GOVERNMENT ARTS COLLEGE
(AUTONOMOUS)
SALEM-636007

Re-accredited with B Grade by NAAC
[Recognized under 12B and 2F of UGC Act]
(Affiliated to Periyar University)

DEPARTMENT OF GEOLOGY

B Sc APPLIED GEOLOGY

Regulations and Syllabus

(Effective from the Academic Year 2021-2022)

1. CONDITIONS FOR ADMISSION

A candidate who has passed Higher Secondary Examination (Academic Stream – Science) conducted by the Department of School Education, Tamil Nadu or an examination equivalent to 10+2 course including CBSE, that is recognized and accepted by Periyar University, Salem – 11, is eligible for admission to the B.Sc. Applied Geology program. The candidates requesting admission shall have passed the qualifying examination with the mandatory subjects under **any one** of the following groups:

Group I : Maths, Physics, Chemistry and Computer Science.

Group II : Maths, Physics, Chemistry and Biology.

Group III : Physics, Chemistry, Botany and Zoology.

Along with the aforesaid conditions for admission of students, the latest (and program relevant) guidelines issued by the Department of Higher Education, Government of Tamil Nadu through the Directorate of Collegiate Education, Chennai – 6 shall be followed.

2. ATTENDANCE REQUIREMENT

Attendance for theory and practical classes are calculated separately. The attendance for theory classes shall be calculated on the basis of 90 days / 540 instructional hours per semester. For practical examinations the attendance for practical classes shall be calculated on the basis of 180 days / 1080 instructional hours by combining the consecutive odd and even semesters for that academic year. The attendance percentage and eligibility conditions for writing the semester examinations for all UG Programs are tabulated below:

Attendance %	**Category**	**Eligibility conditions for writing semester examinations**
75 and above	Eligible	Candidates are eligible to appear for the theory and practical semester examinations without condonation of attendance.
From 65 to 74	Condonation	The candidate shall be allowed to appear for both theory and practical examinations under the condition that the condonation fees have been paid for both theory and /or practical examinations (as applicable).A candidate who is absent for the theory and /or practical examinations after paying the condonation fees has to apply through proper channel to the Principal and COE for permission to reappear for their lapsed theory and (or) practical papers in the forthcoming semesters.
From 64 to 50	Below condonation	Candidates are NOT allowed to appear for the main semester examinations. He/she has to mandatorily pay the condonation and examination fees in the current semester. He/she may appear for the lapsed papers in the next or subsequent semester after getting the permission from the Principal & COE through proper channel. He/she may appear only for arrear examinations of previous semesters in the current semester provided they have recorded attendance above or within the condonation limits.

At 50 or below 50	Re – do or repeat	Candidates are NOT permitted to appear for the examination. Redo or repeat candidates have to apply through proper channel to the Principal and COE for permission to redo or repeat their lapsed semester. This re-do or repeat clause is bound by the conditions detailed in the Transitory Provision guidelines.

3. EXAMINATION

The maximum mark for each course is 100.The Theory Examinations shall be of three hours duration conducted at the end of each semester. The candidate failing to get the minimum marks required for passing in any theory course shall be permitted to reappear for each failed theory subject(s) in the subsequent semesters. The Practical Examinations shall be conducted at the end of even semesters with the duration of three hours. The candidate failing to get the minimum marks required for passing in any practical course shall be permitted to reappear for each failed practical in the subsequent even semesters only.

4. PASSING MINIMUM

The breakup of marks shall be:

<table>
<tr><td rowspan="2">Theory</td><td colspan="4">Continuous Internal Assessment (CIA)</td><td rowspan="2">Semester Theory Examination</td></tr>
<tr><td>Attendance [Either odd or even semester]</td><td>Assignment(s)</td><td>Test(s)</td><td>Total</td></tr>
<tr><td></td><td>5</td><td>10</td><td>10</td><td>25*</td><td>75**</td></tr>
<tr><td rowspan="4">Practical</td><td colspan="5">CIA & Main Practical Examinations</td></tr>
<tr><td>Attendance [Consecutive odd & even semester]</td><td>Practical Tests</td><td>Completion of Mandatory Field Training Program (full attendance on all days), submission of Field Report, and display of collected specimens</td><td>Total</td><td>Semester Practical Examination</td></tr>
<tr><td>5</td><td>10</td><td>25</td><td>40*</td><td>60***</td></tr>
<tr><td colspan="5">* No passing minimum; ** Passing minimum-30 in SE; *** Passing minimum-24 in SE</td></tr>
</table>

5. CONTINUOUS INTERNAL ASSESSMENT (CIA) - Attendance Component

Attendance marks for theory courses are as follows:

Attendance percentage	Marks
90 to 100	5
80 to 89	4
70 to 79	3
65 to 69	2
64 and below 64**	1
** Below condonation limit	

Attendance marks for practical courses are as follows:

Attendance percentage	Marks
90 to 100	5
80 to 89	4
70 to 79	3
65 to 69	2
64 and below 64**	1
** Below condonation limit	

Assignment Component

Three assignments (with maximum 5 marks for each) have to be submitted for each theory course. The marks of the best two assignments shall be normalized to 10 marks for the assignment component in CIA.

Test Component

Maximum marks for theory courses in test component is 10. The average marks of CIA Test 1, CIA Test 2, and Model Test mark will be normalized to 10 for each theory course.

Main Practical Component

The attendance marks for the Main Practical Exam shall be a maximum of 5 (combining the total attendance recorded in the consecutive odd and even semesters). A maximum of 10 marks will be awarded for the practical tests and model practical tests.

A maximum of 25 marks will be awarded for combined completion of Mandatory Field Training Program (all days), with the compulsory submission of Field Report, and display of collected specimens at the main practical examination. **Candidates who are absent for the mandatory field program will be awarded zero (0) marks. Candidates who are absent for one or more days for the mandatory field program will also be awarded zero (0) marks if**

they are unable to provide a factual and acceptable explanation of their absence and submit the same to the Field Coordinators and Head of Department.

Submission of practical record notebooks with proper ***bona fide*** certificate duly signed by the Staff in Charge prior to the Main practical examination is mandatory for the award for record notebook marks. Incomplete or forged record notebooks submitted for the main practical examination will be awarded zero (0) marks. Candidates who do not submit their record notebooks for the Main Practical Examination will be awarded zero (0) marks.

Revaluation

Revaluation of theory courses, re-totaling of marks, supplementary or instant examination, or transparency of Theory courses is **permitted** as per Government Arts College (Autonomous), Salem-7 Examination Guidelines. Candidates are required to apply to the Controller of the Examinations, through the Principal with proper endorsement and recommendation by the Head of the department concerned.

Revaluation of Practical courses, re-totaling of marks, supplementary or instant examination or transparency of Practical courses is NOT permitted as per Government Arts College (Autonomous), Salem-7 Examination Guidelines. The candidate has to apply and re-appear for the practical examination at the subsequent even semester only.

6. CLASSIFICATION OF SUCCESSFUL CANDIDATE

The performance of a student is represented by their earned Grade Points (GP), calculated Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA). A student is deemed to have completed a course successfully only after he/she has earned the requisite credits in the admitted program. The student is considered to have completed the program successfully only after he/she earns a **grade of C and above**.

GP = (Marks obtained in a course x Credit) / 10
GPA = Total Grade points earned in a semester/Total Credits registered in a semester
CGPA = Sum of Grade Points earned / Sum of Credits registered

Classification of Cumulative Grade Point Average (CGPA)

Grade	Cumulative Grade Points Average (CGPA)	Grade Description	Class Obtained	Range of Marks
O	9.0-10	**Outstanding**	**I CLASS WITH DISTINCTION**	90-100
E	8.0-8.9	**Excellent**		80-89
D	7.5-7.9	**Distinction**		75-79
A+	7.0-7.4	**Very Good**	**I CLASS**	70-74
A	6.0-6.9	**Good**		60-69

B	5.0-5.9	**Satisfactory**	**II CLASS**	50-59
C	4.0 to 4.9	**Average**	**III CLASS**	40 to 49
RA	4.0 and below 4.0	**Re-Appear**	NA	Less than 40

7. QUESTION PATTERN

The question pattern for **theory courses** shall be as follows:

Duration of examination: 3 Hours; Maximum Marks: 75

Part A: 15×1=15 Marks

Part A will consist of 15 Objective Type Questions or MCQs. All the question are to be answered. Three questions from each unit will be set. All the questions will carry equal marks. There is no internal choice. There is NO negative marking.

Part B: 2×5 = 10 Marks.

Part B will consist of five questions. Each question will be set with one question from each unit. Of the 5 questions, any two is to be attempted or answered. All the questions will carry equal marks. There is no internal choice.

Part C: 5×10 =50 Marks.

Part C will consist of five questions. Questions will be set with one question from each unit with internal choice. All the question are to be answered. All the questions will carry equal marks.

The question pattern for **practical courses** shall be as follows:

Duration of examination: 3 Hours; Maximum Marks: 60. The number of questions will vary with Practical and there is no internal choice. Maximum marks = 50 Marks; Submitted records = 10 Marks; **Total Marks = 60 Marks**

There is NO negative marking.

8. RANKING

Candidates who have passed all the examinations prescribed for the course **in the first appearance only are eligible for ranking**. A candidate who is **absent** for one or more courses in a semester examination and who later appears for the same course or courses in the subsequent semester examination **is NOT eligible for ranking** even though he/she has completed the course within two academic years / four semesters from his/her year of admission.

9. COMMENCEMENT OF THIS REGULATION

This regulation shall take effect from the academic year 2021-2022. The students admitted to the first year of UG program from 2021-2022 and thereafter shall follow these regulations.

