GOVERNMENT ARTS COLLEGE (AUTONOMOUS)
COIMBATORE-641 018

Learning outcomes-based Curriculum Framework (LOCF) for

B.Sc. GEOLOGY

(Effective from Academic year 2021-2022)

DEPARTMENT OF GEOLOGY

MAY-2021

Preamble

Education is the key to development of any society. Role of higher education is crucial for securing right kind of employment and also to pursue further studies in best available world class institutes elsewhere within and outside India. Quality education in general and higher education in particular deserves high priority to enable the young and future generation of students to acquire skill, training and knowledge in order to enhance their thinking, creativity, comprehension and application abilities and prepare them to compete, succeed and excel globally. Sustained initiatives are required to reform the present higher education system for improving and upgrading the academic resources and learning environments by raising the quality of teaching and standards of achievements in learning outcomes across all undergraduate programs in science, humanities, commerce and professional streams of higher education including computer science.

Over the past decades the higher education system of our country has undergone substantial structural and functional changes resulting in both quantitative and qualitative development of the beneficiaries. Such changes have gained momentum with the introduction of Choice Based Credit System (CBCS) which further expects learning outcome-based curriculum in order to maximize the benefits of the newly designed curriculum. The learning outcome-based curriculum will definitely help the teachers of the discipline to visualize the curriculum more specifically in terms of the learning outcomes expected from the students at the end of the instructional process. It is pertinent to mention here that the purpose of education is to develop an integrated personality of the individual and the educational system provides all knowledge and skills to the learner for this.

Tamil Nadu State Council for Higher Education (TANSCHE) has formed the State Integrated Boards of Studies, which, with great diligence and expertise has devised the mandatory areas that have to be covered for three-year under graduation and two-year post graduation courses to realize the facilitation of the mobility of faculty and students from one university to another and to easily solve the problem of equivalence among courses. Great care has been taken so that these areas would take 75% of the course content and the remaining 25% can be decided by the individual institutions. The areas that must be covered by the student that are mandatory for earning the degree to have due value has been worked out so that the student will gain enough depth of knowledge in the subject concerned. 25% percent of the syllabus should be designed by the institutions, and the areas covered under this also must have a weight age of 25%. This gives the autonomous institution seamless liberty on every Board of Studies (BOS) to innovate and experiment, and more importantly, it is here that the institution devises appropriate strategies by which (i) to make creative and critical applications of what has been learnt in the mandatory components, and (ii) to meaningfully connect the learners to the career demands and expectations. It is essential that the theoretical subject knowledge of the students must be translated into practical hands-on experience.

One of the significant reforms in the undergraduate education is to introduce the Learning Outcomes-based Curriculum Framework (LOCF) which makes it student-centric, interactive and outcome-oriented with well-defined aims, objectives and goals to achieve. LOCF also aims at ensuring uniform education standard and content delivery across the country which will help the students to ensure similar quality of education irrespective of the institute and location. With initiatives of University Grants Commission (UGC) for nation-wide adoption and implementation of the LOCF for bachelor's programmes in colleges, universities and HEIs in general. A Core Expert Committee (CEC) was constituted to formulate the modalities for developing the LOCF in various subjects being taught in the undergraduate courses in sciences, humanities, commerce and professional courses. The CEC also constituted the Subject Expert Committees (SEC) in various subjects to prepare detailed guidelines for the LOCF in subjects concerned.

The key components of the planning and development of LOCF are given in terms of clear and unambiguous description of the Graduate Attributes (GA), Qualification Descriptors (QD), Program Learning Outcomes (PLO) and Course Learning Outcomes (CLO) to be achieved at the end of the successful completion of each undergraduate program to be offered by HEIs. The Qualification Descriptors (QD), Program Learning Outcomes (PLO) and the Course Learning Outcomes (CLO) were also finalized keeping the broad requirement of the programme in view. The LOCF also gives general guidelines for the Teaching Learning Process (TLP) corresponding to each component of theory, experiment, tutorials, projects and industrial / field visits to be followed in order to achieve the stated outcomes for each component. Finally, some suggestions for using various methods in the assessment and evaluation of learning levels of students are also made.

1. Introduction

Outcome based learning is the principle end of pedagogical transactions in higher education in today's world in the light of exponential changes brought about in science and technology, and the prevalent utilitarian world view of the society. Geology as a discipline falls within the special category of science with a multidisciplinary approach.

Academic model of Indian higher education has remained more or less the same for the past century and more. The entire higher education spectrum was divided into streams like Arts, Commerce, Science, Engineering, Medicine, Law, Agriculture etc. Each stream will select the student after the secondary education and provide three or four to five years of education so as to award a degree.

The academic world is increasingly a global village now. India will have to look at reforms of the academic world as well. In fact, Indian graduates will have to seek placements not at the national level but at the international level in future. The number of graduates will be far more than the number of jobs. However, the Indian graduates will be able to grab the international placements only when their academic background and skills will be suitable at the international level.

Many surveys and reviews have indicated that a large number of Indian graduates are not employable since they do not possess the skills that are needed in today's world. Neither the knowledge nor the skills are adequately provided through the current academic model of higher education.

In the Solar System amongst the terrestrial planet the Earth is the only living planet which has Lithosphere, oxygenated Atmosphere, Hydrosphere and the Biosphere. There is seamless interaction among these spheres. The Earth has hot interior and this very heat acts as the fuel to run the Earth engine. To understand how our planet works, at depth and at the surface, the ideas and principles of Biology, Chemistry, Physics, Mathematics and Geography are integrated in the exciting and stimulating studies which make up Earth Sciences. It is a fast-moving, diversifying, multidisciplinary field that ranges from understanding the Earths origin in the solar system, the evolution of hydrosphere and atmosphere as well as the earth's materials at the atomic level, through the geological processes that drive volcanoes and earthquakes, surface processes that shape landscapes and create the geological record, biological processes that build diversity and bring extinction, up to planetary-scale systems, such as plate tectonics, climate and the origins of life and ecosystems. The Earth Science takes us very close to the nature as this is basically a field Science. The geology program integrates field trips with classroom learning to give you the hands-on experience you need to succeed. These opportunities develop your technical skills using measuring instruments and laboratory equipment.

1.1 Course Structure – Types of Courses.

The following types of courses are offered under CBCS-LOCF:

a) **Core Courses (CC).** A core course is a compulsory discipline specific course. A student of Geology has to take 15 such Geology courses over six semesters.

b) **Elective Courses (EC).** An elective course is a course that is to be chosen from a specified set of courses. These courses are of two types. Which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

   i. **Discipline Specific Electives (DSE).** These are elective courses that provide advanced undergraduate training in specialised areas of Geology. A set of six semester-specific, courses of this kind are offered in the First through fourth semester of the Undergraduate programme, Geology.
   ii. **Project.** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project. Such a course is compulsory in sixth semester.
   iii. **Generic Electives (GE).** These courses, in disciplines other than Geology, are intended to broaden the training of a student in the Geology Undergraduate programme. A student of Geology will take one such course, offered by another department, in each of Semester's V to VI.

c) **Ability Enhancement Compulsory Course (AECC).** Two such courses are to be taken, one in Semester I (Environmental Studies) and one in Semester II (Value Education– Gandhian Thoughts).

d) **Skill Enhancement Course (SEC).** A student is to take one such course each in Semester III through Semester VI.

2. Learning outcomes-based approach to curricular planning:

2.1 Nature and extent of UG program in Geology:

The UG program in Geology builds on the basic Natural sciences if taught at the +2 level in all the schools in the country. Ideally, the +2 senior secondary school education should aim and achieve a sound grounding in understanding the basic concepts in Geosciences with sufficient content of topics from modern Geology and contemporary areas of exciting developments in geosciences to ignite the young minds. The curricula and syllabi should be framed and implemented in such a way that the basic connection between theory and experiment and its importance in understanding Geology should be apparent to the student. This is very critical in developing a scientific temperament and urge to innovate, create and discover in Geology.

The undergraduate program in Geology is presently being offered though the course designed for granting the following degree by various colleges and universities in India. The course is of three year duration spread over six semesters after the higher secondary (+2) level Science course; B.Sc. with Geology

2.2 Aims of UG program in Geology

The aims and objectives of our UG educational programs in sciences in general and Geology in particular should be structured to

a) Create the facilities and environment in all the educational institutions to introduce and consolidate the knowledge acquired at +2 level and to motivate and inspire the students to create deep interest in Geology, to develop broad and balanced knowledge and understanding of geological concepts, principles and theories of Stratigraphy, geological mapping, exploration of natural resources and understand Earth evolution.

b) Learn, design and perform experiments in the labs to demonstrate the concepts, principles and theories learned in the classrooms.

c) Develop the ability to apply the knowledge acquired in the classroom and laboratories to specific problems in theoretical and applied Geology.

d) Expose the student to the vast scope of Geosciences as a theoretical and experimental science with applications in solving most of the geogenic problems in nature spanning from disaster management, watershed management, water pollution, oil exploration and mining, etc.

e) Emphasize the need for integrating Geosciences as one of the most important branch of science for pursuing the interdisciplinary and multidisciplinary higher education and/or research in interdisciplinary and multidisciplinary areas.

f) To emphasize the importance of Geology as the most important discipline for sustaining the existing industries and establishing new ones to create job opportunities at all levels of employment.

In view of opening the new windows in higher education and research and opening job opportunities at all levels from technicians to innovator scientists and engineers, two undergraduate programs are offered in our universities and other higher education institutions (HEI) at the entry level of our higher education system.

3. Graduate Attributes in Geology

Some of the characteristic attributes of a graduate in Geology are

3.1 Education and Training

a) Provide training of the highest academic quality in Geosciences in a challenging and supportive learning environment.

b) Develop a systematic understanding of both core areas and advanced topics in the study of the Earth, its materials and structure, its history over 4600 million years, and the processes that have controlled its evolution as a planet by viewing Earth from new and challenging perspectives of time, space, process and pattern.

c) Develop the ability to evaluate primary evidence critically; and the conceptual understanding to present arguments and solutions based on primary data and theory.

d) Promote an appreciation of the limits to our present understanding of the Earth, its processes and the interactions between them.

e) Stimulate students to see Geology as a vital component of our culture, where science develops as informed curiosity about the Earth and Society's environment, promoting human development and sustainability through the search for energy sources, raw materials, water supplies, sites for safe waste disposal, and the mitigation of natural hazards.

f) Provide for student interaction with high-level scientific expertise and advanced equipment in an environment committed to scientific advance.

g) Develop skills in gathering and interpreting the geological and geophysical data used to gain this understanding and thereby equip students with the foundations for their professional careers or additional study.

h) Provide an excellent preparation for a career in professional practice in industrial or environmental Earth Sciences, research in Geosciences, and specialist areas of other physical and natural sciences.

i) Provide, through a strong transferable skills strand, graduates for non-Earth-science industries, commerce, public service and education, particularly those needing to be informed by the methodology of a broad range of physical and natural science.

3.2 Communication Skills:

a) Skills to communicate in written, numerical, graphical and verbal forms, in ways that are appropriate to different audiences and in different situations, ranging from scientific and industry reports, to group and individual oral presentations, and from blogs and outreach articles, to news articles and essays.

b) Formulate a coherent written, electronic or oral presentation on the basis of material gathered (e.g. textual, numerical, verbal, graphical) and organised independently on a given topic.

c) Express clearly ideas and arguments, both orally and in writing and in electronic media.

d) Use group discussions and joint seminar presentations to research and present work collaboratively; and Develop oral presentation and participation skills during seminars and group-work, and in written form through online e- learning tools, dissertations and essays.

3.3 Critical Thinking:

a) Acquire an understanding of the concept in geology and related disciplines and an ability to understand, integrate, and extend it so that all fundamental geological concepts are accessible.

b) Acquire, digest and critically evaluate scholarly arguments, the assumptions behind them, and their theoretical and empirical components.

3.4 Problem Solving:

a) Skills to recognise and articulate a problem and then apply appropriate conceptual frameworks and methods to solve it.

b) Emphasis is placed on larger, integrated problem-solving exercises, during which students are taught how to process complex data sets using a diverse range of skills and knowledge. This provides the foundation for student-led independent, but academically directed, project work.

3.5 Analytical Reasoning:

a) A broad knowledge base in geology and related disciplines and an ability to understand, integrate, and extend it so that all fundamental geological concepts are accessible. Knowledge of the fundamentals of chemistry, physics, biology and mathematics needed to provide insight into these Earth processes (with levels of expertise varying according to choices of more generalist or more specialist courses at honours level).

b) Competency in both field and laboratory skills, and in data analysis, interpretation and presentation that permit the successful pursuit of pure or applied problems in geology.

3.6 Research-Related Skills:

a) Develop a research design, which has an appropriate problem related to earth sciences but may incorporate some scientific methods, ability to plan and write a research paper.

b) Ability to process and interpret large, complex, datasets, to hypothesis set and test, and to function as a numerate, literate scientist able to prove insight and guidance related to real-world problems and issues.

c) Ability to apply knowledge and understanding to address familiar, unresolved and more open-ended problems.

d) Ability to collect, analyse, synthesise, summarise and inter-relate diverse processes and facts, to formulate and test hypotheses and reach conclusions.

3.7 Self and Time Management:

a) Time management skills are developed through interaction with the assessment process in all years: students must learn how to meet deadlines for submission of continuous assessment material and how to set aside appropriate time to prepare for end of year examinations.

b) Time management is integral to the student’s independent mapping project.

3.8 Team Work:

a) Ability to contribute effectively to team objectives and interact productively with others both in project-related settings and in meetings.
b) This is addressed through group exercises in all years of the Geology programme, including in-class presentations, group lab-sessions where students use research equipment, mock-industry presentations to panels of outside industry experts, and group fieldwork mini-projects.

