhi.
4. Murthy D.B.N. (2012) Disaster Management, Deep and Deep Publication PVT. Ltd. New Delhi.
5. Modh S. (2010) Managing Natural Disasters, Mac Millan publishers India LTD.

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Internal Assessment Test-1	05
Internal Assessment Test-2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester– VI
Elective Course (EC)-GEOLOGY

Course Title: GEMMOLOGY AND MEDICAL GEOLOGY
Course Code: C6GEG5T1

Type of Course	Theory / Practical	Credits	Instruction hour/week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
EC-2	**Theory**	**03**	**04**	**45hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: To know about the different Gemstones its properties and its distribution in India.

CO2: To know about the Medical geology and its terminologies.

CO3: Able to distinguish different types of gemstones based on their properties.

CO4: To explain major, minor and trace elements of human body.

UNIT-I	GEMMOLOGY	15 hrs

Introduction: Gem minerals and Gemstones, Classification of gemstones, Gemstone qualities, Gem testing, Gem measurement unit. Gem Properties: Physical Properties - colour, chromophores, colour centres, luminescence, iridescence, dispersion, inclusions, alexandrite effect, hardness, specific gravity, fractures, cleavage and parting planes. Optical Properties – pleochroism, colour zoning chatoyancy, asterism, refractive Index. Flaws in Gemstone – External flaws, zoning, solid inclusions, gas bubbles and fluid inclusions.

UNIT-II	GEMMOLOGY	15 hrs

Synthetic Gemstones: Necessity and growth techniques. Diamond synthesis. Gem cutting techniques – styles of cutting (cabochon cut and faceted cut), diamond cutting and coloured stone cutting. A detailed study of important gem minerals, their properties and distribution in India. Isotropic Gems: a) Diamond b) Garnet. Uniaxial Gems: a) Corundum, b) Beryl. Biaxial Gems: a) Chrysoberyl b) Jade. Organic Gems: a) Pearl b) Amber c) Coral.

UNIT-III	MEDICAL GEOLOGY	15 hrs

Medical Geology: Introduction Definitions and terminology of Medical Geology. Natural and Geological Environment: Atmosphere, hydrosphere, lithosphere, animal life and plant life; colour and composition of different rock types and association of elements in relation to medical geology. Elemental link between different spheres: Litho– hydro– atmo- bio - spheres and its impact on humans. Essential and Non-essential elements with reference to human health. Major, minor and trace elements of human body. Module 5: Health Effects 08 hrs Pathways and Exposures: Air (inhalation), absorption, drinking water, food cycles. Metal induced effects: Carcinogenic, teratogenic, and mutagenic. Trace element deficiency and toxicity health effects: Arsenic, Cadmium, Lead, Mercury, Radon, Fluoride and Selenium. Diseases due to deficiency and toxicity of some elements: Arsenic induced effects, cardiovascular diseases, lung diseases, and liver, kidney and endemic diseases. Mapping Geological factors for human health.

Books Recommended

1. Gems and Gem Materials - Kvans, E.H. &Slawson, S.B.
2. Gemstones - Smith, H.
3. Gems - Webster, R.

4. Gems and Gem Industry in India – R.V. Karanth
5. Gemstones-Enchanting Gifts of Nature – R.V. Karanth
6. Navarathnagalu - Prasaranga Publication, Mys.Univ.
7. Environmental Geology & Conservation, Land use planning and Resource Management – Peter T. Flawn
8. Environmental Geography – Savindra Singh
9. Manual on Natural Disaster Management in India – NDM Division, Government of India
10. Miomir M. Komatina, Effects Of Geological Environments On Human Health, Burgess Publishers-2004
11. OlleSelinus, B. J. Alloway, Essentials of medical geology: impacts of the natural environment on public health, Lewis Publishers, USA-2005
12. C. B. Dissanayake, RohanaChandrajith, Introduction to Medical Geology , Lewis Publishers,USA-2009
13. Rolf O. Hallberg, Medical geology , Environmental geology–Burgess Publishers, 2007
14. MiomirKomatina, Base of medical geology, Lewis Publishers, 2007

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Internal Assessment Test-1	05
Internal Assessment Test-2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–IV/ V/VI
Skill Enhancement Course (SEC)-GEOLOGY

Student shall study SEC in any one of the Semesters either in IV or V or VI semester
College shall decide to allot the students

Course Title: GEOEXPLORATION AND SURVEYING (Practical)
Course Code: C0GEG6P1

Type of Course	Theory / Practical	Credits	Instruction hour/week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
SEC	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**10**	**40**	**50**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: To know about the various Principles of Geophysical techniques.

CO2: Will be able to apply the techniques of Gravity, Magnetic, Seismic and radioactive methods in the field.

List of the Expedients, each will have 4rs / Week (Minimum 12 experiments)

1. Basic principles of geophysical exploration.
2. Physical properties of minerals and rocks.
3. Gravity Method: Stable and unstable gravimeters, Worden, Lacoste and Romberg, Hartley Askania and Gulf gravimeters, field procedure and reduction of gravity data.
4. Magnetic Method: Fluxgate and Proton Precession magnetometers. Anomalies due to point pole and dipole, field practices and corrections.
5. Electrical Method: Elements of SP, IP and resistivity methods, Wenner and Schlumberger configurations. Methods of resistivity profiling and sounding, theory of images, Tagg's method of interpretation.
6. Seismic Method: Elementary principle of reflection and refraction methods, two layered reflection and refraction problems including inclined layer, fundamentals of conventional seismic instruments, fan shooting, profile shooting, continuous profiling and correlation methods of surveying.
7. Radiometric Method: Physical and geological principles of radiometric method, successive disintegrations equilibrium conditions, GM counter, scintillation counter and gamma ray spectrometer, radon measurements.
8. Basic principles of electromagnetic and GPR methods.

Suggested Readings:

1. Dobrin&Savit: Introduction to Geophysical Prospecting
2. Parasnis: Principle of Applied Geophysics
3. Telford et al: Applied Geophysics
4. Sharma: Geophysical Prospecting for Geologists and Engineers
5. Israel & Krebs: Nuclear Radiation in Geophysics.

B.Sc. programme: 2024-25

GENERAL PATTERN OF **THEORY** QUESTION COURSE FOR DSC/ EC

(80 marks for semester end Examination with 3 hrs duration)

Part-A

1. Question number 1-10 carries 2 marks each. : 20 marks

Part-B

2. Question number 11- 18 carries 05Marks each. Answer any 06 questions : 30 marks

Part-C

3. Question number 19-22 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 80 Marks

Note: Proportionate weight age shall be given to each unit based on number of hours Prescribed