10. TRANSITORY PROVISION

The regular duration for a candidate to complete the B.Sc Applied Geology program is **twelve consecutive semesters or six consecutive years from year of admission**. **Thereafter he/she will be permitted to appear for examination only under the syllabus and regulations then in force**. It is mandatory for the candidate to inform the Controller of Examinations and Principal and get written permission from them to appear for their arrear courses after the transitory provision has lapsed in their case.

11. ACADEMIC COUNCIL RATIFICATION AND APPROVAL

These guidelines and regulations will be effective from the academic year 2021-2022. Any changes to these guidelines and regulation will be subject to the ratification and written approval of the Academic Council. Any subsequent changes may be done by the BOS after written permission / communication from the Academic Council. The changes are to be put up with justification for ratification and written approval of the Academic Council. These guidelines and regulations are the property of Government Arts College (A), Salem 636007.

INTRODUCTION TO THE COURSE

Geology is a specialized discipline coming under the broad field of Earth Sciences and is literally translated as ‘the study of the earth’. It encompasses the study of the solid earth and its subdivisions, sometimes including related fields such as climatology, oceanography, pedology, planetary science, and others. Applied Geology draws concepts, natural laws, ideas, and applications from the basic sciences: chemistry, physics, mathematics and biology, hence its coverage is interdisciplinary in nature, application, and depth. A working knowledge of the basic sciences with some computer knowledge is essential for pursuing applied geology at the degree level and other geology related courses offered in some post graduate programs. The prospective

student opting for applied geology can know more about the subject from reliable online sources or by direct interaction with persons with a geological or geology related background. They may consult their Class Tutor prior to or after joining the course.

VISION & MISSION OF OUR GEOLOGY DEPARTMENT

About our Geology Department

Our Geology department was started in 1963 offering B.Sc Geology as a three year program. The two year M.Sc Geology program was later introduced in 1978. Both programs came under the non – semester system. Both programs were renamed as Applied Geology in 1997-98, after the affiliation changed from University of Madras to Periyar University. Our Department officially became a research department by offering M.Phil and PhD degrees from 2006-2007 based on the guidelines and framework issued by Periyar University. The Department has a museum with more than 1500 rock, mineral, and fossil specimens along with representative wooden and fiber glass crystal models. We have a separate laboratories for microscopy, survey, geochemistry & geophysics, and remote sensing. A library with more than 2500 books is available in our Department. Inflibnet and NLIST facilities are also available with their recommended e-books (texts and reference) in the library.

VISION

Our Geology Department objectively aims to constantly strive, achieve, and maintain a worthy and commendable position in the field of geological sciences. We endeavor to accomplish this in our students by imparting, disseminating, participating, and contributing knowledge, skills, and rational values with a local, national, and global perspective, to them.

MISSION

Our objectives are:

To provide, promote and sustain an enriching and transformative educational experience for our students with a strong foundation of basics and applied knowledge in the geological sciences. To promote relevant pedagogical and research practices within and outside the department to enable our students to think critically, visualize and synthesize ideas with originality and application. To impart and imbibe in them, necessary skills like problem-solving, communication, interpersonal, and leadership skills which they may transfer to their job or vocation that they wish to pursue. To engage actively with relevant stake holders and society in general, via participation, co-operation, and consultation outside the traditional borders of the department, locally, nationally, and globally.

Programme Educational Objectives (PEOs)

The following constitute the PEOs for the Bachelor of Science program in Applied Geology offered by the Department of Geology, Government Arts College (A), Salem – 636007. Applied Geology is the combination of pure geology courses with other courses which overlap with physics, chemistry, mathematics, computing, and engineering such as geophysics, geochemistry, geostatistics, mining geology, mineral exploration, remote sensing, engineering geology and others. Like Geology, Applied Geology is a field oriented programme with mandatory field training/internships throughout the duration of the course. The course offers a viable scope for job opportunities or consulting work in geology or options in non-geological fields, after the completion of the undergraduate degree. Progression to higher degrees is an

option for those who want to continue their education for which the higher degree qualification is eligible for relevant job opportunities.

PEO1	The Bachelor of Science program aims to provide to all prospective students a strong foundation combining a broad knowledge and practical skills, of the different courses in Applied Geology at the graduate level with reasonable scope for progression to higher degree programs or jobs relevant to the course.
PEO2	The student is introduced to the different components of the earth system including its composition, and operative processes active in the geological past and present in order to understand the different times scales of geological processes.
PEO3	The student acquires an in depth theoretical and relevant practical framework for understanding the nature and origin of different types of geological materials – rocks, minerals, fossils, and fluids.
PEO4	The student learns to understand and apply established fundamental scientific principles using relevant interdisciplinary skills in physics, chemistry, biology, mathematics, computing, engineering and others.
PEO5	The student learns to apply the knowledge of the different earth materials and related geological processes in geological mapping, mineral and fuel exploration, groundwater exploration, environmental assessments, natural disasters, mining geology, engineering geology and others.
PEO6	The student also learns to visualize, synthesize, apply and integrate field work observations with theory via practical knowledge and skills acquired in the class room and laboratory in order to describe natural geological processes.

Programme Specific Outcomes (PSOs)

As Applied Geology is partly interdisciplinary, the student is provided with courses which bridge both geology and other natural sciences as geophysics, geochemistry, remote sensing, palaeontology, and others. The broad course objectives and teaching methodology are outlined under the appropriate courses and papers. After the successful completion of the Bachelor of Science in Applied Geology program the student acquires the following programme specific outcomes (semester wise):

PSO1	In the **first semester**, students acquire knowledge in the fundamental concepts and components of Geology and Applied Geology and how they relate to one another. In the **second semester**, they are introduced to geomorphology and structural geology. The practical component for both semesters are geological maps and field surveying methods. The mandatory field programs for the first year emphasize geomorphology and structural geology. The student gains a working knowledge of different geomorphic features and geological structures in the field and map with emphasis of their origin and configuration. He/she can identify, interpret, and evaluate

	topographic and geological maps, terrain models, draw profiles and geological cross sections.
PSO2	In the **third semester**, students acquire knowledge in the fundamental concepts and components of paleontology. In the **fourth semester**, they are introduced to crystallography and optical mineralogy. The student gains a working knowledge of different fossil groups in the laboratory and field based on their megascopic characters and biostratigraphic age. Crystal models are studied and identified based on their morphology. Fuel geology and engineering geology are the skill based electives. The practical component for both semesters are crystallography and paleontology. The mandatory field programs for the second year emphasize paleontology and biostratigraphy.
PSO3	In the **fifth** semester, students acquire knowledge in the fundamental concepts and components of mineralogy, stratigraphy & Indian geology, igneous & metamorphic petrology, skilled based elective gemology, and four major based electives: exploration geology, marine geology, remote sensing, and mineral resources of Tamil Nadu. In the **sixth semester,** they are introduced to sedimentary petrology & environmental geology, economic geology, and mining geology, skilled based elective ore dressing, three major based electives: field geological techniques, mineral economics, and watershed management. The practical component for both semesters are mineralogy & petrology; and economic minerals, geochemistry & field geology. The student has an option of doing an individual/group project as a major based elective. The mandatory field programs for the final year emphasize petrology, mining, mineral deposits, and stratigraphy.
PSO4	The student gains a working knowledge of different mineral, rock, and ores in the laboratory and field based on their megascopic characters and geological significance. Compass techniques, identification of geomorphological and geological features on remote sensing images, and qualitative analysis of ores based on simple chemical tests in the geochemical laboratory are skills necessary in geological mapping.

Programme Outcomes (POs)

The student graduating with the degree of Bachelor of Science program in Applied Geology should be reasonably able to acquire a solid foundation with a working and transferable knowledge in the science of Applied Geology within and outside of its different courses. He/she should be able to:

PO1	Demonstrate a working knowledge of the terminology of geology, geophysics, geochemistry, and others, with a comprehensive understanding of the earth's interior, surface, resources, climate, biosphere, and the different methods used to study them.
PO2	Identify with confidence the different geomorphic features and geological structures in the field and map with emphasis of their origin and configuration.
PO3	Identify, interpret, synthesize and evaluate topographic and geological maps, terrain models, draw profiles and geological cross sections.
PO4	Identify with confidence the different minerals, rocks, ores, and fossils in the field or outcrop or

	laboratory, based on their megascopic and microscopic characters and natural crystals based on their morphology along with a working knowledge of their geological origin and significance.
PO5	Identify, interpret, visualize, synthesize and evaluate geophysical data, geochemical data, and remote sensing images.
PO6	Apply the relevant principles of chemistry, physics, mathematics, computing and engineering to varied geological problems.
PO7	Apply and handle Brunton and clinometer compasses, different surveying equipment, geophysical surveying equipment, remote sensing images, topographic maps, terrain models, and others in geological mapping, mineral exploration and other geological investigations.
PO8	Apply the acquired knowledge to mineral and fuel exploration, mine planning and mining geology, remote sensing geology and engineering geology.
PO9	Discuss with confidence the theories and principles for major processes, phenomena and observations within Applied Geology. Synthesize recorded observations, evidences and theory across different areas of earth and planetary science, recognising and explaining similarities and differences between different regions, times, planets and geological processes.
PO10	Develop proficiency in understanding and conveying complex geological ideas and concepts with clarity in written, online and oral communication and to develop positive values and aptitude necessary to obtain and maintain employment as a professional geologist or to further their education.