3.9 Scientific Reasoning:

a) View the Earth from new and challenging perspectives of time, space, process and pattern.
b) Develop a systematic understanding of both core areas and advanced topics in the study of the Earth, its materials and structure, its history over 4600 million years, and the processes that have controlled its evolution as a planet.
c) Provide for student interaction with high-level scientific expertise and advanced equipment in an environment committed to scientific advance.
d) Develop the ability to evaluate primary evidence critically; and the conceptual understanding to present arguments and solutions based on primary data and theory.
e) Promote an appreciation of the limits to our present understanding of the Earth, its processes and the interactions between them.

3.10 Digital Literacy:

a) ability of advanced Word skills and advanced GIS, statistics, databases, spreadsheets, digital drawing through online workbooks and workshops
b) ability to use digital resources for presentations

3.11 Moral and Ethical Values:

a) The degree to which every student engages with these themes will vary but it is important that all think especially about ethical issues
b) Avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights, and adopting objectives, unbiased and truthful actions in all aspects of work.

3.12 Leadership Readiness:

a) Provide training of the highest academic quality in Earth Sciences in a challenging and supportive learning environment

b) Be accessible to those qualified at intake in a broad and diverse range of sciences.

c) Provide an excellent preparation for a career in professional practice in industrial or environmental Earth Sciences, research in Earth Sciences, and specialist areas of other physical and natural sciences.

d) Provide, through a strong transferable skills strand, graduates for non-Earth-science industries, commerce, public service and education, particularly those needing to be informed by the methodology of a broad range of physical and natural science.

3.13 Life-long Learning:

a) Ability to blend academic and practical skills

b) Ability to transfer such skills to other domains of one's life and work.

3.14 Global Competency:

a) After completing course in Geology, the student is expected to be fully knowledgeable about the subject and not only from the point of view of examination.

b) He/She will be ready to accept challenges and stand in competition at a national and global level.

4. Qualification descriptors for a UG programs in Geology

4.1 Qualification descriptors for a B.Sc. Geology

The qualification descriptors for the B.Sc. programme in Geology shall be five learning attributes such as understanding, use, communication, expansion, and application of subject knowledge with a clear understanding of one's location. This also involves an awareness on the students' part of differences pertaining to class, caste, gender, community, region, etc. in order that they can transcend these differences

with transparency of purpose and thought. The key qualification descriptor for B.Sc. Geology shall be clarity of communication as well as critical thinking and ethical awareness. Each Graduate in Geology should be able to:

- Demonstrate a coherent and systematic knowledge and understanding of the field of Geology making intelligible Geoscientific research frontiers and theoretical developments in this field in the global context. This would also include the student's ability to collect, analyse, synthesise, summarise and inter-relate diverse processes and facts, to formulate and test hypotheses and reach conclusions.
- Demonstrate the ability to identify and differentiate rocks, minerals, fossils, other Earth materials and Earth structures in the field, as hand specimens and using laboratory techniques including microscopy and spectroscopic analysis. Skill to observe and record original field and laboratory data and then apply these to evaluate and resolve geological and geotechnical problems.
- Demonstrate the ability to assemble and analyse incomplete and varied observational data and develop testable hypotheses, predictions or explanations from them. Skills to recognise associations between geological observations and then integrate them into their 3D and 4D (space-time) frameworks.
- Demonstrate the ability to share the results of academic and disciplinary learning through different forms of communication such as essays, dissertations, reports, findings, notes, etc. on different platforms of communication such as the classroom, conferences, seminars, workshops, the media and the internet.
- Ability to devise and carry out an independent field-based project, including the formulation and testing of hypotheses whilst in the process of carrying out the project. The integration of field-based, experimental and theoretical principles needed for the Earth Sciences.

The goal of the Geology undergraduate program is to equip students with the fundamental knowledge of the diverse fields of Geology (encompassing Geomorphology and Surface Processes, Hydrology & Low-Temperature Geochemistry, Sedimentology and Paleoecology, and Tectonics and Solid-Earth Processes). In addition, it is critical that students learn to think like a scientist and to apply the scientific method in their coursework and in their lives. The geology program integrates field trips with classroom learning to give you the hands-on experience you need to succeed. These opportunities develop your technical skills using measuring instruments and laboratory equipment. The skills have been split into two groups: skills needed by any science professional and skills specifically needed by geosciences professionals.

Critical Geosciences Skills

1. Make inferences about Earth systems from observations of the natural world
2. Readily solve problems, especially those requiring spatial and temporal interpretation
3. Work with uncertainty, non-uniqueness, incompleteness, ambiguity, and indirect observations
4. Integrate information from different disciplines and apply systems thinking
5. Have strong field skills
6. Have strong computational skills for managing and analysing multi-component datasets
7. Be able to collect, illustrate, and analyse spatial data
8. Critical Professional Scientist Skills
9. Think critically and problem-solve
10. Communicate effectively to scientists and non-scientists
11. Integrate information from different sources and continue to learn.

5. Programme Learning Outcomes relating to B. Sc. Courses in Geology

5.1 Program Learning Outcomes in B.Sc. Geology

The student graduating with the Degree B.Sc. Geology should:

- Acquire a solid base of knowledge in the science of geology as a whole as well as earth materials, earth history, sedimentation and Stratigraphy, deformational processes and structural features, and geomorphic processes and landforms.
- Know the geologic time scale and place important geologic events in a temporal framework
- Use compasses, survey instruments, and images in geological investigations
- Understand the pathways, fluxes, and influence of water and other fluids at Earth's surface and in the subsurface
- Interpret topographic maps and terrain models and create profiles

- Interpret geologic maps and construct cross sections from them
- Interpret geophysical measurements of subsurface properties
- Distinguish between various structural features and determine the types of stress responsible for their formation
- Describe and interpret types of surfacial deposits and landforms
- Apply principles of mathematics, chemistry, and physics to geologic problems
- Develop proficiency in conveying complex geologic concepts in clear, technically correct writing.
- Develop proficiency in oral communication of complex geologic concepts.
- Develop the aptitudes and dispositions necessary to help democratize society by obtaining and maintaining employment as a professional geologist.

6. Structure of BSc Geology Program,

PROGRAMME LEVEL OUTCOME

An undergraduate student of the programme of study in Geology should be able to

PLO 1- (KNOWLEDGE)

- Demonstrate physical and chemical properties of the lithosphere and hydrosphere
  (minerals, rocks, soils and water)
- Demonstrate competence in fundamental geological skills including mineral, rock and identification, interpretation of topographic maps, geological maps and various forms of imagery construction of geological maps and cross section, three Dimensional conceptualization and collection of organized field and laboratory data

PLO 2 - (UNDERSTANDING)

- Gain an understanding about the societal relevance of earth system.
- Develop perspective ideas of Earth.
- Analyze the society's most important problems such as energy, water and mineral resources, the environment, climate change and natural hazards like landslides, volcanoes, earthquakes and floods.

PLO 3- (SKILLS)

- Develop communication skill and drawing
- Learn basic concepts of GIS
- Familiarize with CAD
- Laboratory skills(surveying)

PLO 4 - (ATTITUDES)

- Be diligent to complete the work assigned
- Develop positive attitude towards science and technology
- Enrich cognitive, emotional and behavioural components

PLO 5 - (VALUES)

- Combine a distinctively historical and pragmatic observational approach in combination with exact analytical/experimental techniques using highly sophisticated computational and analytical devices.
- Gain full appreciation for the history of life.
- Learn the significance of challenges and political choices that a wait in the likely event of anthropogenically induced global climate change

PLO 6 - (CRITICAL THINKING)

- Make critical and inquiry in the geosciences including the ability together and evaluate peer reviewed literature, identify source and search plan to collect laboratory/field data and interpret research results.

PLO 7 - (TEAM WORK)

- Learn productively work in a team, develop bonding with fellow students and colleagues.
- Foster great connections and having a collection of hands and minds working together towards a common goal which leads to better ,more accurate results than solo work.

CURRICULLUM FRAMEWORK
Bachelor of Science: GEOLOGY
UNDER CHOICE BASED CREDIT SYSTEM (CBCS)

Part	Sub Code	Title of the Paper	Hrs (wk)	Internal (CA) Marks	External Marks	Total Marks	Ext– Min.	Total Pass Mark	Credits
Semester – I									
I	21TAM11L	**Part–I:**Language:Tamil I	6	50	50	100	20	40	3
II	21ENG12L	**Part–II:** English I	6	50	50	100	20	40	3
III	21BGI13C	**Core:** Physical Geology	6	50	50	100	20	40	4
III		**Core Practical I –** Structural Geology and Surveying							
III	21BGI14A	**Allied – 1:**Mathematics in Geology I	8	50	50	100	20	40	5
III	21BGI14A	**Allied – 1:** Allied Chemistry I	6	30	45	75	18	30	4
III		**Allied Practical :** Allied Chemistry Practical							
IV	21ENV1GE	Environmental Studies	2	50	50	100	20	40	2
Semester – II									

I	21TAM21L	**Part–I:** Language: Tamil-II	6	50	50	100	20	40	3
II	21ENG22L	**Part–II:** English- II	6	50	50	100	20	40	3
III	21BGI23C	**Core-2:** Geomorphology and Structural Geology	3	50	50	100	20	40	4
III	21BGI26P	**Core Practical II :** Structural Geology and Surveying	2	50	50	100	20	40	4
III	21BGI25A	**Allied -2 :** Mathematics in Geology II	8	50	50	100	20	40	5
III	21BGI25A	**Allied – 2:** Allied Chemistry II	6	30	45	75	18	30	4
III	21BGI25P	**Allied Practical :** Allied Chemistry Practical	2	25	25	50	10	20	2
IV	21BGI24S	**Skill Based Subject I:** Field Geology	3	50	50	100	20	40	3
IV	21VAL2GE	**Value Education-** Gandhian Thoughts	2	50	50	100	20	40	2
	Total								
Semester – III									
I	21TAM31L	**Part–I:**Language: Tamil III	6	50	50	100	20	40	3
II	21ENG32L	**Part–II:** English III	6	50	50	100	20	40	3
III	21BGI33C	**Core : 3** Paleontology	4	50	50	100	20	40	4

III	21BGI34C	**Core : 4** Geo-exploration	3	50	50	100	20	40	4
III		**Core Practical II –** Paleontology and Crystallography	2						
III	21BGI35A	**Allied-3:**Allied Physics I	6	30	45	75	18	30	4
III		**Allied Practical –** Allied Physics Practical 2							
IV	21BGI36S	**Skill Based Subject – II :** Remote Sensing	3	50	50	100	20	40	3
Semester – IV									
I	21TAM41L	**Part–I:**Language: Tamil IV	6	50	50	100	20	40	3
II	21ENG42L	**Part–II:** English IV	6	50	50	100	20	40	3
III	21BGI43C	**Core 5 :** Crystallography and Optical Mineralogy	4	50	50	100	20	40	4
III	21BGI44C	**Core 6 :** Coal and Petroleum Geology	4	50	50	100	20	40	4
IV	21BGI44A	**Allied - 4 :** Allied Physics- II	6	30	45	75	18	30	4
III	21BGI5P	**Core Practical- II :** Paleontology and Crystallography	2	50	50	100	20	40	4

IV	21BGI46P	**Allied Practical-** Allied Physics Practical	2	25	25	50	10	20	2
V	21EXA4GE	**@Extension Activities: NCC/NSS/SPORTS//YRC**	-	-	-	-	-	-	1
Semester – V									
III	21BGI51C	**Core 7 :** Stratigraphy and Indian Geology	5	50	50	100	20	40	4
III	21BGI52C	**Core 8 :** Igneous and Metamorphic petrology	5	50	50	100	20	40	4
III	21BGI53C	**Core 9 :** Mineralogy	5	50	50	100	20	40	4
III		**Core Practical III :** Mineralogy and Petrology							
		Project and viva-voce							
IV	21BGI54S	**Skill Based Subject – III :** Hydrogeology	5	50	50	100	20	40	3
IV	21BGI5EL	**Non-Major Elective Paper – I:** Geology and Natural Resource Management	2	50	50	100	20	40	2
Semester – VI									
III	21BGI61C	**Core 10 :** Sedimentary Petrology and Environmental Geology	5	50	50	100	20	40	4

III	21BGI62C	**Core 11 :** Economic Geology	5	50	50	100	20	40	4
III	21BGI63C	**Core 12 :** Mining Geology and Ore Dressing	5	50	50	100	20	40	4
III	21BGI64P	**Core Practical III :** Mineralogy and Petrology	6	50	50	100	20	40	4
III	21BGI65V	**Project &– Viva Voce**	2	50	50	100	20	40	15
IV	21BGI66S	**Skill Based Subject -IV:** Gemmology	5	50	50	100	20	40	3
IV	21BGI6EL	**Non-Major Elective Paper – II:** Geology and Natural Disaster Management	2	50	50	100	20	40	2
	Overall	**Total/Credits**				**3600**			**140**

Theory+ 2 hrs. Practical

****Allied Mathematics** will be taught to those who studied Mathematics in +2 level- 6hrs.

****Allied Chemistry** will be taught to those who studied Pure Science in +2level-6 hrs.

Year	Core	Subject Title	Semester	Subject Code	Hours/Week
2021-22 onwards	1	Physical Geology	I	21BGI13C	6

COURSE LEVEL OUTCOMES:

On successful completion of the course, the student will be able to

CO1: Illustrate the features of the planet, earth and its atmosphere

CO2: Explain the interior of the earth and summarize the various phenomena that helped to know more about earth

CO3: Analyze continental drift and plate tectonics and discuss the concept of sea floor spreading.

CO4: Recognize the natural disasters and familiar with prevention methods.