Graduate Attributes

Characteristic attributes relevant to a graduate in Applied Geology are:

Education and Training	To provide education and training of the highest quality in Applied Geology in a stimulating and supportive learning environment. This is to ensure and promote a deep and systematic understanding of core areas and advanced topics in the study of the Earth, and of its materials, structure, origin, history, along with the processes that have controlled its evolution as a planet. To perceive Applied Geology as an essential component of our culture, promoting human development and sustainability through the search for energy sources, raw materials, water supplies, sites for safe waste disposal, mitigation of natural hazards and others. To provide for student interaction with scientific expertise and advanced

	equipment to develop skills in gathering and interpreting the geological and geophysical data to equip students with the foundations for their professional careers or additional study. To confidently prepare for a career in professional practice in industrial or environmental sciences, research in Applied Geology, and specialist areas of other physical and natural sciences. To provide relevant transferable skills to graduates for non-Earth-science industries, commerce, public service and academics, particularly those needing to be informed by the methodology of a broad range of physical and natural science.
Communication Skills	To independently formulate and express clearly, ideas and arguments, both orally, in writing, presentations, and in other forms of electronic media of a given topic. To develop skills to communicate to different audiences and in different situations, ranging from scientific and industry reports, to group and individual oral presentations, blogs, outreach articles, news articles, online e-learning tools, dissertations and essays. To do research and present work as an individual or as a group member and to develop skills to participate actively in group discussions and seminar presentations.
Critical Thinking, Problem Solving & Analytical Reasoning	To develop the ability to understand and evaluate primary evidence critically; and to present arguments and solutions based on primary data and theory; and to advance the limits to our present knowledge of the Earth, its processes and their mutual interactions. To acquire an understanding of the concepts in applied geology and related disciplines with the ability to understand, visualize, synthesize, numerize, and extend it so that all fundamental geological concepts are accessible. To acquire, digest and critically evaluate scholarly arguments, the assumptions behind them, and their theoretical and empirical components. To apply knowledge of the fundamentals of chemistry, physics, biology and mathematics needed to provide insight into these Earth processes. To develop competency in both field and laboratory skills, and in data analysis, interpretation and presentation that lead to the successful pursuit of pure or applied problems in geology.
Scientific Reasoning & Research Related Skills	To develop a systematic understanding of both core areas and advanced topics in the study of the Earth, its materials and structure, and the processes that have controlled its evolution as a planet. To provide for student interaction with high-level scientific expertise and advanced equipment in an environment committed to scientific advance. To develop the ability to evaluate primary evidence critically; and the conceptual understanding to present arguments and solutions based on primary data and theory. To promote an appreciation of the limits to our present understanding of the Earth, its processes and the interactions between them. To acquire skills to recognize and articulate a problem and then apply appropriate conceptual frameworks and methods to solve it with emphasis placed on integrated problem-solving exercises, where students are taught on how to process complex data sets using a diverse range of skills and knowledge. This provides the foundation for student-led independent, with academically directed, project work. To develop the ability to apply knowledge and understanding to address familiar, unresolved and more open-

	ended problems along with the ability to choose and formulate an original problem topic based on the scientific method. This is subsequently followed by a rational plan of work to be done progressively or in stages. To develop the skill to process and interpret large and complex primary datasets with a set hypothesis and test, and to function as a numerate, literate scientist able to prove insight and guidance related to real-world problems and issues. To develop the skill to collect, analyze, synthesize, summarize and inter-relate diverse processes and facts, to formulate and test hypotheses, reach conclusions and publish the findings as a research paper.
Team Work	Ability to contribute effectively to team objectives and interact productively with others both in project-related settings and in meetings. This is addressed through group exercises in all years of the Applied Geology programme, including in-class presentations, group lab-sessions where students use research equipment, presentations to panels of outside industry experts, group fieldwork and mini-projects.
Self and Time Management & Digital Literacy	Active participation with the assessment process for the duration of the course orients a student to manage time for themselves to meet the mandatory course requirements. The student is encouraged to make ample time for understanding the taught materials, prepare their own notes, understand the idea of exam wiseness, revise and over learn prepared materials, practice problems with understanding and receive feedback to further their progress. A knowledge of study methods applicable to science and math is desirable. They are also encouraged to learn and plan on how to distribute their work through out the semester(s) to meet different course deadlines for submission of records, assignments, continuous assessment material, and all other course related work. They also need to prepare a working and flexible study plan or time table to confidently prepare for end of semester examinations. Participation in different extracurricular activities is encouraged and suggested to be planned and done without disturbing the normal routine of course work throughout the semester. Time management learned during students days are habit forming and transferable skills for future progression to higher studies or a job. Learning to code using python, ‘r’ language, perl, and others, to use them for their learning and project work is desired. These can be initiated via Swayam online courses and others recommended by the teachers. Acquirement of essential skills in word processing, GIS, statistics, databases, spreadsheets, digital drawing through online workbooks and workshops, and to use digital resources for presentations are useful.
Moral and Ethical Values & Leadership	The student is encouraged to follow ethical behavior by adopting objective, unbiased, and rational decisions in all aspects of their student life and future work. Undesirable practices like fabrication, falsification or misrepresentation of data, plagiarism, not adhering to intellectual property rights, are patently discouraged. Adherence to rational moral values is

	desirable in the long run and in all walks of life. Leadership qualities are learned by cooperation and active participation in different forms of group activities like field work, mini-projects, extracurricular activities, and others. Leadership qualities are learnt in the long run and are an extension of rational moral and ethical values.
Life-long Learning & Global Competency	After completing course in Applied Geology, the student is expected to be reasonably knowledgeable about the subject, able to think independently, gather relevant facts, discuss subject topics, and to apply practical skills learnt in the classroom/laboratory to actual field conditions with reasonable confidence. To progress to higher education or transition to a job after the successful completion of their course, students are encouraged to be a life long learner to keep him/her self up to date on their acquired knowledge and skills. The ability to synthesize academic and practical skills which are transferable to other domains of one's life and work is desirable for progress. He/She will be ready to accept challenges and stand in competition at a national and global level.

PREREQUISITES FOR A CAREER IN GEOLOGY

Geology and Applied Geology are primarily field oriented subjects. Geologists carry out field work in seasons followed by laboratory work and writing out scientific reports. Field work in academic course of study is limited as there are more theoretical and practical aspects to be understood prior to field training. The material learned in practical are realized in field work or some job related skill. In undergraduate geology or applied geology programs, students are exposed to places of geological importance in compulsory educational field programs. Intrinsic interest and understanding is improved and enhanced by applying class room topics to real field conditions. Seeing and understanding things at different angles with an inquiring mind are essential and need to be practiced. The following skills are imparted by pedagogy: methodological observation of geological features, practical application of a laboratory skill to field situations, visualization of hidden geological features and application of scientific method: method of deduction and induction to allow proper inference of results from collected and available field data. The taught skills are written as a report and submitted during practical exams for evaluation. To attain the above prerequisites a student must develop an intrinsic interest and motivation in their chosen field(s), involvement in the course by asking questions, getting

clarifications so as to understand basic concepts and principles thoroughly, and acquiring mastery over the relevant practical aspects.

CAREER PLANNING

Career planning is an important aspect of student life. Job openings today require some form of written test followed by an interview prior to appointment. Job options and openings regularly change depending on vacancies available, qualification, experience or training, and salary offered. Career planning involves goal setting: both long and short term. Long term goals lead to a career choice(s) and appointment, while short term goals allow continuous acquisition of necessary skills for the job: subject qualification and knowledge application in the future job, training, competency skills, soft skills, and prior preparation for different competitive exams. All career goals involve competition among peers, internal and external compulsions during the actual job search, salary range available, place and type of work, and others.

The student is advised to be aware of changing and new job related information regularly by proper and established avenues: newspapers, net based web content, official sources and others. Students should carefully plan their career goals so that they can be achieved by reasonable effort and hard work. Flexibility in planning is advised to accommodate changes in job prospects and vacancies. Changing job scenarios such as limited vacancies, over competition for limited posts, etc. should not discourage students with a rational career plan. Career plans must never underestimate or impede the student's potential for success.

Application and knowledge of interviewing skills along with demonstrated interest in one's own discipline is recommended. Today's job opportunities stress interpersonal skills, emotional and social intelligence skills (a part of soft skills) as a more reliable criterion than academic qualifications or intelligence. Ethical and job related values are imbibed in the rational values a person learns and uses throughout one's life. A demonstrated ability of discipline, hard work, and integrity, and a disinterest in irrational values are seen as exemplary reasons for appointment and are ably tested in all types of personality tests and interviews (including group discussions, psychological and psychometric tests). All students need to be aware of this.

The academic criterion should demonstrate depth of understanding and application of knowledge by disciplined hard work and effort which is a manifestation of rational values mentioned above. Students should not be fooled by unethical short term skills and shortcut methods. Planning one's career after completing the UG or PG degree is costly in terms of lost or wasted time and re-preparation for competitive exams. Students become disappointed when their skills and qualifications do not measure up to the real competition for limited jobs. Age is a factor for applying and there is always an age limit for recruitment to some job vacancies. This invariably results when students procrastinate and put off career planning still late after acquiring the PG degree. Hence career planning should be initiated and charted out early, i.e. before admission or in the final year of study and must be followed up till appointment.

Career planning should be flexible to changing job prospects and environment. Knowledge of competitive exams relevant to the chosen discipline is useful. Collecting relevant material such as old question papers, texts, syllabi, etc. of different competitive exams is suggested. The study schedule may be adjusted to incorporate preparation for competitive exams. The idea of exam wiseness is emphasized here also.

Career choices and information of most competitive exams can be obtained from their Tutors or Course Teachers. Discussing career goals with teachers, parents, and professionals will allow the student to chart the career choices and goals in his or her future. Acquiring job related and work related soft skills are essential in the long run. The job openings relevant to geological sciences require a first class PG degree and are mainly directed towards the mining industry, oil exploration companies, mineral exploration and geological mapping. Allied fields include: ground water management, remote sensing, seismology, engineering geology, and others. Career Options after B.Sc Degree in Applied Geology are listed as follows:

1. Progression to M.Sc Degree in Pure or Applied Geology.
2. UPSC & TNPSC job opportunities which require a UG degree as a prerequisite qualification.
3. BSRB and other Bank recruitment related opportunities (entrance test).
4. Employment (by clearing a written test and interview) in Public & Private Sector concerns: SAIL, TISCO, Reliance, and others.
5. Self employment: family business, agency, geological consultant, geological assistant, geology curator in museums.
6. MBA or MCA degree program admission through TANCET or CAT or XAT.
7. TOEFL, IELTS, and GRE for admission to foreign Universities.
8. Most jobs under TNPSC which require 10^{th} or 12^{th} standard qualification.
9. Diploma in Teacher Training.
10. Diploma courses in Computer Science.
11. General recruitment in LIC, IRS, RRB, and others.

STUDENT LIFE IN GENERAL

Student life should be intrinsically enjoyed in the proper and rational sense without any regrets or misgivings. **Interest in the chosen line or subject of study must be cultivated by knowing more about the career options and framing tangible and proper goals both long and short time by the student.** They should be free to search for proper and relevant information regarding their chosen field from established sources. Interest is sustained by regular study (work) with ample scope for enjoying student life. It is up to the student to decide and stick to his or her goals in life and see through it by diligent and proper follow up. Problems in study related activities are mainly due to lack of time management and life priorities, lack of information of chosen field, poor effort, disinterest in study, lack of future goals, laziness and procrastination, and poor intrinsic motivation. The student may seek counseling from their teachers and parents with concrete goals related to their future career and other study related matters at the earliest. Some books related to study methods, careers, and scholarships, are listed below:

1. Race, P. (1998). How to get a Good Degree. Viva Books Ltd. Chennai.
2. Barnes, R. (1992). Successful Study for Degrees. Routledge India Pvt. Ltd. New Delhi.

3. Barass, R. (2002). Study. Foundation Books India. New Delhi.

4. Albuquerque, U. (2005). Handbook of Careers: Volumes I & II. Penguin, New Delhi.

5. Anon. (2018). List of Scholarships: Indian & Foreign. SAP Publications. New Delhi.

DEPARTMENT OF GEOLOGY

COURSE STRUCTURE/CURRICULUM ABSTRACT FOR

BACHELOR OF SCIENCE IN APPLIED GEOLOGY 2021

Part	Category	No. of Courses	Total Credits	Marks
I	Language I – Tamil	4	12	400
II	English + Communicative English	2+2	12	400
III	Core Course (CC)	10	46	**1000**
III	Core Practical (CP)	4	16	**400**
III	Allied Theory (AT)	4	16	**400**
III	Allied Practical (AP)	2	6	**200**
III	Major Based Elective Course (MBEC)	4	20	**400**

IV	Skill Enhancement Course (SEC)	4	8	400
IV	Non-Major Elective Course **(**NMEC**)**	2	4	200
IV	Ability Enhancement Compulsory Course (AECC)	2	4	200
IV	Ability Enhancement Elective Course(AEEC)	1	2	100
IV	Professional English (Mandatory) (PE)	2	4	100
V	Extension Activity (ELECTIVE)	1	2	100
	TOTAL	**44**	**152**	**4300**

Part III

Total number of Courses: 24 **Cumulative total number of courses : 44**

Total Credits : 104 **Cumulative total of credits : 152**

Total marks : 2400 **Cumulative total of marks : 4300**

COURSE OF STUDY & SCHEME OF EXAMINATION 2020-21

Bachelor of Science (B.Sc) APPLIED GEOLOGY

S. No	PART	COURSE CODE	COURSE NAME	H@	CR	MARKS		MAX
						IA	SE	
SEMESTER – I								
1	I	**21FTL01**	Language – I: Tamil	5	3	25	75	100
2	II	**21FEL01**	Communicative English-I	5	3	25	75	100
3	III	**21UGL01**	CC I – Fundamentals of Geology	5	4	25	75	100
4	III	**21ACHA1**	AT – I: Chemistry	5	4	25	75	100
		21AMT01	AT – I: Maths					
5	III	**21UGLP1**	CP – I: Structural Geology & Surveying	3	**PRACTICAL EXAM WILL BE CONDUCTED IN EVEN SEMESTER**			
6	III	**21ACHPA**	AP – I: Chemistry	3				
		21AMPT1	AP – I: Mathematics Practical	3				

7	IV	**21AECC1**	AECC – I: Value Based Education	2	2	25	75	100
8	IV	**21UPE01**	Professional English – I	2	2	50	-	50
TOTAL				**30**	**18**			**550**
SEMESTER – II								
1	I	**21FTL02**	Language –II: Tamil	5	3	25	75	100
2	II	**21FEL02**	Communicative English-II	5	3	25	75	100
3	III	**21UGL02**	CC II – Geomorphology & Structural Geology	5	4	25	75	100
4	III	**21ACHA2**	AT – II: Chemistry	5	4	25	75	100
		21AMT02	AT – II: Maths					
5	III	**21UGLP1**	CP – I: Structural Geology & Surveying	3	4	40	60	100
6	III	**21ACHPA**	AP I: Chemistry Practical	3	3	40	60	100
		21AMPT1	AP I: Mathematics Practical					
7	IV	**21AECC2**	AECC-II: Environmental Studies	2	2	25	75	100
8	IV	**21UPE02**	Professional English – II	2	2	50	-	50
TOTAL				**30**	**25**			**750**
CUMULATIVE TOTAL					**43**			**1300**
SEMESTER – III								
1	**I**	**21FTL03**	Language – III Tamil	5	3	25	75	100
2	**II**	**21FEL03**	Foundation English – I:	5	3	25	75	100
3	**III**	**21UGL03**	CC III – Paleontology	5	4	25	75	100
4	**III**	**21AGL03**	AT-II Course I : Physics	5	4	25	75	100
5	**IV**	**21UGLS1**	SEC – I: Fuel Geology	2	2	25	75	100
6	**IV**	**21UGLN1**	NMEC – I: Natural Resource Management	2	2	25	75	100
7	**III**	**21UGLP2**	CP II – Crystallography & Paleontology	3	**PRACTICAL EXAM WILL BE CONDUCTED IN EVEN SEMESTER**			
8	**III**	**21AGLP1**	AP – II: Physics	3				
9	**V**	**21EXAT1**	NATIONAL CADET CORPS	**Self study**	**2**			**100**
		21EXAT2	NATIONAL SOCIAL SERVICE					
		21EXAT3	Indian Heritage and Culture					
		21EXAT4	Public Health and Personal Hygiene					

TOTAL				**30**	**20**			**700**
CUMULATIVE TOTAL					**63**			**2000**
SEMESTER – IV								
1	**I**	**21FTL04**	Language – IV Tamil	6	3	25	75	100
2	**II**	**21FEL04**	Foundation English – II	6	3	25	75	100
3	**III**	**21UGL04**	CC IV- Crystallography & Optical Mineralogy	6	4	25	75	100
4	**III**	**21AGL04**	AT – II: Physics	6	4	25	75	100
5	**IV**	**21UGLS2**	SEC - II: Engineering Geology	2	2	25	75	100
6	**IV**	**21UGLN2**	NMEC – II: Natural Disaster Management	2	2	25	75	100
7	**III**	**21UGLP2**	CP – II: Crystallography & Paleontology	3	4	40	60	100
8	**III**	**21AGLP1**	AP – II: Physics	3	3	40	60	100
9	**IV**	**21AEEC1**	Gandhian Thoughts	**Self study**	**2**			**100**
		21AEEC2	Human Rights					
		21AEEC3	Business Startup Fundamentals					
		21AEEC4	Professional Ethics & Cyber Netiquette					
TOTAL				**36**	**27**			**900**
CUMULATIVE TOTAL					**90**			**2900**
SEMESTER – V								
1	**III**	**21UGL05**	CC V: Mineralogy	5	5	25	75	100
2	**III**	**21UGL06**	CC VI: Igneous & Metamorphic Petrology	5	5	25	75	100
3	**III**	**21UGL07**	CC VII: Stratigraphy & Indian Geology	4	5	25	75	100
4	**III**	**21UGLM1**	MBE I: Exploration Geology	4	5	25	75	100
		21UGLM2	MBE II: Marine Geology					
5	**III**	**21UGLM3**	MBE III: Remote Sensing	4	5	25	75	100
		21UGLM4	MBE IV: Mineral resources of Tamil Nadu					
6	**IV**	**21UGLS3**	SEC III: Gemmology	2	2	25	75	100
7	**III**	**21UGLP3**	CP – III: Mineralogy & Petrology	3	**PRACTICAL EXAM WILL BE CONDUCTED IN EVEN SEMESTER**			
8	**III**	**21UGLP4**	CP – IV: Economic Minerals, Geochemistry & Field Geology	3				

			TOTAL	**30**	**27**			**600**
			CUMULATIVE TOTAL		**117**			**3500**
			SEMESTER – VI					
1	**III**	**21UGL08**	CC – VIII: Sedimentary Petrology & Environmental Geology	5	5	25	75	100
2	**III**	**21UGL09**	CC – IX: Economic Geology	5	5	25	75	100
3	**III**	**21UGL10**	CC – X: Mining Geology	4	5	25	75	100
4	**III**	**21UGLM5**	MBE – V: Field Geological Techniques	4	5	25	75	100
		21UGLM6	MBE – VI: Mineral Economics					
5	**IV**	**21UGLM7**	MBE – VII: Watershed Management	5	5	25	75	100
		21UGLPR	Project Work: Single or Group					
6	**IV**	**21UGLS4**	SEC- IV: Ore Dressing	2	2	25	75	100
7	**III**	**21UGLP3**	CP – III: Mineralogy & Petrology	3	4	40	60	100
8	**III**	**21UGLP4**	CP – IV: Economic Minerals, Geochemistry & Field Geology	3	4	40	60	100
			TOTAL	**30**	**35**			**800**
			CUMULATIVE TOTAL		**155**			**4300**

H$^{@}$ – Hours per timetable cycle/six day order cycle ; CR – Credits; IA – Internal Assessment; SE – Semester External.