CO5: Demonstrate how the physical features of the earth are formed.

UNIT I: Introduction to Geology-Branches and applications of Geology. Solar System: Definition-A brief outline of: Planets-Satellites- Comets-Asteroid belt and asteroids– Meteorite- Kepler's Laws of Planetary Motion- Bode's Law. Origin of the Solar System: Planetesimal Model-Tidal Model-Nebular and Gas Cloud Models. Age of the Earth- Direct Methods- Introduction to radioactivity- Radioactive minerals- Radioactive decay and isotopes-Concept of half life - Parent and Daughter elements. Outline and application of: U-Pb method; K-Ar method; Rb-Sr method and C14method- Direct and indirect methods. Short account of Earth parameters: Outline of size, shape, rotation, revolution- Milankovitch cycle-perigee and apogee positions.

UNIT II : Interior of the Earth: Internal structure based on travel time of seismic waves: Structure and composition of Crust-Mantle-Core. Brief account of seismic boundaries and discontinuities- shadow zones-Earthquakes: Definition –Seismic waves: types-basic properties- generation of seismic waves in the earth. Richter's Scale- Location of Els : focus (hypocentre)– epicenter-Magnitude and intensity of Els_-brief introduction seismogram and seismograph- The causes of Els- The prediction of Els and remedial measures-A brief introduction of Seismic zones and Indian Els- Tsunamis & Seiche Waves: Definition-Types-Generation-Remedial measures.-brief outline of Indian Tsunamis.

UNIT III: Continental Drift: Definition- Evidences-Mechanisms-Wegener's and Taylor's idea of continental drift- Sea floor spreading: Definition -mechanism-evidences. Plate Tectonics: Concept of plate tectonics-Types of crustal plates-Major and Minor plates- plate movement and their causes-plate boundaries: convergent, divergent,& transform- Brief

account of features related to plate tectonics- Island Arcs-Folded Mountain chains-Subduction zones- Trenches-Rift and ramp valleys- Ring of Fire-A Short account of volcanic and earthquake belts as related to plate tectonics. Orogeny and epiorogeny, origin and evolution of oceans, geo synclines- Profiles of continental margin.

UNIT IV: Volcanoes: Definition of volcano and lava-Types of volcanoes- Volcanic products-Causes of Volcanism- Styles and types of volcanic eruption- Prediction of volcanic eruptions-Volcanic landforms: craters- lava flows- pillow lava -domes- columnar lava structures- Distribution of volcanoes- Examples of Indian volcanoes. Atmosphere: Definition- vertical extent- layers- composition- temperature variation- generation of wind on earth's surface- Mountains: Definition of Mountain- Types and classification of Mountains-Origin of Mountains- Distribution of mountains in Indian sub continent. Isostasy: Concept of Isostasy- Models of Isostasy: Airy's model- Pratt's model- submarine topography- features, principles of geodesy –neo tectonics , mid oceanic ridges

UNIT V: Plateaus and plains: Definition- characteristics and types of plateaus and plains-Short account of Deccan Plateau- Weathering : Definition-processes: erosion- transport–deposition-Agents and types of weathering-physical, chemical and biological factor affecting weathering- Outline of products of weathering: sediments-soil–regolith-Rivers: Definition-origin- types of streams- stages of rivers- deltas and alluvial fans. Lakes: Definition- Types of Lakes- Formation of Lakes- Paleo-magnetism and its application- Raised beach, river terraces, river meandering.

PEDAGOGY STRATEGIES

- ❖ Power point slide presentations and animated videos
- ❖ Assignments
- ❖ Quiz
- ❖ Group discussion
- ❖ Board and chalk lecture
- ❖ Online and offline class practical and demonstration

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1. Mahapatra,G.P Physical Geology, CBS Publishers, New Delhi(1994).
2. HoImes.A & P.LDuft. (1996) Principles of Physical Geology, 4 *revised edition, ELBS, (1996)

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1. Emiliani.C, Planet Earth, Cambridge University Press, Delhi (1992)
2. Porter,S.C. &B.J. Skinner, The Dynamic Earth, John Wiley &Sons, New York(1995)

3. Leet,D &Judson, Physical Geology, McGraw Hill. New Jersey(1992)
4. Zumberge.J, Physical Geology, Freeman, New York.(1980)
5. Patwardhan,A.M., Dynamic Earth System, Prentice Hall, New Delhi(1999)
6. Das gupta, A.B. Physical Geography, CBS PubIishers, Delhi(1978)
7. Mukherjee A.K, Principles of Geology, EW Press, KoIkata(1990)
8. Reed, J.S. &T.H. Wicander, Essentials of Geology, McGraw Hill., New York(2005)
9. Mahapatra G.P ,Text book of Geology, CBS Publishers, New Delhi (1992)
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2. Science.com>science>geology>minerals and rocks.
3. www.qld.gov.au>land>soil.
4. www.closs,net>samples-chapters
5. Layturr,com>types of stream.
6. Geo.libretexts.org
7. www.nationalgeographic.org
8. Solarsysytem.nasa.gov
9. Science.nasa.gov

COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOMES

Program Level Outcomes (PLO)	**Course Level Outcome (CLO)**						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Knowledge	✓	✓		✓		✓	
Understanding		✓	✓		✓		✓
Skills		✓	✓	✓			✓
Attitudes	✓	✓			✓		✓
Values	✓		✓	✓		✓	
Critical Thinking			✓	✓	✓	✓	
Team Work	✓		✓		✓		✓

I SEMESTER

Year	Semester	Subject Code	Title of the paper	Hours/Week
2021 -2022 onwards	I	21ENV1GE	ENVIRONMENTAL STUDIES (For all UG courses)	2

COURSE LEARNING OUTCOMES:

On the successful completion of the course, students will be able to:

1. Recognize the role of the environment and the need to conserve it for sustaining life.
2. Enumerate the natural resources
3. Explores the adverse effects of deforestation and over exploitation of natural resources
4. Associate the components of the ecosystem and need for biodiversity conservation.
5. Evaluate the environmental pollution hazards and their effects on the living system.
6. Interpret the different disaster management procedures.
7. Analyse the climatic change and global effects
8. Infer the need for environmental laws in the constitution of India.
9. Relate the growth of the human population and its impact on the environment.

UNIT I: Environment – Introduction – Nature - Scope – Content – Need for study. Natural resources- Forest and energy resources - Use and overexploitation - deforestation. Energy resources- renewable and non-renewable energy resources.

UNIT II: Ecosystem – concept – types- Forest, Grassland, Desert and Aquatic (Pond)- Structure and function of an ecosystem – Producers- consumers and decomposers – Food chain – food web- ecological pyramids- energy flow. Biodiversity and its conservation- *in situ* and *ex situ* conservation- Mega biodiversity centres and hotspots.

UNIT III: Environmental pollution- definition- causes-effects and control measures of air, water, soil, thermal and nuclear pollution. Waste management- Industrial and solid waste. Disaster management – earthquake, cyclone, flood and landslides.

UNIT IV: Social Issues and the environment-Urbanization-Urban problems related to energy and watershed management. Environmental Ethics- Issues and possible solutions- Wasteland

reclamation- Climate change - causes and effects. Global warming- Acid rain- Ozone layer depletion- Public awareness. Environmental laws- Environment Protection Act, Wildlife Protection Act, Forest Conservation Act.

UNIT V: Human population and its impact on environment- Population growth- Resettlement and Rehabilitation of project affected persons- Case studies – Sardar Sarovar Project, Maharashtra and Bandipur National Park- Project Tiger, Karnataka, NTPC, India. Role of Indian and Global religions and Cultures in environmental conservation- Case study: sacred groves in Western Ghats (kavu) & Chinese culture. Human and Wildlife Conflict.

PEDAGOGY STRATEGIES

- ❖ Board and Chalk lectures
- ❖ PowerPoint slide presentations
- ❖ Assignments

Textbooks:

1. Sharma, P. D. 2000. Ecology & Environment. Rastogi Publications, Meerut, India.
2. Bharucha, E. 2003. Text book of Environmental Studies. UGC, New Delhi & Bharati Vidyapeeth Institute of Environmental Education and Research.
3. Arumugam, M. and Kumaresan, V. 2016. Environmental Studies (Tamil version). Saras Publications, Nagercoil.

Online/E-Resources:

- https://www.edx.org/course/subject/environmental-studies.
- https://www.coursera.org/courses?_facet_changed_=true&domains=life-sciences%2Cphysical-science-and-engineering%2Csocial-sciences&query=environmental%20science%20and%20sustainability&userQuery=environmental%20science%20and%20sustainability .
- https://www.open.edu/openlearn/nature-environment/free-courses.

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

Program Level Outcomes (PLO)	**Course Level Outcome (CLO)**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Disciplinary Knowledge		✓	✓		✓	✓			
Communication Skills		✓		✓				✓	✓
Critical Thinking	✓		✓		✓		✓		
Research related skills	✓		✓			✓		✓	
Analytical reasoning	✓			✓		✓		✓	
Problem Solving		✓	✓			✓			✓
Team Work				✓	✓		✓		✓
Moral and ethical awareness		✓		✓		✓		✓	✓

Year	Core	Subject Title	Semester	Subject Code	Subject Code
2021 -2022 onwards	2	Geomorphology and Structural Geology	II	21BGI23C	3

COURSE LEVEL OUTCOMES:

On successful completion of the course, student will be able to,

CO1: Identify the landforms and explore earth surface processes

CO2: Explain the impact of river landforms and discuss the large expansion of rivers during the present day of earth history.

CO3: Discuss landforms and their impact on earth.

CO4: Examine earth structures and learn to identify the rock

CO5: Experiment on rock joints and tilt, dip and plunge.

UNIT I: Concept of Geomorphology: Geomorphic cycles- A brief account of first, second order and third order landforms- Land forms created by Wind: Erosion and deflation: features produced by erosion and deflation-Abrasion- features produced by abrasion. Attrition: features produced by attrition. Transportation: suspension, saltation, and surface. Deposition: loess, sand deposits. Sand dunes and their types.

UNIT II: Land Forms created by rivers: Erosion processes, erosional features: Pot holes, Waterfalls, River valleys, Gorges, Canyons, Escarpments, Hogback, Cuesta, Pediments, Badlands. Transportation, Deposition: Depositional features: Alluvial fans and cones, Flood plains, Meanders, ox-bow lakes, River patterns, Drainage patterns .Outline of Rivers of India with special reference to TamilNadu. Land: Definition and sources of groundwater. Erosional features of groundwater: dolines, sink, caverns, solution valley, stylolite, depositional features: stalactites, stalagmites, siliceous inter and traverline, geode and concretionary structures.

UNIT III: Land Forms Created by Glaciers: Definition of glaciers, formation of glaciers, movement of glaciers. Types: Valley glaciers, piedmont glaciers, continental glaciers, Surface features of glaciers. Glacial action: Erosion: plucking, rasping, avalanche, erosional features produced by valley glaciers: Horn, hanging valleys, glacial boulders, glacial scars, fjords-Depositional Features produced by continental ice sheets: crescentic gorges; drumlin-.Land Forms Created by Ocean: Shore profile and shoreline development: continental shelf, continental slope, continental rise; Ocean floor-Marine erosion, Features formed by marine reefs deep sea deposits, abyssal deposits, polygenic sediments, volcanogenic sediments, outline of mid oceanic ridges.

Unit IV: Introduction and scope of Structural Geology. Cardinal directions of a compass-whole circle and quadrant. Magnetic and true North-Rock outcrops: definition, types of rocks- Orientation of rock outcrops: strike-trend. Tilto frock outcrops: Dip, apparent dip and plunge. Surficial structures of sedimentary beds: ripple marks, mud cracks, and rain imprints. Concordant bodies: Sills-Laccoliths- Lopoliths and Phacoliths- Discordant bodies: Dykes-Volcanic vents- Batholiths and stocks-Lava flows- Pillow lava structure.

UNIT V: Rock Joints: Definition-types- classification-outline of genesis. Definition of foliation and lineation .Faults: Definition and types fault -Horst and Graben- Criteria for recognition of faults in the field- Folds: Definition and Classification-Plunging of folds - Anticlinorium –Synclinorium- outliers and inliers-recognition of folds in the field and on the map.

PEDAGOGY STRATEGIES

- ❖ Group discussion
- ❖ Seminar
- ❖ Video show
- ❖ Chalk and Lecture technique

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1. Mahapatra G.B. Textbook of Physical Geology, CBS publications, Delhi(1994).
2. Radhakrishnan V, General Geology, V.V.P. Publications, Tuticorin(1996),
3. Bloom A., Principles of Geomorphology (1985).

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1. Worcester ,P.G.,A Text Book of Geomorphology, East West Press Ltd. Delhi.(1960)
2. Sathya Narayanaswami B.S. Structural Geology. Dhanpat Rai & Sons. New Delhi.(1994)
3. GokhaIe,N.W , Theory of Structural Geology, CBS, Delhi(1995)
4. Davis,G.H, Structural Geology of Rocks and Regions. Elements of Structural geology, Wiley(1985)
5. HiIIs E.S., Elements of Structural Geology, Chapman &Hall. London(1963)
6. Ragan D.M., Structural Geology-An Introduction to geometrical Techniques. Wiley. New York(2000)
7. Park,P.G, Foundations of Structural Geology, BIackie. London (1983).

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2. http://www.patnasciencecollege.org
3. https://geomorphology.org.uk
4. https://gradeup.co
5. https://www.nps.gov>subjects>gla
6. https://www.britannica.com
7. https://web.arc.losrios.edu

COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOMES

Program Level Outcomes (PLO)	Course Level Outcome (CLO)						
	1	2	3	4	5	6	7
Knowledge	✓	✓		✓		✓	
Understanding		✓	✓		✓		✓
Skills	✓		✓	✓		✓	
Attitudes		✓			✓	✓	✓
Values	✓		✓	✓			✓
Critical Thinking	✓	✓			✓	✓	
Team Work			✓		✓	✓	✓

Year	Skill based Subject	Subject Title	Semester	Subject Code	Subject Code
2021 -2022 onwards	1	Field Geology	II	21BGI24S	3

COURSE LEVEL OUTCOMES:

On successful completion of the course, the student will be able to

CO1: Investigate field with basic equipment using topographic maps

CO2: Demonstrate mapping techniques

CO3: Interpret to photographic maps

CO4: Identify the method of handling compass

CO5: Draw conclusions on GPS label and number specimens.

Unit I: Definition and scope of Field Geology – Prior planning– Basic equipments required for field work-Some field suggestions and precaution- Field work objectives and types of data collected-Introduction to topographic maps: parts, symbols and other information. Basic concepts: relief, contours, slope, gradients, profiles and sections- Interpretation of topographic maps. Base map preparation and map scale.

Unit II: Rock outcrops and their surfacial expressions. Basic concepts: strike, dip, apparent dip and rock trends- Introduction to the outcrop features used in mapping: foliations, lineations, bedding, and lithological contacts. Geological mapping: Traverse methods: Compass and Contact traverse.

Unit III: Field Equipments- Clinometer compass: different parts and their functions. Handling of the compass- determination of; 'bearings–advantages and limitations- Brunton Compass: different parts and their functions– determination of bearings– advantages and limitations- Brief account of the utility of Prismatic Compass and Plane Table in mapping.

Unit IV: Use of Aerial Photographs in geological mapping–Structural mapping– Stratigraphic mapping methods-outline of mapping methodology for igneous terrain, sedimentary terrain and metamorphic terrain- Methods of mapping in areas with sparse outcrops- Applications of GPS in field geology.

Unit V: Field geological report preparation. Geological and topographic map symbols- Brief introduction of field indicators used in geological mapping: geomorphological, weathering, mineral composition and petrography. Geological materials: types of samples–mineral, ore,

fossil, rock-Methods of sampling- care and packing of samples in the field- outline of preparation of thin sections of geological samples.

PEDAGOGY STRATEGIES

- Demonstration technique
- Conducting Practical sessions
- Chalk and lecture
- Group discussion

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1. Compton, R.R, Geology in the Field, John Wiley &Sons Inc., New Delhi(1985)
2. Lahee F, Field Geology, CBS Publishers, New Delhi (1987).

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1. Compton, R.R., Manual of Field Geology. 2nd ed., New York, Wiley(1966)
2. Mathur.S.M. Guide to Field Geology. Prentice Hall India. New Delhi (2001)
3. Coe.A.L, Geological Field Techniques Open University Press,
4. Milton Keynes, UK (2010)
5. Barnes J.W, Basic Geological Mapping. John Wiley& Sons Inc., New Delhi(2004)
6. Freeman T, Procedures in Field Geology. John Wiley& Sons Inc., New Delhi (1999)
7. Mc Clay K.R, The Mapping of Geological Structures, 2nded., John Wiley& Sons
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9. Gokhale N.W, A Guide to Field Geology. CBS Publishers, New Delhi(2001).

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3. https//www.tandfonline.com>
4. https//www.encyclopedia.com>
5. https://link.spring.com
6. https://www.usgs.gov

COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOMES

Program Level Outcomes (PLO)	Course Level Outcome (CLO)						
	1	2	3	4	5	6	7
Knowledge	✓	✓		✓		✓	
Understanding		✓	✓		✓		✓
Skills	✓		✓		✓	✓	
Attitudes		✓		✓	✓		✓
Values	✓		✓		✓	✓	
Critical Thinking		✓		✓		✓	✓
Team Work	✓		✓		✓		✓

SEMESTER II

Year	Subject Title	Semester	Sub Code
2021 -22 Onwards	**VALUE EDUCATION – GANDHIAN THOUGHTS(For all UG courses)**	**II**	**21VAL2GE**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, student will be able to:

1. Interpret Gandhiji's experiments to his spiritual pursuits and search for purity, political activities through fasting protests, and even his role as an educator using diet and meals as teaching exercises.

2. Lead a life marked with humility and truthfulness and subsequent realization of the Truth as the purpose of human life.

3. Infer **lessons that are fundamental to living in harmony and social progress such as respect, empathy, equality, solidarity and** critical thinking.

4. Promote tolerance and understanding above and beyond our political, cultural and religious differences.

5. Create special emphasis on the defense of human rights, the protection of ethnic minorities

6. Emerge as responsible citizens with clear conviction to practice values and ethics in life.
7. Transform themselves to become good leaders.

8. Realize their role and contribution to the nation building.

UNIT I: Birth and Parentage - Childhood - At the High school - Stealing and Atonement - Glimpses of Religion - Gandhi's choice - Experiments in Dietetics - Acquaintance with Religions - The Great Exhibition.

UNIT II: The first case - Preparing for South Africa - same experiences - on the way to Pretoria – Coolie - Natal Indian Congress - Education of Children - Brahmacharya.

UNIT III: Simple life - The Boer war - Sanitary Reform and Famine Relief - Lord Curzon's Darbar - A month with Gokhale - Experiments in Earth and water treatment - Indian opinion - Coolie Locations or Ghettoes - The Black plague.

UNIT IV: The Magic spell of a Book - The Zulu Rebellion - The Birth of Satyagraha - More experiments in Dietetics - Kasturbai's Courage - Domestic Satyagraha- Fasting - Shanti Niketan - Woes of Third-Class passengers.

UNIT V: Kumbha mela - Lakshman Jhula - Founding of the Ashram - Abolition of Indentured Emigration - The Kheda Satyagraha - The Rowlatt Bills - Navajivan and young India - Congress Initiation - The Birth of Khadi.

TEXT BOOKS

1. M.K.GANDHI, “The Story of My Experiments with Truth”, An Autobiography Apple publishing International(P) Ltd, Chennai.
2. . மகாத்மா காந்தியின் சுயசரிதை - சத்தியசோதனை தமிழாக்கம் - -ரா.வேங்கடராஜுலு, நவஜீவன் பரசுராலயம், அகமதாபாத

PEDAGOGY STRATEGIES

- Board and Chalk lecture
- Powerpoint slide presentations
- Seminar
- Assignments
- Quizes
- Group discussion

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)							
			1	2	3	4	5	6	7	8
Program Level Outcomes (PLO)	1	Reflective thinking	✓	✓			✓		✓	✓
	2	Communication skills		✓		✓	✓	✓	✓	✓
	3	Critical thinking	✓			✓		✓	✓	✓
	4	Multicultural competence				✓	✓	✓	✓	✓
	5	Analytical reasoning		✓	✓	✓		✓		
	6	Problem solving		✓	✓	✓		✓	✓	✓
	7	Team work	✓		✓		✓	✓	✓	
	8	Leadership readiness/qualities			✓		✓	✓		✓
	9	Moral and ethical awareness	✓		✓		✓	✓		✓

Year	Core Practical	Subject Title	Semester	Subject Code	Hours/ Week
2021 -2022 onwards	1	Structural Geology and Surveying	II	21BGI16P	3

COURSE LEVEL OUTCOMES:

On successful completion of the course, student will be able to

CO1: Discuss geological maps

CO2: Examine different types of mapping

CO3: Improve instrument handling skills

CO4: Analyze nature

CO5 : Appraise the environment

CO6: Measure the distance, angle with more accuracy

Unit I: GEOLOGICAL MAPS: Study of Topographical maps: Identification of landforms, structures such as fold, fault, unconformities and intrusions.

Unit II: Utility of Clinometer and Brunton Compass- Laboratory exercises in structural Geology maps: Contours-Completion of outcrops- Three point problems, Fold Maps. Faults.

Unit III: Maps, Unconformity maps. Complex maps with two structures such as fold and fault, fault and unconformity, etc. Preparation of cross sections across the geological maps to bring out the structure of the area, interpretation of structures, determining the order of superposition of beds and writing the geological history of the area.

Unit IV: Exercise on structural geology problems: Graphical Determination of Diping radient. Determination of true dip by simple calculation. Determination of thickness of a bed by calculation on a level ground.

Unit V: SURVEYING: Chain surveying: Open traverse, closed traverse, Prismatic Compass surveying: Determination of the distance between two inaccessible stations. Method of radiation and intersection- Plane table surveying: Determination of the distance between two inaccessible stations- Method of radiation and intersection- Levelling: Rise and fall method.

PRACTICAL/ASSIGNMENT:

- Accuracy in measurement is taught
- Safety precautions
- Group discussion

PEDAGOGY STRATEGIES

- Board and chalk lecture
- Demonstration classes
- Group discussion
- Field study

REFERENCES

1. A.M.Chandra, Plane Surveying, New Age International Publishers,2002.
2. N.N. Basak,Surveying and Levelling, Tata McGrawHill, 1994.
3. DevisR.E., Surveying theory and practices, Foot F.S
4. Gokhale, Manual of geological maps,2017

FURTHER READING

1. T.P. Kanetkarand S.V .Kulkarni, Surveying and Levelling Vol. I and Vol. II, Pune Vidyarthi Griha Prakashan 2006
2. Subramanian, Surveying and Levelling, Oxford University Press(2_{nd}edition)
3. Dr.B.C.Punmia, Ashok K. Jain , Arunk. ,Surveying Vol I and II
4. C.Venkatramaiah ,Textbook of Surveying ,University Press
5. John Uren and Bill Price, Surveying for Engineers, Palgrave Macmillan
6. S.K.Duggal, Surveying I and II, Tata Mc-Graw Hill
7. John G.Ramsay, Richard J.Lisle,Modern Structural geology2000.

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2. https://www.quora.com
3. https://open.umn.edu
4. https://www.geo.cornell.edu
5. https://www.sanfoundry.com

6. https://buildmyvocab.com

COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOMES

Program Level Outcomes (PLO)	Course Level Outcome (CLO)						
	1	2	3	4	5	6	7
Knowledge	✓	✓		✓		✓	
Understanding		✓	✓		✓		✓
Skills	✓		✓	✓		✓	
Attitudes		✓		✓	✓		✓
Values	✓		✓		✓	✓	
Critical Thinking		✓		✓		✓	✓
Team Work	✓		✓		✓		✓

Year	Core	Subject Title	Semester	Subject Code	Hours/ Week
2021 -2022 onwards	3	Palaeontology	III	21BGI33C	4

COURSE LEVEL OUTCOMES:

On successful completion of the course, the student will be able to

CO1: Discuss fossils and their preservation

CO2: Arrange the soft body animal and learn how they are formed into fossil and microfossils

CO3: Interpret the coral morphology and their Stratigraphy

CO4: Distinguish between the Stratigraphic and morphologic characters of fossils

CO5: Analyze vertebrate animal fossils and plant fossils.

Unit I: Definition of palaeontology- Outline of Geological time scale- Definition of Fossils- Modes of preservation of fossils: Unaltered hard parts, altered hard parts, petrification, premineralisation, carbonisation, crystallization, silifiation- Index fossil- Uses of fossils- .Outline of uses of microfossils- Phylum Porifera–Sponges- Phylum Brachiopoda: Morphological characters–classification–geological and stratigraphical importance.

Unit II: Phylum Mollusca: Pelecypods -morphological characters–classification– geological and stratigraphical importance-Gastropods- morphological characters– classification–geological and stratigraphical importance.

Unit III: Phylum Hemichordata: Class- Graptoloidea -Morphological characters –classification–geological and stratigraphical importance –Phylum Coelenterata: Class Anthozoa-Corals: Morphological characters–classification–geological and stratigraphical importance.

Unit IV: Phylum Echinodermata: Morphological characters– classification–geological and stratigraphical importance- Phylum Arthropoda: Class-Trilobita -Morphological characters–classification–geological and stratigraphical importance.

Unit-V: Vertebrate Paleontology: A short account on the classification of vertebrates- Introduction to Dinosaurs-Short account of Indian dinosaurs: Kotasaurus, Rajasaurus, Stegosaurus, and Ankylosaurus- Paleobotany: Classification of plant fossils–modes of preservation of plant fossils- Short account of Gondwana flora; Glossopteris, Gangamopteris, Calamites, Lepidodendron, Sigillaria and Ptilophyllum.

PEDAGOGY STRATEGIES

- Demonstration technique
- Field visit
- Conducting exhibition
- Group discussion

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1. Agashe, S.N, Paleo botany, Oxford & IBH. Delhi(1995)
2. Stewart W.N. & G.W. Roth well, Paleobotany, Cambridge University Press. D 2005)

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1. Black R.M, Elements of Paleontology, Oxford University Press. Oxford. UK (1972)
2. Easton W.H, Invertebrate Paleontology, Harper &Brothers. New York (1960)
3. Benton M.J, Vertebrate Paleontology, Wiley. New Delhi(1995)
4. Jain M.L. & P.C. Anantharaman, An Introduction to Paleontology, Vishal Publications (2017)
5. Sahni A, Dinosaurs of India. NBT. Delhi (2001)
6. Colbert E.H. et al.,Evolution of the Vertebrates, Wiley. New Delhi 2002)
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COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOMES

Program Level Outcomes (PLO)	Course Level Outcome (CLO)						
	1	2	3	4	5	6	7
Knowledge	✓	✓		✓		✓	
Understanding	✓		✓		✓		✓
Skills		✓	✓	✓		✓	
Attitudes	✓		✓	✓			✓
Values	✓	✓	✓			✓	
Critical Thinking		✓		✓	✓		✓
Team Work	✓		✓			✓	✓

Year	Core	Subject Title	Semester	Subject Code	Hours/ Week
2021 -2022 onwards	4	Geo-exploration	II	21BGI34C	3

COURSE LEVEL OUTCOMES:

On successful completion of the course, the student will be able to

CO1: Discuss Geological explorations

CO2: Analyze the geophysical exploration, methods and field procedures

CO3: Interpret geodesy of the earth

CO4: Explain magnetic prospecting

CO5: Describe the geochemical exploration.