Course Code	Paper Title	Lectures	Tutorials	Practical	Credits
21UGL01	**FUNDAMENTALS OF GEOLOGY**	**4**	**1**		**4**

Broad Objectives & Teaching Methodology:

Geology is the study of the Earth as a whole. This course presents the varied topics which defines Geology as a branch of Physical Science. It aims to provide a 'bird's eye' view on the fundamentals of geology as an orientation for applied geology in the later semesters. It also supplements the topics which overlap to those taught in the school years. The teaching methodology is executed via class room lectures, use of physical models, pictures, multi media resources, interactive sessions, student involvement sessions with practical and laboratory demonstrations, field visits and others.

UNIT I

Introduction to Geology – Branches, applications, and scope of Geology. **Solar system**: Outline of: planets – satellites – comets – asteroid belt and asteroids – meteorites. Kepler's Laws of Planetary Motion – Bode's Law. Origin of the Solar System: Planetesimal Model – Tidal Model – Nebular and Gas Cloud Models. **Earth in the solar system** – origin, age**,** size, shape, mass, density, rotational and revolution parameters, magnetic field, internal heat distribution and geothermal gradient.

UNIT II

Earthquakes: Definition of Earthquake – Seismic waves: types – basic properties – generation of seismic waves in the earth – shadow zones. Location of EQs: focus (hypocentre) - epicentre. Magnitude and intensity of EQs – A brief introduction to seismogram and seismograph. Causes of EQs. Tsunamis & Seiche Waves. **Interior of the Earth:** Internal structure based on travel time of seismic waves: crust – mantle – core. Brief account of seismic boundaries and discontinuities.

UNIT III

Understanding the past from Stratigraphic records

Fundamental laws of stratigraphy: laws of original horizontality, vertical and lateral continuity, superposition, uniformitarianism and faunal succession. Brief description of the Geological time scale. **Determination of age of rocks:** 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 C^{14} method. Relative dating methods: - Cross cutting relations – Unconformable surfaces – Changes in lithology – Superposition of beds. **Indirect Methods: -** Short outline of glacial and lacustrine varves – tree rings – ocean salinity.

UNIT IV

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. **Volcanoes**- types, products and their distribution. Ring of fire. Outline of isostasy.

UNIT –V

Introduction to Earth materials: definition of igneous, sedimentary and metamorphic rocks; Definition of minerals, crystals, ores, and fossils. Outline of morphology of crystals. Brief account of megascopic properties of minerals and ores. Outlines of processes in fossilization. **Weathering:** definition - processes: erosion - transport - deposition. Agents and types of weathering: physical - chemical – biological. Soils: definition, vertical sections, and brief account of origin. **Hydrosphere and Atmosphere:** Origin of atmosphere, atmospheric circulation; Oceanic currents, tides and waves. Outline of Indian monsoon, Milankovitch cycle and eustasy.

REFERENCE BOOKS

1. **Holmes,A & P.L.Duff.** (1996). Principles of Physical Geology, 4 th edition, ELBS,London

2. **Emiliani,C.(1992).** Planet Earth, Cambridge University Press, Delhi.

3. **Porter,S.C. & B.J. SkinnerJ.** (1995). The Dynamic Earth, John Wiley & Sons, New York.

4. **Leet,D & Judson,S** (1987). Physical Geology, McGraw Hill. New Jersey.

5. **Zumberge,J.(**1980). Physical Geology, Freeman, New York.

6. **Reed,J.S. & T.H. Wicander.** (2005). Essentials of Geology, McGraw Hill., New York.

TEXTBOOKS

1. **Radhakrishnan,V.** (1996). General Geology, V.V.P. Publishers,Tuticorin.

3. **Mahapatra,G.P.** (1994). Physical Geology, CBS Publishers,New Delhi.

4. **Mahapatra,G.P.** (1992). Textbook of Geology, CBS Publishers,New Delhi.

5. **Patwardhan,A.M.** (1999). Dynamic Earth System,Prentice Hall, New Delhi.

6. **Dasguptha,A.B.** (1978). Physical Geography,CBS Publishers,Delhi.

7. **Mukherjee,A.K.** (1990). Principles of Geology,EW Press,Kolkata.

Web resources: The student can approach the Teacher concerned, for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: Soft copies related study materials are available in the Department for access with proper permission from the Teacher concerned.

A**ssignments:** Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Supervised field visits are suggested with the submission of a field report.

S. No.	COURSE & LEARNING OUTCOMES	
CO1	The student is able to describe the different characteristics of earth and how they relate to the to the solar system.	Remember
CO2	The student is able to understand how earth quakes are generated. Ideas on how the earth's interior is demarcated using seismic waves generated from natural earth quakes is also appraised.	Understand & Apply
CO3	The student is introduced to geological time via stratigraphy and on the different methods of determining the age of the earth. He/she is able to apply the appropriate method in assessing the age of earth materials.	Understand & Apply
CO4	The student is introduced to the revolutionary concept of continental drift which later evolved to the plate tectonics paradigm. He/she is also introduced to volcanoes which are controlled by plate tectonic boundaries and isostasy which explains how plate buoyancy and uplift are related.	Evaluate
CO5	The student is introduced to different earth materials which will be dealt in detail in the later semesters. The process of weathering is discussed in illustrative detail along with the soil products generated. The role of hydrosphere and atmosphere is explained and analyzed relevant to the earth's system.	Understand & Analyze

MAPPING WITH PROGRAM OUTCOMES (S – Strong; M- Medium; L-Low)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	L	S	S	L	L	S	M
CO2	S	L	M	L	S	S	M	L	S	M
CO3	S	L	M	M	M	S	L	M	S	M
CO4	S	M	M	L	M	M	M	M	S	M
CO5	S	M	M	M	M	M	L	M	S	L

Course Code	Paper Title	Lectures	Tutorials	Practical	Credits
21UGL02	**GEOMORPHOLOGY & STRUCTURAL GEOLOGY**	**4**	**1**	**3**	**4**

Broad Objectives & Teaching Methodology:

Geomorphology is the study of all landforms on the earth's surface including those observed on the ocean floor. It encompasses all surficial geological processes which have sculpted the landforms on earth's surface after the emergence of the atmosphere and hydrological cycle in the geological past. Geomorphology involves the identification of different landforms, associated processes related to their origin and development, evolution of landforms in terms of geological time, and others. It also includes the ways and means on how geomorphology is useful in the construction of different engineering structures, watershed management, mineral exploration, and others.

Structural Geology is the study of the different structures (of varying scales) in crustal rocks derived from different forces active on and within the earth's crust. It also includes their identification and recognition in the field, applicable mapping techniques, relative age, origin, associated mineral deposits, tectonic relations, and others. Structural geology is intimately associated with plate tectonics paradigm. The teaching methodology is executed via class room lectures, use of physical models, pictures, multi media resources, interactive sessions, student involvement sessions with practical and laboratory demonstrations, field visits and others.

GEOMORPHOLOGY
UNIT I

Geomorphology: A brief account of first order, second order, and third order landforms. **Land forms created by Wind:** detailed outline of erosion, deflation, abrasion, and attrition with descriptive notes on the geomorphic features generated by them. Descriptive study of different transportation processes. Short notes on loess and sand deposits. **Sand dunes**: definition, parts and morphological features of sand dunes, types of sand dunes with a note on their origin. Outline on the concepts and ideas of geomorphic cycles. Outline of the major geomorphic features of Tamil Nadu.

UNIT II

Land forms created by rivers: detailed outline of different erosion processes and their erosional features. Description of transportation and depositional processes. Detailed outline of different depositional features. Outline of the cycle of erosion and different drainage patterns with a note on their origin. Outline of rivers of India with special reference to Tamil Nadu. **Land forms derived from underground water:** definition and sources of groundwater. Detailed outline of factors controlling groundwater movement. Detailed outline of different erosional features and depositional features of groundwater.

UNIT III

Land forms created by glaciers: definition, formation, and movement of glaciers. Detailed outline on the different types of glaciers. Surface features of glaciers. Detailed outline of the processes in glacial erosion. Description of different erosional features of glaciers. Short note on 'roches mountonnees' and glacial fjords. Detailed outline of depositional features of glaciers and continental ice sheets. **Land forms created by ocean:** detailed outline of features related to shore profile and shoreline development. Descriptive outline of ocean floor erosion features, features formed by marine reefs – deep sea deposits, abyssal deposits, polygenic sediments, volcano-genic sediments. Short account of mid oceanic ridges and submarine canyons.

STRUCTURAL GEOLOGY

UNIT IV

Introduction and scope of Structural Geology. Detailed outline of different components of topographic maps and their significance. **Rock outcrops**: definition, types: sedimentary, igneous and metamorphic. **Foliation and Lineation**: definition and detailed description of common types of foliation and lineation in metamorphic and igneous rocks. Cardinal directions of a compass: whole circle, quadrant, magnetic and true North. Detailed study of orientation, tilt, and attitude of rock outcrops and their measurement using Brunton and Clinometer compasses. S**edimentary beds**: definition and types. Detailed outline of different surficial structures on sedimentary rocks. **Unconformity**: definition, types, genesis, geological significance, and criteria for their recognition in the field and prepared geological maps. Detailed outline of concordant and discordant igneous rocks with a note on their identification and recognition in geological maps. **Rock Joints**: definition, types, classification, and outline of genesis.

UNIT V

Faults: definition and nomenclature of the parts of a fault. Descriptive outline of different fault plane features. Classification of faults: geometric, genetic, and tectonic classification of faults. Outline of fault related geomorphic features. Descriptive criteria for recognition of faults in the field and in a geological map. **Folds**: definition and different parts of a fold. Outline of geometry and nomenclature of folds. Classification of folds based on closing and facing directions, inter limb angle, attitude of axial plane, fold profiles, and dip isogons. Short notes on outliers and inliers. Detailed criteria of recognition of folds in the field and in a geological map. **Stereographic projection in structural geology**: definition and description of dip and strike for planes, plunge and trend for linear structures. Theory behind the stereographic projections, representation of planes and lines on the stereograms.

REFERENCE BOOKS

1. Worcester, P.G.(1960), A Text Book of Geomorphology, East West Press. Delhi.

2. Bloom, A. (1985), Principles of Geomorphology, Prentice Hall of India, Delhi.

3. Billings, M.P. (1974) Structural Geology. PHI India Ltd. New Delhi.

4. Davis, G.H. (1985). Structural Geology of Rocks and Regions. Wiley, New Delhi.

5.Hills,E.S. (1963). Elements of Structural Geology, Chapman & Hall. London.

6.Ragan, D.M.,(2000).Structural Geology .Wiley. New York.

7.Park,P.G.(1983).Foundations of Structural Geology, Blackie. London.

8. Lisle, R.J & Peter R Leyshon. (2004). Stereographic Projection Techniques for Geologists and Civil Engineers. Cambridge University Press. New Delhi.

9. Fossen,H. (2010). Structural Geology. Cambridge University Press. New Delhi.

10.Lisle, R.J. (2004). Geological Structures and Maps. Elsevier. New Delhi.

TEXT BOOKS

1. Radhakrishnan ,V. (1996), General Geology, V.V.P. Publications, Tuticorin.

2. Mahapatra, G.B. (1994), Text book of Physical Geology, CBS Publications, Delhi.

3. Singh,S. (2007) Geomorphology. S. Chand & Co. New Delhi.

4. Sathya Narayanaswami, B.S. (1994). Structural Geology. Dhanpat Rai & Sons. New Delhi.

5. Gokhale,N.W. (1995), Theory of Structural Geology, CBS, Delhi.

Web resources: The student can approach the Teacher concerned, for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: Soft copies related study materials are available in the Department for access with proper permission from the Teacher concerned.

A**ssignments:** Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Supervised field visits are suggested with the submission of a field report.

S. No.	COURSE & LEARNING OUTCOMES	
CO1	The student is able to demarcate different orders of landforms, recognize describe, and identify different landforms generated by wind, define geomorphic cycles, and categorize the major geomorphic features of Tamil Nadu.	Remember, understand, and apply.
CO2	The student is able to recognize, describe, and identify different landforms generated by rivers and underground water, define erosional cycles and drainage patterns related to rivers, and to differentiate the major river systems of Tamil Nadu.	Understand, apply and evaluate
CO3	The student is able to recognize, describe, and identify different landforms generated by glaciers and oceans and underground water, define marine erosional features and their deposits.	Understand, apply and evaluate
CO4	The student is introduced to structural geology and its scope. The student will be able to distinguish, compare, and describe rock outcrops, their field configuration, and inherent structures. The significance of unconformities and rock joints is emphasised. Use of the Brunton and Clinometer compasses in measuring these structures is emphasized as a skill.	Apply, illustrate analyze, and evaluate
CO5	The student is introduced to different fault and fold structures. The student will be able to identify, distinguish, compare, and describe these structures, their field configuration, and their related structures. Use of the Brunton and Clinometer compasses in measuring these structures is emphasized as a skill. The student in introduced to stereographic projections for evaluating structural data collected in the field.	Apply, illustrate analyze, and evaluate

MAPPING WITH PROGRAM OUTCOMES (S – Strong; M- Medium; L-Low)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	L	M	M	L	M	S	S
CO2	S	S	S	L	M	M	L	M	S	S
CO3	S	S	S	L	M	M	L	M	S	S
CO4	S	S	S	M	M	M	S	S	S	S
CO5	S	S	S	M	M	M	S	S	S	S

Course Code	Paper Title	Lectures	Tutorials	Practical	Credits

21UGL03	**PALEONTOLOGY**	**4**	**1**	**3**	**4**

Broad Objectives & Teaching Methodology:

Paleontology is the study of ancient and extinct organisms preserved in appropriate sedimentary rocks. The remains of organisms preserved in sedimentary rock are termed as fossils. Paleontology involves the identification, age determination, evolutionary characteristics, and stratigraphic significance of fossils. It also extends to the estimation and determination of paleo-climates, as fossil indicators in coal and petroleum exploration, and is intimately related to stratigraphy of evident life of Phanerozoic Eon of the geological time scale. The teaching methodology is a combination of class room lectures, use of physical models, pictures, multi media resources, interactive sessions, student involvement sessions with practical and laboratory demonstrations, field visits and others.

UNIT I

Definition and types of fossils. Conditions and processes of fossilization. Different modes of preservation of animal organisms as fossils. Uses of fossils. Short notes on the exceptional preservation of fossils or lagerstatten. Outline of Geological time scale. Morphological characters, classification, geological and stratigraphical importance of the following Phyla: Brachiopoda; Porifera; Mollusca: Class – Pelecypoda.

UNIT II

Invertebrate Paleontology I: Morphological characters, classification, geological and stratigraphical importance of the following Phyla: Phylum Mollusca: Class: Gastropoda; Class: Cephalopoda. Morphological characters, classification, geological and stratigraphical importance of the Phylum Hemichordata: Class – Graptoloidea. Morphological characters, classification, geological and stratigraphical importance of the Phylum Arthropoda;

UNIT III

Invertebrate Paleontology II: Morphological characters, classification, geological and stratigraphical importance of the Phylum Coelenterata: Class Anthozoa – Corals: Morphological characters, classification, geological and stratigraphical importance of the following: Phylum Echinodermata: Classes – Echinoidea, Blastoidea, and Crinoidea. Morphology and geological history of Foraminifera and Ostracoda.

UNIT IV

Vertebrate Paleontology: A short account on the classification of vertebrates. Outline of evolution of vertebrates through geological time. Brief account of Ostracoderms and Icthyostegids and their stratigraphic significance. Dinosaurs: definition, characteristics, classification, stratigraphic significance, and outline of their extinction. Short account of Indian dinosaurs: Kotasaurus, Rajasaurus, Stegosaurus, and Ankylosaurus. A brief account of Archaeopteryx and Pterosaurs.

UNIT V

Paleobotany: Detailed description and classification of land plant fossils. Detailed study of modes of preservation of plant fossils. Outline of important steps in plant evolution with geological time. Outline of adaptations relevant to land colonization of plants. Brief account of

stromatolites and their geological significance. Short account of Gondwana flora; Glossopteris, Gangamopteris, Calamites, Lepidodendron, Sigillaria and Ptilophyllum.

REFERENCE BOOKS

1. Black, R.M. (1972). Elements of Paleontology. OUP. Oxford. UK.
2. Clarkson, E.N.K. (2005). Invertebrate Paleontology and Evolution. Wiley. New Delhi.
3. Easton, W.H. (1960). Invertebrate Paleontology. Harper & Brothers. New York.
4. Moore, R.C. et al. (1952). Invertebrate Fossils. CBS. Delhi.
5. Stewart, W.N. & G.W.Rothwell. (2005). Paleobotany. CUP. Delhi.
6. Benton, M.J. (1995). Vertebrate Paleontology. Wiley. New Delhi.
7. Colbert, E.H. et al. (2002). Evolution of the Vertebrates. Wiley. New Delhi.
8. Richard, C. (2000). History of Life. Wiley. New Delhi.
9. Milsom, C & S.Rigby. (2010). Fossils at a Glance. Wiley Blackwell. New Delhi.
10. Babin, C. (1980). Elements of Paleontology. Wiley. Delhi.

TEXT BOOKS

1. Ray, A.K. (2008). Fossils in Earth Sciences. PHI. New Delhi.
2. Agashe,S.N. (1995). Paleobotany. Oxford & IBH. Delhi.
3. Jain,M.L..(2013). An Introduction to Paleontology. Vishal Publications. Delhi.
4. Sahni,A. (2001). Dinosaurs of India. NBT. Delhi.
5. Jain,S. (2017). Fundamentals of Invertebrate Paleontology Macrofossils. Springer India. New Delhi.
6. Jain,S. (2017). Fundamentals of Invertebrate Paleontology Microfossils. Springer India. New Delhi.

Web resources: The student can approach the Teacher concerned for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: Soft copies related study materials are available in the Department for access with proper permission from the Teacher concerned.

A**ssignments:** Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Supervised field visits are suggested with the submission of a field report.