UNIT I: Geological exploration: marginal information of toposheet and study of the field equipment. Pitting and trenching the ore bodies. An introduction to drilling –types and uses.

UNIT II: Geophysical Exploration: a concise account of limitations and application various geophysical exploration methods; principles, instruments, field procedures and interpretations of electrical methods–Self potential methods.

UNIT III: Geodesy of the earth. Newton's law and its application. The earth's gravitational field –gravity measuring instruments- Corrections& anomalies. Elastic properties of rocks.

UNIT IV: Basic concepts and principles of magnetic prospecting. Magnetism of the earth and palaeomagnetism-Magnetic Susceptibility of rocks. Principles of Radioactive decay, radioactivity of rocks and minerals-instruments, field procedure.

UNIT V: Geochemical exploration: Origin and abundance of geochemical elements in the earth's crust. Geochemical exploration for gold and copper. Application of geochemistry in mineral exploration studies.

PEDAGOGY STRATEGIES

- Board and chalk lecture

- Power point slide presentation
- Assignment
- Seminars
- Group discussion

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COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOMES

Program Level Outcomes (PLO)	Course Level Outcome (CLO)						
	1	2	3	4	5	6	7
Knowledge	✓		✓	✓		✓	
Understanding		✓		✓	✓		✓
Skills	✓		✓		✓		✓
Attitudes		✓		✓	✓		✓
Values	✓	✓		✓		✓	
Critical Thinking			✓		✓	✓	✓
Team Work	✓	✓				✓	✓

Year	Skill Based	Subject Title	Semester	Subject Code	Hours/ Week
2021 -2022 onwards	2	Remote sensing	III	21BGI36S	3

COURSE LEVEL OUTCOMES:

On successful completion of the course, the student will be able to

CO1: Explain remote sensing

CO2: Demonstrate the aerial photographs and how to utilize it constructively

CO3: Examine satellites, their working and applications

CO4: Discuss the satellites in India and the space missions.

CO5: Explore the minerals and groundwater

UNIT-I: Definition and scope of Remote Sensing in Geology-Electromagnetic spectrum – definition and components- outline of interaction of electromagnetic spectrum with atmosphere and earth surface features- spectral signatures-atmospheric windows.

UNIT-II: 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. Aerial remote sensing: Types of Aerial Photographs: vertical and oblique- Scale of aerial photographs- flight procedures-Stereoscopes: pocket and mirror stereoscopes.

UNIT-III: Photo interpretation elements. Mosaics: controlled and uncontrolled mosaics- advantage and disadvantages- application of mosaics in Geology studies- Image processing system - Satellite remote sensing: Principles of optical remote sensing: Satellite orbiting mechanisms- along track and across track scanning- Types of resolution- data acquisition and interpretation.

UNIT-IV: Thermal Remote Sensing: Thermal radiation principles- atmospheric windows- advantages and disadvantages- SLAR - principle and applications- A short account of LANDSAT, SPOT- History of space imaginary and recent satellite data.-Indian Remote Sensing satellites- Indian Space Mission**.**

UNIT-V: A short account of the remote sensing techniques in the study of drainage patterns, major landforms, geological structures-Groundwater exploration and mineral exploration-Basic principles of GIS: Component of GIS- Hardware and software module –Raster and vector data structures -Introduction of GPS- Application of GPS in geological studies.

PEDAGOGY STRATAGIES

- Demonstration
- Group Discussion
- Power point
- Field visit
- Presentation
- Seminar

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1. Curran P.B, Principles of Remote Sensing, ELBS. London(1985).
2. Sabins F.F, Remote Sensing Principles and Interpretation. Freeman. New
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4. Reddy A, Principles of Remote Sensing and GIS, CBS. Delhi(2010)

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COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOMES

Program Level Outcomes (PLO)	Course Level Outcome (CLO)						
	1	2	3	4	5	6	7
Knowledge	✓	✓		✓		✓	
Understanding	✓		✓		✓		✓
Skills		✓	✓	✓		✓	
Attitudes	✓	✓	✓			✓	
Values	✓			✓	✓		✓
Critical Thinking		✓		✓	✓		✓
Team Work	✓		✓			✓	✓

Year	Core	Subject Title	Semester	Subject Code	Hours/ Week
2021 -2022 onwards	5	Crystallography and Optical Mineralogy	III	21BGI43C	4

COURSE LEVELOUTCOMES:

On successful completion of the course, the student will be able to

CO1: Correlate the crystals with their internal forms

CO2: Infer the cubic and tetragonal type minerals in field

CO3: Distinguish the types of hexagonal, orthorhombic, monoclinic and triclinic types of minerals

CO4: Assess optical mineralogy and know about the microscope and its working

CO5: Identify minerals and their applications.

UNIT–I: CRYSTALLOGRAPHY: Definition of crystal and amorphous form-

Morphological characters of crystals: Faces-Forms-Edges-Solid angles-Interface angles-Contact Goniometer and its uses- Symmetry elements in crystals-Crystallographic axes and axial ratio– Parameters-Indices and symbols: Weiss and Miller system of notation- Laws of Crystallography: Law of constancy of interfacial angles-Law of Rational Indices. Classification of crystal systems- Study of holohedral, hemihedral, hemimorphic and enantiomorphous forms of crystals.

UNIT–II: 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- A brief outline of imperfection and irregularity in crystals.

Unit-III: 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-Twin crystals: Definition–evidence of twinning-laws of twinning-compositional plane, twinning plane and twin axis-twins: simple, repeated (polysynthetic twin), contact, and penetration twin and cyclic twin.

UNIT-IV: Optical mineralogy: Light: Corpuscular, electromagnetic and quantum theories. ordinary light and plane polarized light-Refractive index and its determination: Relief method, Becke line, central illumination and oblique illumination methods- Isotropism, isotropic minerals and isotropicray velocity surface-behaviour of light in isotropic minerals-petrological microscope and its parts-optical accessories and their uses: Quartz wedge, Gypsum plate and Mica plate-study of Isotropic minerals using the petrological microscope: properties of isotropic minerals under parallel Nicol conditions.

UNIT-V: Anisotropism and anisotropic minerals- behavior of ordinary light in uniaxial minerals: Double refraction- Indicatrix- Optic axes- Optic sign.- Nicol prism and its construction.- behaviour of polarized light in uniaxial minerals- Pleochroism, retardation, birefringence, extinction and interference colours in uniaxial minerals- study of Uniaxial minerals using the petrological microscope: under parallel(PN) and crossed Nicol(XN) conditions- Uniaxial interference figure- behaviour of ordinary light in biaxial minerals-behaviour of polarized light in biaxial minerals-study of Biaxial minerals using the petrological microscope: under PN and XN conditions. Biaxial Indicatrix- optic axes and optical axial angles – Trichroism -Biaxial interference figure-Michel Levi interference colour chart and orders of interference colour.

PEDAGOGY STRATEGIES

- Chalk and talk
- Group discussion
- Demonstration
- Seminar
- Power point presentation

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COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOMES

Program Level Outcomes (PLO)	Course Level Outcome (CLO)						
	1	2	3	4	5	6	7
Knowledge	✓	✓			✓	✓	
Understanding			✓	✓		✓	✓
Skills	✓	✓		✓	✓		
Attitudes			✓	✓		✓	✓
Values	✓	✓			✓	✓	
Critical Thinking		✓	✓	✓			✓
Team Work	✓		✓		✓	✓	

Year	Core	Subject Title	Semester	Subject Code	Hours/ Week
2021 -2022 onwards	6	Coal and Petroleum Geology	IV	21BGI44C	4

COURSE LEVEL OUTCOMES:

On successful completion of the course, the student will be able to

CO1: Distinguish Coal and Petroleum and their physical and chemical properties

CO2: Identify the distribution of Coal fields in India

CO3: Examine about the Petroleum and natural gas resources

CO4: Discuss the methods of drilling

CO5: Discriminate geotechnical order and duties of Well–site Geologist

UNIT–I: Geological basis of coal formation- physical and chemical properties of coal-Varieties and rank of coal-Development of coal facies -Types of deposition and diagenesis of coal-Sampling of coal.

UNIT–II: Coal bed methane and gas hydrates. Carbonization and gasification of coal-conservation of coal- distribution of Gondwana and tertiary coal fields in India -lignite deposits in India.

UNIT–III: Origin of petroleum and natural gas, source rocks and traps-physical and chemical properties of Petroleum-Migration and accumulation of oil and gas-Porosity and permeability of reservoir rock-Petroleum basins of India.

UNIT–IV: Introduction to drilling methods: types of drilling operation, designing of oil well. Downhole equipment: drilling rigs, its components and function- Drilling methods and equipments for directional, horizontal and multilateral wells-types of offshore drilling rigs.

UNIT–V: Duties of a well–site geologist- Geotechnical order-Mud logging- Archie's Formula – porosity, permeability, Preparation of composite logs - well completion , Enhanced oil recovery techniques- Gas hydrates and coal bed methane.

PEDAGOGY STRATEGIES

- Chalk and talk
- Group discussion
- Demonstration

- ❖ Seminar
- ❖ Power point presentation

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COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOMES

Program Level Outcomes (PLO)	Course Level Outcome (CLO)						
	1	2	3	4	5	6	7
Knowledge	✓		✓	✓		✓	
Understanding		✓	✓		✓		✓
Skills	✓		✓		✓	✓	
Attitudes		✓		✓	✓		✓
Values	✓		✓		✓	✓	
Critical Thinking	✓	✓		✓			✓
Team Work		✓	✓		✓	✓	

Year	Core Practical	Subject Title	Semester	Subject Code	Hours/ Week
2021 -2022 onwards	2	Palaeontology and Crystallography	IV	21BGI45P	2

COURSE LEVEL OUTCOMES:

On successful completion of the course, the student will be able to

CO1: Identify fossils

CO2: Compare animal and plant fossils

CO3: Discuss crystal systems

CO4: Operate instruments

CO5: Distinguish between monoclinic and triclinic system

CO6: Infer crystal structures

Unit–I: PALAEONTOLOGY: Identification of fossils on the basis of morphological characters. Fixing the biological position and range in the time of the following classes of fossils. Foraminifera: Texturalia,Quinqueloculine,Globigerina,Lagena,Nummulites. Porifera: Siphonia and Ventriculites. Pelecypods: Meretrix,Arca,Cardium,Cardita,Pecten,Venus, Unio,Pinna,Modiola,Lima,Inoceramus,Alectryonia,Gryphaea,Exogyra,Spondylus,Pentencull us,Radiolites,Trigonia. Gastropods: Turritella,Cerithium,Turbo,Trochus,Natica,Conus, Fusus,Physa,Busycon,Voluta,Murex,Bellerophon,Helix,Cyprea,Euomphalus.

Unit–II: Cephalopods:Orthoceras,Nautilus,Goniatites,Ceratites,Acanthoceras, Schloenbachia, Scaphites,Perisphinctes,Turrilites,Baculites,Belemnites. Brachiopods: Lingula,Spirifer, Productus,Terebratula,Rhynchonella,Pentamerus,Atrypa,Athyris. Corals: Calceola, Zaphrentis,Thecosmilia,Cyclolites,Favosites,Omphyma,Halysites,Lithostrotion. Echinoids: Echinus,Cidaris,Hemicidaris,Micraster,Holaster,Hemiaster,Stigmatophygus. Crinoidea: Enchinus,Apiocrinus,Pentacrinus. Blastoidea, Pentremites. Trilobites: Paradoxides, Calymene, Olenellus, Olenus, Asaphus, Trinucleus, Phacops. Graptolites: Monograptus, Rastrites, Diplograptus, Phyllograptus, Tetragraptus. Plantfossils: Glossopteris, Gangamoptris, Ptilophyllum, Lepidodentron, Sigillaria, Stigmaria, Calamites.

Unit –III: CRYSTALLOGRAPHY: Measurements of interfacial angle by using contact Goniometer. Stereographic projection exhibiting symmetry elements of normal classes of the six crystal systems. Study of Crystal Models: Determination of system and class on the basis of symmetry elements.

Unit -IV: Description of forms present and determination of Miller indices of the following crystal models. Cubic System: Galena, Garnet, Fluorite, Magnetite, Pyrite, Tetrahedrite, Boracite.TetragonalSystem:Zircon,Apophyllite,Rutile,Vesuvianite,Cassiterite,Octahedrite,Scheelite,Meionite,Chalcopyrite. Hexagonal System: Beryl, Zincite, Apatite, Hematite, Calcite, Corundum, Tourmaline, Phenacite, Alpha Quartz. Orthorhombic System: Barite, Olivine, Sulphur, Topaz, Staurolite, Calamine, Epsomite.

Unit -V: Monoclinic System: Gypsum, Augite, Orthoclase, Epidote, Hornblende. Triclinic System: Axinite, Albite, Anorthite, Kyanite, Rhodonite Study of Twin Crystal Models of the following Crystal Systems: Cubic: Spinel, Iron Cross twin. Tetragonal: Rutile, Zircon, Cassiterite. Hexagonal: Brazil law–Calcite, Quartz. Orthorhombic: Cuniform, Aragonite–Staurolite. Monoclinic: Mica, Orthoclase: Carlsbad, Manebach and Baveno type, Gypsum. Triclinic: Albite– Simple Twin.