S. No.	COURSE & LEARNING OUTCOMES	
CO1	The student is able to demarcate different orders of landforms, recognize describe, and identify different landforms generated by wind, define geomorphic cycles, and categorize the major geomorphic features of Tamil Nadu.	Remember ,understand, and apply.
CO2	The student is able to recognize, describe, and identify different landforms generated by rivers and underground water, define erosional cycles and drainage patterns	Understand, apply and

	related to rivers, and to differentiate the major river systems of Tamil Nadu.	evaluate
CO3	The student is able to recognize, describe, and identify different landforms generated by glaciers and oceans and underground water, define marine erosional features and their deposits.	Understand, apply and evaluate
CO4	The student is introduced to structural geology and its scope. The student will be able to distinguish, compare, and describe rock outcrops, their field configuration, and inherent structures. The significance of unconformities and rock joints is emphasised. Use of the Brunton and Clinometer compasses in measuring these structures is emphasized as a skill.	Apply, illustrate analyze, and evaluate
CO5	The student is introduced to different fault and fold structures. The student will be able to identify, distinguish, compare, and describe these structures, their field configuration, and their related structures. Use of the Brunton and Clinometer compasses in measuring these structures is emphasized as a skill. The student in introduced to stereographic projections for evaluating structural data collected in the field.	Apply, illustrate analyze, and evaluate

MAPPING WITH PROGRAM OUTCOMES (S – Strong; M- Medium; L-Low)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	L	L	M	M	L	M	M	S	S
CO2	S	L	L	M	L	L	L	M	S	M
CO3	S	L	L	M	L	L	L	M	S	M
CO4	S	L	L	M	M	L	L	M	S	S
CO5	S	L	L	M	M	L	L	M	S	S

Course Code	Paper Title	Lectures	Tutorials	Practical	Credits
21UGL04	CRYSTALLOGRAPHY & OPTICAL MINERALOGY	4	1	3	4

Broad Objectives & Teaching Methodology:

Crystallography is a core part of mineralogy. It is the study of the morphological characters of crystals. It also extends to how these characters are related to its atomic structure, chemical composition, physical and optical properties. Crystallography draws on concepts based on physics and chemistry. The teaching methodology is done by class room lectures, use of physical models, multi media resources, interactive sessions, student involvement sessions with practical and laboratory demonstrations, and others.

UNIT I

Crystallography: definition of a crystal and detailed study of its morphological characters. Interfacial angles and use of contact goniometer. Descriptive study of crystallographic axes and axial ratios of the different crystal systems. Concept of Weiss parameters, Millerian indices and symbols. Laws of Crystallography: Law of constancy of interfacial angles and Law of Rational Indices. Symmetry elements in crystals. Classification of crystal systems. Study of: holohedral, hemihedral, hemimorphic and enantiomorphous forms in 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.

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.

UNIT IV

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.

UNIT V

Optical Mineralogy: Petrological Microscope and its parts. **Isotropic minerals**. Study of the optical properties of Isotropic minerals. **Anisotropic minerals.** Behavior of ordinary light in **uniaxial** minerals: double refraction; indicatrix; optic axis; and optic sign. Behavior of polarized light in uniaxial minerals: retardation, birefringence, extinction, interference colors and interference figure. Study of the optical properties of uniaxial minerals. Behavior of polarized light in biaxial minerals: indicatrix; optic axes; optical axial angles; interference colors; extinction and extinction angles. Study of the optical properties of biaxial minerals. Biaxial interference figure. Account of the methods used in the determination of refractive index of minerals.

REFERENCE & TEXTBOOKS

1. Klein, C. & C.S. Hurlbut, Jr. (1993). Manual of Mineralogy, 21st ed. Wiley. New York.

2.Ford, W.E. (1988). Dana's textbook of Mineralogy. CBS. Delhi.

3.Senguptha.S. (1980). Crystallography & Optical mineralogy. EW Press. New Delhi.

4.Battey,M. (1978). Mineralogy for Students, OUP, UK.

5.Berry, L.G.,B.Mason & R.V.Dietrich. (1985). Mineralogy, CBS New Delhi.

6.Kerr, P.F. (1977). Optical Mineralogy, 4th ed. McGraw Hill New York.

7.Hota,R.N. (2011). Practical Approach to Crystallography and Mineralogy, CBS, New Delhi.

8. Phillips, F.C. (1965). Crystallography. ELBS. London.

9. Bishop,A. (1967). An Outline of Crystal Morphology. Hutchinson. London.

10. Raith,P.M. (2011). Optical Mineralogy. Mineralogical Society of America. Virginia, USA.

Web resources: The student can approach the Teacher concerned, for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: Soft copies related study materials are available in the Department for access with proper permission from the Teacher concerned.

A**ssignments:** Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Supervised field visits are suggested with the submission of a field report.

S. No.	COURSE & LEARNING OUTCOMES	
CO1	The student is able to understand and describe the different morphological characters of crystals combined with the discussion of crystal forms, parameters, and others.	Remember, understand & Apply
CO2	The student is able to understand and describe the different morphological characters of crystals of the cubic and tetragonal system combined with the discussion of their crystal forms, parameters, and others.	Understand & Apply
CO3	The student is able to understand and describe the different morphological characters of crystals of the hexagonal and rhombohedral divisions of the hexagonal system and the orthorhombic system, combined with the discussion of their crystal forms, parameters, and others.	Understand & Apply
CO4	The student is able to understand and describe the different morphological characters of crystals of the monoclinic and triclinic systems combined with the discussion of their crystal forms, parameters, and others. Twin crystals are also discussed.	Understand & Apply
CO5	The student is able to understand and describe the different optical properties of minerals combined with the discussion of their optical properties which can be determined by polarizing microscope techniques.	Understand & Apply

MAPPING WITH PROGRAM OUTCOMES (S – Strong; M- Medium; L-Low)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	-	-	S	M	S	M	M	S	M
CO2	S	-	-	S	M	S	-	M	S	M
CO3	S	-	-	S	M	S	-	M	S	M
CO4	S	-	-	S	M	S	-	M	S	M
CO5	S	-	-	S	M	S	M	M	S	M

Course Code	Paper Title	Lectures	Tutorials	Practical	Credits
21UGL05	**MINERALOGY**	**4**	**1**	**3**	**5**

Broad Objectives & Teaching Methodology:

A sound base in mineralogy is essential for understanding petrology, economic geology, field geology, mining geology, exploration geology, other courses in Applied Geology. The study of mineralogy also extends to meteorite petrology and other planetary materials. Physical and chemical characters of minerals find use in geophysics and geochemistry. The proper identification of minerals in the laboratory or in the field, is a precursor to assess the rock types in which they occur. The student is introduced to the different mineral groups emphasizing their overall morphological properties for megascopic and microscopic thin section identification, and their mode of occurrence to observe and evaluate their distribution in different earth materials. The teaching methodology is done by class room lectures, use of physical models, multi media resources, interactive sessions, student involvement sessions with practical and laboratory demonstrations, field visits, microscopic techniques and others.

UNIT I

Mineral: definition and basic differences between minerals, mineraloids, and crystals. Megascopic properties of minerals based on external appearance: different forms, habits, and states of aggregation; colour: idiochromatic and allochromatic colours; lustre and their types; diaphaneity and their types; Mineral properties based on crystal structure: hardness based on Moh's and Vicker's scale; tenacity and its types; cleavage and its types; fracture and its types; short note on mineral partings.

UNIT II

Mineral properties based on sense of taste; odour; and tactile feeling. Specific gravity and density of minerals. Thermal, magnetic, and electrical properties of minerals. Radioactivity in minerals. Short account of silicate structures. Megascopic, chemical, optical properties, mode of occurrences, petrological association, and uses of the following mineral groups and their members: quartz group; feldspar group; feldspathoids group. Short note on twinning in feldspars.

UNIT III

Basic crystal chemistry: Types of chemical **b**onding in minerals and outline of Pauling's rules; principles of ionic substitution in minerals; ionization potential; electronegativity. Short notes on mineral polymorphism, isomorphism, exsolution, mixed crystals, and intergrowth. Megascopic, chemical, optical properties, mode of occurrences, petrological association, and uses of the following mineral groups and their members: pyroxene group; amphibole group; olivine group.

UNIT IV

Megascopic, chemical, optical properties, mode of occurrences, petrological association, and uses of the following mineral groups and their members: mica group; garnet group; zeolite group; chlorite group.

UNIT V

Megascopic, chemical, optical properties, mode of occurrences, petrological association, and uses of the following mineral groups and their members: epidote group; spinel group; kyanite group; descriptive study of the following minerals: tourmaline, scapolite, sphene, cordierite;

beryl, calcite, apatite, fluorite, and monazite.

REFERENCE BOOKS

1. Deer, W.A, et al. (2013).An Introduction to the Rock-Forming Minerals. ELBS. London.

2. Klein, C. & C.S. Hurlbut, Jr. (1993).Manual of Mineralogy, 21st ed. Wiley. New York.

3.Wenk,H.R & A. Bulakh. (2006). Minerals. Cambridge University Press, New Delhi.

4.Perkins, D. (2010). Mineralogy, 3rd ed. PHI India, New Delhi.

5.Battey,M. (1978). Mineralogy for Students, OUP, UK.

6.Berry, L.G.,B.Mason & R.V.Dietrich. (1985). Mineralogy, CBS New Delhi.

7.Kerr, P.F. (1977). Optical Mineralogy, 4th ed. McGraw Hill New York.

8.MacKenzie, W.S. (1993) Atlas of Rock-Forming Minerals in Thin Section, Longman, UK.

9.Heinrich, E.W.(1965).Microscopic Identification of Minerals. McGraw-Hill, India.

10.Perkins, D.& K.R.Henke. (2003). Minerals in Thin Section, PHI. India.

TEXTBOOKS

1.Gribble, C.D. (1988). Rutley's Elements of Mineralogy. CBS, New Delhi.