PRACTICAL /ASSIGNMENTS:

- ❖ Error deduction
- ❖ Group Discussion

PEDAGOGY STRATEGIES

- ❖ Board and Chalk lecture
- ❖ Demonstration classes
- ❖ Group discussion
- ❖ Sample identification

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3. Ulrich Muller ,Symmetry relationship between crystal structures,2011
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COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOMES

Program Level Outcomes (PLO)	Course Level Outcome (CLO)						
	1	2	3	4	5	6	7
Knowledge	✓	✓	✓	✓			
Understanding		✓	✓		✓		✓
Skills	✓		✓	✓		✓	
Attitudes		✓		✓	✓		✓
Values	✓			✓		✓	✓
Critical Thinking		✓	✓		✓	✓	
Team Work	✓			✓	✓		✓

Year	Core	Subject Title	Semester	Subject Code	Hours/ Week
2021 -2022 onwards	7	Stratigraphy and Indian Geology	V	21BGI51C	6

COURSE LEVEL OUTCOMES:

On successful completion of the course, the student will be able to

CO1: Associate Stratigraphy and its nomenclature

CO2: Locate types of plains in India and understand the concept of structure, tectonics and physiographic divisions of India

CO3: Match Proterozoic and Palaeozoic group

CO4: Assess fossil content and mineral deposits.

CO5: Describe and classify the bed sand the outline of ice ages in India

UNIT-I: STRATIGRAPHY: Definition and scope of Stratigraphy- Principles and laws of Stratigraphy- Methods of Stratigraphic Correlation.–stratigraphic classification- Concept of homotaxial and contemporaneous formations-Stratigraphic Nomenclature: Lithostratigraphy- Biostratigraphy- Chronostratigraphy, Geological Time Scale and Standard Geological divisions- Imperfections in the Geological record.

UNIT—II: INDIAN GEOLOGY: Physiographic divisions of India. Structure and Tectonic divisions of India: Peninsular India, Extra-Peninsular India and Indo-Gangetic alluvial plains.–Arches of Eastern Ghats-The Saucer series-Study of Archaean Group: Dharwar system of Karnataka-mineral riches-Dharwar formations in TamilNadu.

UNIT-III: Study of the following geological formations of India: Proterozoic Group: Cuddapah System; Delhi System; Vindhyan System; Kurnool System. Palaeozoic Group: Palaeozoic of Spiti;Permo-Carboniferous of Salt Range-Age of Saline series, Upper Carboniferous and Permian rocks of Salt Range- Distribution of Palaeozoic rocks in India.

UNIT-IV: Study of the following geological formations of India: Gondwana Group: Classification-lithology-deposits-fossil content-climate- economic importance. Triassic of Spiti;-The lilang system- Jurassic of Kutch; Cretaceous of Trichinopoly and Narmada valley.

UNIT—V: 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.-Mineral wealth of tertiary group rocks in India-Karewa formation; Recent: Placer deposits of TamilNadu.- Rise of Himalayas.

PEDAGOGY STRATEGIES

- Group investigation
- Seminar
- Assignment
- PowerPoint presentation

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COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOMES

Program Level Outcomes (PLO)	Course Level Outcome (CLO)						
	1	2	3	4	5	6	7
Knowledge	✓		✓	✓		✓	
Understanding	✓	✓		✓	✓		
Skills		✓	✓			✓	✓
Attitudes	✓		✓	✓	✓		
Values		✓			✓	✓	✓
Critical Thinking		✓		✓	✓	✓	
Team Work	✓		✓	✓			✓

Year	Core	Subject Title	Semester	Subject Code	Hours/ Week
2021 -2022 onwards	8	Igneous and Metamorphic Petrology	V	21BGI52C	5

COURSE LEVEL OUTCOMES:

On successful completion of the course, the student will be able to

CO1: Correlate the origin of magma and its evolution

CO2: Classify and identify forms and structures of igneous rocks

CO3: Link petrogenesis of common igneous rock types

CO4: Discuss metamorphism and their grades.

CO5: Categorize Metasomatism and their important products

UNIT-I: Igneous Petrology-definition and scope-Magma: definition, composition and constituents of magma. Definition and description- Crystallinity:Crystallites and Microlites-Devitrification, Granularity-Crystallization of a unicomponent magma: Augite system. Crystallization of binary magma: Diopside –Anorthite system - simple eutectic. Albite-Anorthite system-solid solution series-Forsterite- Silica system- in congruent melting.-Crystallization of a ternary system: Diopside-Anorthite–Albite Bowen's Reaction Series. Mechanism and processes of magmatic differentiation.

UNIT-II: Field configurations of igneous rocks: intrusive forms and extrusive forms. Assimilation of host rocks by magmas. Classification of igneous rocks based on: mode of occurrence, silica and alumina saturation, chemical and mineralogical schemes and Tyrell's tabular classification. Megascopic classification –classification based on colour index- merits and defects of CIPW classification

UNIT-III: Textures and structures of igneous rocks-Outline of petrography of acid rocks, intermediate rocks and basic rocks-Stages of crystals, mutual relations- equigranular textures: allotriomorphic, hypidiomorphic, panidiomorphic. Inequigranular textures: porphyritic and intergrowth texture. Descriptive study of lamprophyre, carbonatite, anorthosites, dunite, pyroxenite and kimberlite. A short note on: consanguinity,kindred, petrographic provinces and periods- Short account of Harker’s variation diagram- Bowen’s reaction series – Magmatic differentiation: fractional crystallization liquid immiscibility, assimilation.

UNIT-IV: Metamorphic Petrology: Metamorphism: definition and scope. Agents and kinds of metamorphism. Metamorphic zones, facies 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- Contactor Thermal metamorphism of pelitic sediments and calcareous rocks-Cataclastic metamorphism and its products.

UNIT—V: Regional metamorphism of argillaceous, calcareous and impure calcareous rocks and their products-Injection metamorphism and auto metamorphism-Plutonic metamorphism and its products-Short notes: retrograde metamorphism, anatexis and palingenesis-descriptive petrography of the following metamorphic rocks; slate, phyllite, quartzite, schist, gneiss, migmatite, granulite, charnockite, amphibolite, eclogites, Hornfels, marble and skarn rocks.

PEDAGOGY STRATEGIES

- ❖ Chalk and talk lecture
- ❖ Group discussion
- ❖ Seminar
- ❖ Interaction
- ❖ Power point presentation

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COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOMES

Program Level Outcomes (PLO)	Course Level Outcome (CLO)						
	1	2	3	4	5	6	7
Knowledge	✓		✓	✓		✓	
Understanding	✓	✓			✓		✓
Skills	✓		✓	✓		✓	
Attitudes		✓			✓	✓	✓
Values			✓		✓	✓	✓
Critical Thinking	✓	✓		✓		✓	
Team Work		✓	✓		✓		✓

Year	Core	Subject Title	Semester	Subject Code	Hours/ Week
2021 -2022 onwards	9	Mineralogy	V	21BGI53C	5

COURSE LEVEL OUTCOMES:

On successful completion of the course, the student will be able to

CO1: Delineate the composition of rock sand in turn the earth's composition

CO2: Identify minerals, various properties or criteria applied like physical properties, chemical composition and optical properties of quartz group-feldspar group-feldspathoid

CO3: Distinguish between minerals and various properties

CO4: Organize and understand physical properties, chemical composition and optical properties of Mica group-garnet group- zeolite group

CO5: Compare and contrast various groups of minerals

UNIT-I: Definition of a mineral-Basic crystal chemistry-Minerals as ionic solids- bonding: types and general rules of bonding in minerals- ionization potential- electronegativity-Outline of silicate structures and ionic substitutions-Properties based on external appearance:-form-habit and state of aggregation–colour-lustre-diaphaneity- Properties based on crystal structure: hardness and tenacity-cleavage-fracture- parting. Properties based on taste-odour-tactile feeling-Specific gravity of minerals- Thermal, magnetic, and electrical properties of minerals-Radioactivity in minerals- Paramorphism, Pseudomorphism, Dimorphism, Isomorphism and polymorphism- Molecular and empirical formula of minerals.

UNIT-II: Physical, chemical, optical properties, association, mode of occurrences and uses of the following mineral groups: Quartz Group- Feldspar Group- Feldspathoid Group. Short note on twinning in feldspar.

UNIT-III: Physical, chemical, optical properties, association, mode of occurrences and uses of the following mineral groups: Pyroxene Group- Amphibole Group-Chlorite Group.

UNIT-IV: Physical, chemical, optical properties, association, mode of occurrences and uses of the following mineral groups: Mica Group- Garnet Group-Zeolite Group.

UNIT-V: Physical, chemical, optical properties, association, mode of occurrences and uses of the following mineral groups: Olivine Group- Epidote Group-Spinel Group. Descriptive study of the following minerals: Andalusite, Kyanite, sillimanite, Scapolite, apatite, tourmaline, cordierite, sphene, beryl, Rutile, and fluoride- Mineral wealth of TamilNadu,- Mineralogy mode of occurrences, uses and distribution of the minerals required for the following industries in India: Abrasives, Ceramic, Cement and paint.

PADEGOGY STRATEGIES

- Group discussion
- Demonstration
- PowerPoint presentation
- Interaction

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COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOMES

Program Level Outcomes (PLO)	Course Level Outcome (CLO)						
	1	2	3	4	5	6	7
Knowledge			✓	✓	✓		✓
Understanding	✓	✓		✓	✓		
Skills	✓	✓	✓			✓	
Attitudes	✓			✓	✓		✓
Values		✓	✓		✓		✓
Critical Thinking		✓	✓	✓		✓	
Team Work			✓	✓	✓		✓

Year	Skill Based	Subject Title	Semester	Subject Code	Hours/ Week
2021 -2022 onwards	3	Hydrogeology	V	21BGI54S	5

COURSE LEVEL OUTCOMES:

On successful completion of the course, the student will be able to

CO1: Identify the scope of hydrology and source of groundwater, porosity and their factors.

CO2: Tabulate yield and retention of water, Water spring and its types

CO3: Infer aquifers, types and layers

CO4: Explain groundwater exploration with advanced techniques and remote sensing.

CO5: Correlate physical and chemical relationship of groundwater

UNIT -I: Definition and scope of Hydrogeology. Concise account of the hydrologic and Hydrogeological cycle. Origin and sources of groundwater: meteoric water, connate water and juvenile water- Vertical distribution of groundwater and subsurface movement of groundwater-Rock properties affecting groundwater occurrence in rocks: porosity: primary and secondary, factors controlling porosity-Groundwater occurrence in igneous, sedimentary and metamorphic rocks.

UNIT- II: Specific yield and specific retention-Darcy's Law and its limitations- Laminar and turbulent flow- Permeability and permeameters- Coefficient of permeability-Water springs and their types.

UNIT-III: Aquifers: definition and types of aquifers: unconfined, confined, leaky and perched aquifers. Confining layers of aquifers: aquitard, aquifuge and aquiclude. Isotropic, anisotropic aquifers and layered aquifers. Aquifer properties: transmissivity, storativity and compressibility-Artesian wells-Types of wells and drilling methods.

UNIT- IV: Groundwater exploration: Outline of field geological, remote sensing, and resistivity methods-Outline of drilling techniques for groundwater- Artificial and natural recharge of groundwater- Brief account of rainwater harvesting- Fluctuations of groundwater levels- Stable isotopes in water cycle- Isotope effects in precipitation

UNIT–V: Groundwater Quality and Chemistry: Physical criteria of water quality. Chemical analyses of groundwater and units used-Groundwater problem in arid region and remediation- An introduction to groundwater pollution- Biological analysis of groundwater-

Outline of groundwater provinces of TamilNadu- Introduction to artificial recharge of ground water

PADEGOGY STRATEGIES

- Group discussions
- Demonstration
- PowerPoint Presentation
- Interaction
- Field visit

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COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOMES

Program Level Outcomes (PLO)	Course Level Outcome (CLO)						
	1	2	3	4	5	6	7
Knowledge		✓	✓		✓	✓	
Understanding	✓	✓		✓			✓
Skills	✓	✓		✓	✓		
Attitudes		✓		✓		✓	✓
Values	✓		✓		✓		✓
Critical Thinking			✓	✓		✓	✓
Team Work	✓		✓		✓		✓

Year	Non-Major Elective	Subject Title	Semester	Subject Code	Hours/ Week
2021 -2022 onwards	1	Geology and Natural Resources Management	V	21BGI5EL	2

COURSE LEVEL OUTCOMES:

On successful completion of the course, the student will be able to

CO1: Classify the natural resources and factors influencing resources

CO2: Examine Google maps on forest, land and water resources

CO3: Summarize the energy resources, food resources, fish and other marine resources

CO4: Correlate the mineral resources, resources management, paradigms, resources conflicts

CO5: Articulate the management of common international resources.

UNIT-I: Introduction to Geology and its relationship with Natural Resources: Concept of resource, classification of natural resources- Factors influencing resource availability, distribution and uses-Interrelationships among different types of natural resources- Concern on Productivity issues- Ecological, social and economic dimension of resource management. Prevention and mitigation damage from natural hazards and disasters.

UNIT-II: Forest resources: Status and distribution-Use and over-exploitation, Deforestation-Major effect of deforestation-Timber extraction, mining, dams and their effects on fore stand tribal people, forest management studies-Land resources: Land as a resource- Dry land, land use classification, land degradation, man induced landslides, soil erosion and desertification-Landscape impact analysis, wetland ecology &management-Water resources: Use and over-utilization of surface and groundwater, floods, drought, conflicts over water, dams-benefits and problems. Water ecology and management.

UNIT -III: Energy resources: Growing energy needs, renewable and non- renewable energy sources, use of alternate energy sources- Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer pesticide problems, water logging, salinity. Fish and other marine resources: Production, status, dependence on fish resource, unsustainable harvesting, issues and challenges for resource supply, new prospects-Problems associated with natural resources, energy strategies.

UNIT-IV: Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources- Metallic and non-metallic resources- Resource Management

Paradigms: Resource management- the evolution and history of resource management paradigms- Resource conflicts: Resource extraction, access and control system-Approaches in Resource Management: Ecological approach; economic approach; ethnological approach; implications of the approaches; integrated resource management strategies- Poverty in developing countries, causes and link with resources scarcity and poverty.

UNIT-V: Management of Common International Resources: Ocean, climate, atmosphere, polar regions- International fisheries and management commissions; Antarctica: the evolution of an international resource management regime-Applications of Geological Knowledge on Natural Resource Management

PADEGOGY STRATEGIES

- Group discussions
- Demonstration
- Power point presentation
- Interaction

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COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOMES

Program Level Outcomes (PLO)	Course Level Outcome (CLO)						
	1	2	3	4	5	6	7
Knowledge	✓		✓		✓		✓
Understanding	✓	✓			✓	✓	
Skills		✓	✓			✓	✓
Attitudes			✓	✓	✓	✓	
Values	✓	✓		✓			✓
Critical Thinking		✓	✓		✓	✓	
Team Work	✓		✓	✓			✓

Year	Core	Subject Title	Semester	Subject Code	Hours/ Week
2021 -2022 onwards	10	Sedimentary Petrology and Environmental Geology	VI	21BGI61C	5

COURSE LEVEL OUTCOMES:

On successful completion of the course, the student will be able to

CO1: Predict the types of sedimentary rocks and able to explain the textures of the sedimentary rocks.

CO2: Deduce the structures and learn the deposits of sedimentary rocks

CO3: Analyse and differentiate the sedimentary deposits of chemical and organic origin

CO4: Illustrate ecosystem, natural resources and ground water pollution

CO5: Delineate the impact of energy resources, coastal environment and enhance the outline of environmental law in India

UNIT-I: SEDIMENTARY PETROLOGY: Definition and scope of Sedimentary Petrology- Sedimentary rocks: definition, origin, disintegration and decomposition of rocks. Transportation and deposition of sediments- Textures of sedimentary rocks- clastic textures. Outline of sedimentary processes-Classification of sedimentary rocks: Tyrell's classification, Megascopic classification-Textures of sedimentary rocks.

UNIT-II: Outline of depositional sedimentary environments. Structures of sedimentary rocks- Sedimentary residual deposits: soils, regolith, laterite and terra Rosa - Sedimentary mechanical deposits- Outline of different sedimentary environments-Mechanical deposits rudaceous, arenaceous and argillaceous groups.

UNIT-III: Sedimentary deposits of chemical origin: evaporite, siliceous, carbonate, ferruginous and clay rich deposits-Sedimentary deposits of organic origin: calcareous, phosphatic, iron rich and silica rich deposits- Petrographic description of: conglomerate, Breccia, sandstone, shale and lime stones-A brief study of chert, gypsum, rock salt, siderite.

UNIT-IV: ENVIRONMENTAL GEOLOGY: Definition and scope of environmental geology. Definition of ecology. Different ecosystem. Classification and types of natural resources- Renewable and non-renewable resources- Impact of man on the environment. Geological factors in environmental health- Trace elements and human health-Chronic disease and geological environment- Environmental problems due to surface geological processes, cause, hazards and remedial measures relating to landslides, flood and soil erosion, impact of wind on environment.

UNIT-V: Energy resources: definition, types, renewable and non-renewable resources-Environmental impact due to mining and mineral processing and its remediation-Types of human generated waste and outline of methods of disposal-Outline of Environmental Law in India.

PADEGOGY STRATEGIES

- Group discussions
- Demonstration
- Power point presentation
- Interaction
- Field visit

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COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOMES

Program Level Outcomes (PLO)	Course Level Outcome (CLO)						
	1	2	3	4	5	6	7
Knowledge	✓	✓		✓	✓		
Understanding	✓		✓			✓	✓
Skills		✓	✓	✓		✓	
Attitudes	✓	✓		✓	✓		
Values	✓	✓	✓			✓	
Critical Thinking			✓	✓		✓	✓
Team Work	✓			✓	✓		✓

Year	Core	Subject Title	Semester	Subject Code	Hours/ Week
2021 -2022 onwards	11	Economic Geology	VI	21BGI62C	5

COURSE LEVEL OUTCOMES:

On successful completion of the course, the student will be able to

CO1: Outline the different facts and basic theory of palaeontology

CO2: Identify the control process of magma composition and composition of igneous rock

CO3: Evaluate the valuable minerals from hot waters

CO4: Exemplify the presence or absence of foliated metamorphic rocks in the earth history

CO5: Infer the most valuable pretty deposits which the industries depend on like Cu,Fe,Mn and Au

UNIT-I: 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 Bateman's scheme of classification of mineral Deposits-Outline of Metallogenic Epochs and Provinces.

UNIT-II: Processes of Ore Formation I:-Magmatic Concentration- Oxidation and Supergene Enrichment-Sublimation- Residual and Mechanical Concentration– Metamorphic-Metasomatism- Evaporation- Bactriogenic -hydrothermal process, supergene enrichment.

UNIT-III: 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 pigments. Magmatic process, supergene magmatic process and deposits dissemination, segregation and injection. Oxidation and sulphide enrichment-solution and deposition in the zone of oxidation. Gossans and capping

UNIT- IV: Brief account of ore textures and structures. Ore mineralogy, association, genesis, mode of occurrence and Indian distribution of the following metallic ore deposits: -Fe,Cu,Mn, Au and Mo, graphite,corundum, gypsum, magnetite, fluorite and wollastonite.

UNIT-V: Ore mineralogy, association, genesis, mode of occurrence and Indian distribution of the following metallic ore deposits:- Al, Pb& Zn,andCr-Mineral Economics:-Concept of strategic, critical and essential minerals-Demand and supply-Mineral conservation and substitution- Outline of National Mineral Policy and Mineral Concession Rules-Building stones:-definition-characters-classification-outline of Indian distribution-Short account of granite industry in Tamil Nadu.

PADEGOGY STRATEGIES

- Group discussions
- Demonstration
- Power point presentation
- Interaction
- Chalk and talk lectures

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COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOMES

Program Level Outcomes (PLO)	Course Level Outcome (CLO)						
	1	2	3	4	5	6	7
Knowledge	✓	✓		✓	✓		
Understanding	✓	✓			✓	✓	
Skills			✓	✓		✓	✓
Attitudes		✓		✓	✓	✓	
Values	✓		✓	✓			✓
Critical Thinking	✓	✓			✓	✓	
Team Work			✓		✓	✓	✓

Year	Core	Subject Title	Semester	Subject Code	Hours/ Week
2021 -2022 onwards	12	Mining Geology& Ore Dressing	VI	21BGI63C	5

COURSE LEVEL OUTCOMES:

On successful completion of the course, the student will be able to

CO1: Distinguish the methods and techniques used in breaking overburdened rocks.

CO2: Select the methods and equipment used in mining.

CO3: Summarize the formation of ores and sediments and clarify every steps

CO4: Detect the mineral ventilation, groundwater problems, modes of transportation and subsurface coal mining methods

CO5: Develop the skill of understanding the processes involved in Ore dressing and justify the techniques and equipment involved.

UNIT-I: Definition and scope of mining geology-Methods of breaking overburden and rocks: manual methods, mechanical methods and utility of explosives in mining- Sampling of mined materials: channel, grab, chip and bulk sampling-Sizing, pulverization and coning and quartering of samples- Drilling: definition and purpose- Drilling methods: rotary, percussion and diamond Auger drilling-Geological logging of borehole samples- Core samples and their preservation.

UNIT–II: Opencast mining methods: Parts of an opencast Mine: overburden, surface adit, bench, slope, drop-cut, over-break- Opencast mining equipment: bulldozer, frontend loader, poclain, drag line with bucket and wheel excavators- Strip mining and surface augering of coal bed sand seams- Quarrying method for hard rocks -Glory hole mining. A short note on explosive methods of breaking rocks.

UNIT–III: Alluvial mining of unconsolidated sediments and soft rocks- Hydraulic method-panning and sluicing of sediments- Dredging of offshore unconsolidated sediments-Subsurface and underground mining methods: Components of an underground mine: adit, shaft, level, cross cut, drift, tunnel, winze, raise, stope, and foot-wall and hanging wall-Mine sloping methods: open slope, level sloping, supported slopes, square set slopes, pillar supported slopes and shrinkage slopes.

UNIT–IV: Outline of subsurface mine ventilation- Groundwater problems and their management in opencast and underground mines- Modes of transportation of broken ore in opencast and underground mines-Subsurface coal mining methods: stope and pillar, long wall, room ground mines and pillar and caving.

UNIT–V: Ore Dressing: Definition and scope of ore dressing in mining. Properties of minerals used in ore beneficiation processes- Manual crushing of ores- Types of crushers: jaw, gyratory and cone types; Types of grinders: tumbling ballan, drop mills- Sizing and screening of crushed ores: purpose of screening, types of screens: outline of fixed types and moving types-Outline of ore classifiers-Concentration of ores by jigging, floatation and magnetic separation-Outline of flowcharts used in ore dressing.

PADEGOGY STRATEGIES

- Group discussions
- Demonstration
- Power point
- Presentation
- Interaction

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COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOMES

Program Level Outcomes (PLO)	Course Level Outcome (CLO)						
	1	2	3	4	5	6	7
Knowledge	✓	✓		✓	✓		
Understanding	✓	✓		✓	✓		
Skills			✓	✓		✓	✓
Attitudes		✓		✓	✓	✓	
Values	✓		✓	✓			✓
Critical Thinking	✓	✓			✓	✓	
Team Work			✓		✓	✓	✓

Year	Skill Based	Subject Title	Semester	Subject Code	Hours/ Week
2021 -2022 onwards	4	Gemmology	VI	21BGI66S	5

COURSE LEVEL OUTCOMES:

On successful completion of the course, the student will be able to

CO1: Appraise gem and understand about gemstone characters and desirable features

CO2: Classify gemstone in depth

CO3: Explore the techniques used in gemstone prospecting and processing of gemstones cutting and polishing

CO4: Infer the feasibility and economics of gemstones cutting and polishing industries in Tamil Nadu

CO5: Identify important gemstone provinces in India and the regulations relevant to gemstone in India

UNIT–I: Definition and scope of Gemmology-Minerals as gemstones-Classification of gemstones: gem minerals and other schemes- Characteristic and desirable features of gemstones- Weight standards used in gemmology and metal jewellery.

UNIT–II: Identification of Gemstones: Basic Megascopic and optical properties of gemstones- Gemstone testing equipment: Gemstone Refractometers, Polaroid films or plates-Gemstone microscope- Hardness testing kits-Heavy liquids, UV light, and Spectroscope methods- Gem stimulants, proxies and synthetic gemstones-their identification from natural gemstones.

UNIT–III: Introduction to exploration techniques used in gemstone prospecting-Host rocks for gemstone mineralization and gemstone deposits. Outline of gemstone extraction and mining from host rock- Processing of gemstones for cutting and polishing- Gemstone cutting: cutting instruments: Diamond saw.

UNIT–IV: Cutting and polishing techniques applied to different gemstones. Polishing equipment and instruments. Small scale gemstone cutting and polishing industries in TamilNadu. Feasibility and economics of gemstone related industries in India (with emphasis on TamilNadu).

UNIT –V: Outline of important gemstone provinces in India- Gemstone areas of TamilNadu: Karur Kangeyam belt, Sittampundi Area, Samalpatti Area, Pakkanadu Mulakkadu Area, and

Edappadi Area-Brief outline of mining regulations relevant to gemstone mining in India-Feasibility and economics of gem industries in India with special references to TamilNadu.

PADEGOGY STRATEGIES

- Group discussions
- Demonstration
- Power point presentation
- Interaction
- Chalk and talk lectures

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COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOMES

Program Level Outcomes (PLO)	Course Level Outcome (CLO)						
	1	2	3	4	5	6	7
Knowledge	✓		✓		✓		✓
Understanding	✓	✓			✓	✓	
Skills		✓	✓			✓	✓
Attitudes			✓	✓	✓	✓	
Values		✓	✓		✓	✓	
Critical Thinking	✓	✓		✓			✓
Team Work	✓		✓	✓			✓

Year	Non-Major Elective	Subject Title	Semester	Subject Code	Hours/ Week
2021 -2022 onwards	2	Geology and Natural Disaster Management	VI	21BGI6EL	2

COURSE LEVEL OUTCOMES:

On successful completion of the course, the student will be able to

CO1: Summarise management techniques about natural disasters

CO2: Delineate deforestation and landslide hazard due to ground water extraction

CO3: Identify the impact of natural hazards

CO4: Estimate the tangible and intangible losses

CO5: Interpret defending disaster management techniques during earthquake, Tsunami and cyclone

UNIT–I: Geology and its relationship with Natural Disasters: Natural hazards- Hydrological, atmospheric & geological hazards; earthquake: seismic waves, epicentre ; volcanoes: causes of volcanism, geographic distribution; floods: types and nature, frequency of flooding; landslides: causes and types of landslides, landslide analysis; drought: types of drought-meteorological, agricultural, hydrological and famine; Glacial Lake Outburst Floods(GLOF) ; tornadoes, cyclone & hurricanes; tsunamis: causes and location of tsunamis; coastal erosion-sea level changes and its impact on coastal areas and coastal zone management.

UNIT- II: Anthropogenic hazards –Impacts of anthropogenic activities such as rapid urbanization, injudicious groundwater extraction, sand mining from riverbank, deforestation, mangroves destruction; role of construction along riverbanks in elevating flood hazard; disturbing flood plains-Deforestation and landslide hazards associated with it; large scale developmental projects, like dams and nuclear reactors in hazard prone zones; nature and impact of accidents, wildfires and biophysical hazards-Man's influence on Earth's energy balance-Pollution- concept and definition-Acid rain, greenhouse effect, ozone depletion.

UNIT-III: Risk and vulnerability assessment, Concept of risk and vulnerability; two components of risk: likelihood and consequences, qualitative likelihood measurement index; categories of consequences (direct losses, indirect losses, tangible losses and intangible losses)-The essential strategic planning for emergency management for natural and man-made hazards.

UNIT-IV: Application of Geo-informatics in hazard, risk &vulnerability assessment. Concept of mitigation; types of mitigation: use of technologies in mitigations such as barrier, deflection and retention systems; importance of planning, exercise and training in

preparedness; role of public and media in hazard preparedness-Awareness conservation movement-education and training of disasters.

UNIT–V: Disaster management in India-Lessons from the past –considering the examples of Bhuj earthquake, tsunami disaster, and Bhopal tragedy; National Disaster Management Frame work, national response mechanism, role of government bodies such as NDMC and IMD; role of armed forces and media in disaster management; role of space technology in disaster management; case study of efficient disaster management during cyclone Phailin in 2013-The role of disaster mitigation institution- Meteorology, seismological, industrial safety inspection. -Different approach to disaster recovery, planning, prevention, and preparedness.

PEDEGOGY STRATEGIES

- Board and chalk lecture
- PowerPoint slide preparations
- Seminar
- Assignments
- Quiz competitions
- Group discussions

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2. Coppola D.P, Introduction to International Disaster Management, Butterworth Heinemann(2007)
3. Pine,J.C, Natural Hazards Analysis: Reducing the Impact of Disasters, CRC Press, Taylor and Francis Group(2009)

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COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOMES

Program Level Outcomes (PLO)	Course Level Outcome (CLO)						
	1	2	3	4	5	6	7
Knowledge	✓	✓		✓	✓		
Understanding	✓	✓		✓	✓		
Skills			✓	✓		✓	✓
Attitudes		✓		✓	✓	✓	
Values	✓		✓	✓			✓
Critical Thinking	✓	✓			✓	✓	
Team Work			✓		✓	✓	✓

Year	Core Practical	Subject Title	Semester	Subject Code	Hours/ Week
2021 -2022 onwards	3	Mineralogy and Petrology	VI	21BGI64P	6

COURSE LEVEL OUTCOMES:

On successful completion of the course, the student will be able to

CO1: Identify rocks and quartz crystal

CO2: Diagnose minerals

CO3: Distinguish between microscopy and megascopy

CO4: Outline Megascopic features of rocks

CO5: Explain spectrographic identification of rocks

CO6: Compare minerals and rocks

Unit–I: MINERALOGY: Megascopic Identification of rock forming silicate on the basis of their physical properties, chemical composition and determination of system of crystallization of the following groups of minerals:

Quartz Group: Rock Crystal, Blue quartz, Smoky quartz, Chalcedony, Opal, Agate, Flint, Jasper, Amethyst. Feldspars Group: Orthoclase, Microcline, Albite, Oligoclase, Labradorite, Anorthite, Perthite. Feldspathoid Group: Nepheline, Sodalite, Lazurite.

Pyroxene Group: Enstatite, Bronzite, Hypersthene, Augite, Diopside, Rhodonite, Wollastonite. Amphibole Group: Anthophylite, Actinolite, Tremolite, Hornblende, Glaoucophane.

Mica Group: Muscovite, Biotite, Phlogopite, Lepidolite, Vermiculite. Alumina Group: Kyanite, Sillimanite, Andalusite

Zeolite Group: Leucite, Natrolite, Apophyllite, Stilbite.

Miscellaneous Silicates: Olivine, Garnet, Beryl, Zircon, Cordierite Talc, Steatite, Kaolin, Topaz, Tourmaline. Non-Silicates: Apatite, Calcite, Dolomite, Fluorite.

Unit–II: MINERAL MICROSCOPY: Petrographic identification of mineral thin sections based on their crystallography and diagnostic optical properties.

Isometric Minerals: Garnet, Fluorite, Analcite, Spinel, Sodalite, Scapolite

Tetragonal Minerals: Zircon, Leucite, Apophyllite, Rutile.

Hexagonal Minerals: Quartz-basal and non-basal, Tourmaline, Calcite, Dolomite, Beryl, Corundum.

Orthorhombic Minerals: Olivine, Hypersthene, Cordierite, Andalusite, Sillimanite

Monoclinic Minerals: Staurolite, Orthoclase, Augite, Aegirine, Diopside, Spondumene, Muscovite, Biotite, Chlorite, Epidote, Hornblende, Sphene, Serpentine, Stilbite, Actinolite, Tremolite.

Triclinicminerals: Microline,Albite,Oligoclase,Andesine,Anorthite, Labrodorite, Kyanite.

Unit–III: Rock Megascopy: Megascopic identification of rocks based on petrographic characters, mineralogy and other diagnostic, Megascopic feature Igneous rocks

I. Acid igneous rocks: Granites, Graphic granite, Aplites, Pegmatite, Tourmaline Granite, Schorl rock, Pyroxene granite, Hornblende granite, Mica granite, Pink granite, Porphyritic granite, granodiorite. Intermediate Igneous Rocks: Syenites: Quartz syenite, Corundum syenite, Nepheline syenite, Perthitic syenite, Pyroxene Syenite, Hornblende syenite, Mica syenite, Porphyritic syenite, Diorite.

Basic Igneous rocks: Gabbro, norite, Dolerite

Ultra basic Igneous rocks: Anorthosite

Alkaline Igneous rocks: Lamprophyre, Carbonatite, Kimberlite

Volcanic Igneous Rocks: Basalts: Vesicular, Amygdaloidal, Vitrophyic basalt, Pitchstone, Scoria, Pumice, Obsidian, Rhyolite.

II. Metamorphic rocks

Regional Metamorphic Rocks: Slate and Porphyroblastic varieties; phyllite, Schist, Mica, Kyanite, Amphibole and talc. **Non- clastic rocks:** Limestone and its varieties, Flint, Chert

Coal: Peat, Lignite, Bituminous and Anthracite

UNIT IV: Rock Microscopy: Petrographic identification of rocks. Thin sections based on their Petrographic characters, mineralogy and diagnostic features

Igneous Rocks: Graphic granite, Aplite, Pegmatite, Tourmaline granite, Schorl rock, Hornblende granite, Mica granite, Pink granite, Porphyritic granite, Granodiorite, Quartz syenite, Nepheline syenite, Perthitic syenite, Pyroxene syenite, Hornblende syenite, Mica syenite, Porphyritic syenite, Diorite, Gabbro, Norite, Dolerite, Anorthosite, Dunite, Peridotite, Pyroxenite, Lamprophyre, Carbonatite, Kimberlite, Basalts: Vesicular, Amygdaloidal, Vitrophyric basalt. Pitchstone, Scoria, Pumice, Obsidian, Rhyolite, Rhyodacite, Trachyte, Phonolite.

UNIT V: Metamorphic Rocks: Slate, Phyllite, Schists, Mica, Kyanite, Amphibole and Talc.Gneisses: Banded, Garnetiferous, Injection type, Migmatite varieties, Amphibolite, Eclogite, Granulite, Charnockite, Khondalite, Gondite, Grodurite, Leptynite: Marble, Quartz, Skarn, Hornfels.

Sedimentary Rocks: Sandstone and its varieties, Breccias, Conglomerate, Shale, and its varieties, Grey wackes, Limestone and its varieties, Flint, Chert

PRACTICAL /ASSIGNMENT:

- Colouring the mineral and rock sections Group discussion

PEDAGOGY STRATEGIES

- Board and chalk lecture
- Demonstration classes
- Group discussion
- Rocks identification

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COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOMES

Program Level Outcomes (PLO)	Course Level Outcome (CLO)						
	1	2	3	4	5	6	7
Knowledge	✓	✓		✓	✓		
Understanding	✓	✓		✓	✓		
Skills			✓	✓		✓	✓
Attitudes		✓		✓	✓	✓	
Values	✓		✓	✓			✓
Critical Thinking	✓	✓			✓	✓	
Team Work			✓		✓	✓	✓

Year	Subject Title	Semester	Subject Code	Hours/ Week
2021 -2022 onwards	Project Viva-Voce	VI	21BGI65V	2

Objectives:

- To understand about the various research methods and its applications
- To familiarize about data collection, types, analysis, interpretation and report with suggestion

Write–up:general guidelines:

1. Introduction
2. Statement of the problem
3. Relevance of the study
4. Review of Literature
5. Aim and Objectives
6. Data and Tools
7. Methodology
8. Data arrangements, Analysis and Interpretation
9. Results and Discussion
10. Summary and Conclusions
11. References
12. Appendices

The total number of pages should be minimum of 60, including text, figures, tables, photographs, references and appendices.

The viva-voce presentation is with the help of equipment, which are available in the department.

7.Teaching Learning Methodologies

The teaching-learning process should be in-line with the course objective and outcomes. Teaching has to ensure that the suggested outcomes are ensured for each course and overall programme. Teaching-aids should be used wherever required to facilitate proper and impactful learning. Blended learning is recommended with the use of MOOC platforms and classroom teaching.

To meet the set objectives of the course and enable students achieve the expected outcomes of the course the teaching-learning process should be appropriately chosen. Though the teachers are best positioned to create innovative models suitable for teaching the course, certain well accepted and widely tested processes are suggested to achieve the desired outcomes.

CLASSROOM TEACHING – Regular classroom and face to face teaching and tutorials can be primarily used for imparting theoretical foundations of Information Technology. Applications of the same may be explained from time to time so that the student can appreciate the theory.

LABORATORY – Lab exercises in programming and usage of package/ software tools should be made mandatory and integral part. Open source software/Packages should be preferred over proprietary tools wherever available.

SEMINARS – Guest lectures and seminars involving industry experts and eminent teachers should be arranged to help the students understand the practices in the industry and developments in the field.

ASSIGNMENTS – Home assignments should be designed to make student collect information from various sources and solve unfamiliar problems and make comparisons of solutions.

PROJECT – The project in the final semester should be based on the student proposals keeping in mind that opportunity to demonstrate the knowledge and skills gained during the course. One-One mentoring support should be provided. Simulation - Packages to provide simulated environments to teach various components of networking and hardware working should be used wherever feasible.

8.Assessment Methods

Academic performance in various courses i.e., core, discipline electives, generic electives and skill enhancement courses are to be considered as parameters for assessing the achievement of students in Geology. A number of appropriate assessment methods of Geology will be used to determine the extent to which students demonstrate desired learning outcomes. Following assessment methodology should be adopted;

- The oral and written examinations (Scheduled and surprise tests),
- Closed-book tests,
- Problem-solving exercises,
- Practical assignments and laboratory reports,
- Observation of practical skills,
- Individual and group project reports,
- Efficient delivery using seminar presentations,
- *Viva voce* interviews are majorly adopted assessment methods for this curriculum.
- The computerized adaptive testing, literature surveys and evaluations, peers and self-assessment, outputs from individual and collaborative work are also other important approaches for assessment purposes.

QUESTION PAPER MODEL FOR UG SEMESTER

(CORE/ SBS / NME)

TIME: 2 Hrs. **Max.Marks:50**

PART-A

I. Choose the Best Answer. **(5x1=5)**

1.

2.

3.

4.

5.

II. Answer any three questions. (3x2=6)

Short Answers not exceeding 25 words each

6.

7.

8.

9.

10.

PART – B

Short Answers not exceeding 100 words each **(5x3=15)**

Answer all questions

11. a) or b)
12. a) or b)
13. a) or b)
14. a) or b)
15. a) or b)

PART –C

Answer any THREE questions not exceeding 750 words each **(3x8=24)**

16.

17.

18.

19.

20.

QUESTION PAPER MODEL FOR UG SEMESTER

(CORE/ SBS / NME)

TIME:2Hrs. **Max.Marks:50**

PART-A

I. Choose the best answer. **(5x1=5)**

1. A ball of mostly ice that moves around in outer space.

a) Comets b) Asteroids

c) Meteorites d) satellites

2. The Composition present in the continental crust.

a) SIAL b) SIMA

c) Mg, Al d) Al ,Fe

3. The plates move away from each other.

a) Convergent b) Divergent

c) Transformation d) Shear

4. An eruption driven by the heat from magma interacting with water.

a) Hydrothermal eruption b) Phreatic

c) Phreato magmatic d) Thermal eruption

5. Where is Deccan plateau exactly located in India?

a) Southern side b) northern side

c) Eastern side d) western side

II. Answer any three questions. **(3x2=6)**

Short answers not exceeding 25 words each

6. Define geodesy.
7. What is meant by hypocenter?
8. List the types of volcanoes.
9. Tell the difference between lava or magma?
10. Mention the agents of weathering.

PART – B

Short Answers not exceeding 100 words each **(5x3=15)**

Answer all questions

11. a) Elucidate the Branches of Geology.

Or

b) Explain Malankovitch cycle.

12. a) Write short notes on Tsunami

Or

b) Describe the Interior of the Earth

13. a) Discuss the Sea Floor Spreading

Or

b) Analyze about the Folded Mountain Chain

14. a) Classify the types of Volcanoes

Or

b) Categorize the mountain types.

15. a)Comment on Weathering and its agents.

Or

b) Summarize the types of streams.

PART –C

Answer any THREE questions not exceeding 750 words each (3x8=24)

16. Outline the salient features of Solar System.
17. Narrate the process of Earthquake
18. Sketch the concept of Plate Tectonics
19. Summarize the origin and types of lakes
20. Describe about Volcanoes.