2.Blackburn, W.H. (1994).Principles of Mineralogy. WCB Publishers, Dubuque, IA.

3.Hota,R.N. (2011). Practical Approach to Crystallography and Mineralogy, CBS, New Delhi.

4.Haldar,S.K. & J. Tisjlar. (2014). Introduction to Mineralogy and Petrology, Elsevier, Netherlands.

5.Gribble,C.D.& A.J. Hall.(1985).A Practical Introduction to Optical Mineralogy. Springer India.

Web resources: The student can approach the Teacher concerned for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: Soft copies related study materials are available in the Department for access with proper permission from the Teacher concerned.

A**ssignments:** Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Supervised field visits are suggested with the submission of a field report.

S. No.	COURSE & LEARNING OUTCOMES	
CO1	The student is able to describe the different megascopic characteristics of minerals in general and how they help to demarcate their diagnostic properties for identification purposes.	Remember, understand, apply, and assess.
CO2	The student is able to describe the different megascopic characteristics of mineral groups and understand their diagnostic properties for nomenclature and identification	Understand, apply, and assess.

	purposes. The physical properties of minerals are also discussed.	
CO3	Topics relevant to basic crystal chemistry as applied to minerals is discussed. Different morphological phenomenon observed in minerals are also discussed. The student is able to describe the different megascopic characteristics of mineral groups and understand their diagnostic properties for nomenclature and identification purposes.	Understand, apply, and assess.
CO4	The student is able to describe the different megascopic characteristics of mineral groups and understand their diagnostic properties for nomenclature and identification purposes.	Understand, apply, and assess.
CO5	The student is able to describe the different megascopic characteristics of mineral groups and understand their diagnostic properties for nomenclature and identification purposes.	Understand, apply, and assess.

MAPPING WITH PROGRAM OUTCOMES (S – Strong; M- Medium; L-Low)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	S	S	S	S	S	M
CO2	S	M	M	S	S	S	S	S	S	M
CO3	S	M	M	S	S	S	S	M	S	M
CO4	S	M	M	S	S	S	S	M	S	M
CO5	S	M	M	S	S	S	S	M	S	M

Course Code	Paper Title	Lectures	Tutorials	Practical	Credits
21UGL06	**IGNEOUS & METAMORPHIC PETROLOGY**	**4**	**1**	**3**	**5**

Broad Objectives & Teaching Methodology:

Petrology is the study of rocks. Igneous rocks are the products of magma or lava consolidation. It also extends to meteorites, lunar rocks, and related extraterrestrial materials. Metamorphic rocks are the products of pre-existing rocks which have experienced varying conditions of pressure and temperature within the earth's crust, with little or minimal alteration by chemically active fluids. Sedimentary rocks are the cemented and compacted products of weathered materials on the earth's surface. Petrology is the foundation for structural geology, economic geology, field geology, mining geology, exploration geology, other courses where rock identification and petrography is essential and necessary. The proper identification of rocks in the laboratory or in the field, is a precursor to assess their mode of occurrence, association, expected economic mineralization, and others. The teaching methodology is done by class room lectures, use of physical models, multi media resources, interactive sessions, student involvement sessions with practical and laboratory demonstrations, field visits, microscopic techniques and others.

UNIT I IGNEOUS PETROLOGY

Igneous Petrology: definition and scope. Magma: definition, composition and constituents. Field configurations of igneous rocks: intrusive forms and extrusive forms. Assimilation of host rocks by magmas. Bowen's Reaction Series. Mechanism and processes of magmatic differentiation. Classification of igneous rocks based on: mode of occurrence, silica and alumina saturation, and IUGS schemes.

UNIT II

Outline of experimental petrology and phase rule. Binary systems: definition, components, application of lever rule. Melting relations and course of crystallization of the Diopside-Anorthosite system – simple eutectic. Albite – Anorthite system – solid solution series. Forsterite – Silica system – incongruent melting. Ternary system: definition, components, and method of plotting. Melting relations and course of crystallization in the Diopside – Anorthite – Albite system and Diopside – Nepheline – Quartz system.

UNIT III

Textures and microstructures of igneous rocks. Outline of petrography of acid rocks, intermediate rocks, and basic rocks. Descriptive study of lamprophyre, carbonatite, anorthosites, dunite, pyroxenite and kimberlite. A short note on: consanguinity, kindred, petrographic provinces and periods. Outline of variation diagrams and a short account of Harker's variation diagram.

UNIT IV METAMORPHIC PETROLOGY

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

UNIT V

Pneumatolytic and injection metamorphism. Cataclastic metamorphism and its products. Regional metamorphism of argillaceous, calcareous, and impure calcareous rocks and their 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, and marble.

REFERENCE BOOKS

1. Winter, J.D.(2010).Principles of Igneous and Metamorphic Petrology. PHI.New Delhi.

2. McBirney, A.R. (1993). Igneous Petrology. CBS. New Delhi.

3. Best,M.G. (2003). Igneous and Metamorphic Petrology. Wiley.New Delhi.

4. Hyndman,D.W. (1985). Petrology of the Igneous and Metamorphic Rocks. McGraw Hill.

5. Middlemost,E.A.K. (1985). Magmas and Magmatic Rocks.Longman. UK.

6. Mason, R. (1988). Petrology of the Metamorphic Rocks. CBS. New Delhi.

TEXTBOOKS

1. Tyrell,G.W. (1958). Principles of Petrology. B.I. Publications. New Delhi.

2. Haung,W.T. (1962). Petrology. McGraw Hill. New York.

3. Williams,H. et al. (1982). Petrography. CBS. New Delhi.

Web resources: The student can approach the Teacher concerned for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: Soft copies related study materials are available in the Department for access with proper permission from the Teacher concerned.

A**ssignments:** Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Supervised field visits are suggested with the submission of a field report.

S. No.	COURSE & LEARNING OUTCOMES	
CO1	The student is able to describe the different outcrop configurations of igneous rocks. He/she is also able to classify igneous rocks on standard schemes for nomenclature, identification, and affinity to a group or clan of igneous rocks.	Remember, understand, apply, and assess.
CO2	The student is able to describe the course of crystallization of binary, and ternary systems related to different magmatic types. The student understands the role of magmas in the formation of igneous rocks.	Understand, apply, and assess.
CO3	The microscopic features of igneous rocks are described for understanding the ambient physical conditions present during the magma to rock consolidation stages,	Understand,

	and to assess why minerals are grouped as essential or accessory based on their relative abundances. Petrographic description of common and important rocks are discussed for familiarity and megascopic properties.	apply, and assess.
CO4	The student is able to describe the processes in metamorphism, petrographic characters of different metamorphic rocks, and their megascopic characteristics for nomenclature and identification purposes.	Understand, apply, and assess.
CO5	The student is able to describe the processes and petrographic characters of different metamorphic rocks, and their megascopic characteristics for nomenclature and identification purposes.	Understand, apply, and assess.

MAPPING WITH PROGRAM OUTCOMES (S – Strong; M- Medium; L-Low)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	M	S	S	S	S	M
CO2	S	M	M	S	-	S	S	S	S	M
CO3	S	M	M	S	-	M	S	S	S	M
CO4	S	M	M	S	-	M	S	S	S	M
CO5	S	M	M	S	M	M	S	S	S	M

Course Code	Paper Title	Lectures	Tutorials	Practical	Credits
21UGL07	**STRATIGRAPHY & INDIAN GEOLOGY**	**3**	**1**		**5**

Broad Objectives & Teaching Methodology:

Stratigraphy constitutes the foundation for all geological formations exposed on the

earth's crust and explorable subsurface. The geology of any area after mapping, is defined by its stratigraphy and its position in the geological time scale. Stratigraphy draws on petrology, field geology, geological mapping, and others to establish and understand the limited geological history of the area being mapped for geological structures, relative ages of layered rocks, mineral exploration, mining geology, and others. Stratigraphy is also essential for understanding other courses in Applied Geology such as tectonics, sedimentology, paleontology, paleo-ecology, fuel geology, and evolution of extinct fossil groups. The study of stratigraphy also extends to layered rocks observed in other planetary surfaces. The teaching methodology is done by class room lectures, use of physical models, multi media resources, interactive sessions, student involvement sessions with practical and laboratory demonstrations, field visits, and others.

UNIT I

Definition of Stratigraphy. Descriptive outline of the principles and laws of Stratigraphy. Detailed study of the different methods of stratigraphic correlation. Short account of homotaxial, synchronous, and contemporaneous formations. Detailed study of stratigraphic nomenclature: lithostratigraphy; biostratigraphy; chronostratigraphy; Study of the geological time scale and standard geological divisions.

UNIT II

Descriptive outline of imperfections in the geological record and their probable causes. Detailed study of the Indian Stratigraphic time scale. Detailed outline of the physiographic, structural and tectonic divisions of India. Outline account of the origin of Himalayan mountain ranges. Lithological characteristics, stratigraphic divisions, areal distribution, outline of equivalent formations, and mineral deposits of the Archaean Dharwar system.

UNIT III

Lithological characteristics, stratigraphic divisions, areal distribution, outline of equivalent formations, and mineral deposits of the Proterozoic Group: Cuddapah System; Delhi System; Vindhyan System; Kurnool System. Lithological characteristics, stratigraphic divisions, representative fossil content areal distribution, outline of equivalent formation, and mineral deposits of the Paleozoic Group: Paleozoic succession of Spiti; Permo-carboniferous succession of Salt Range.

UNIT IV

Lithological characteristics, stratigraphic divisions, representative fossil content areal distribution, palaeogeography, paleoclimate, and mineral deposits of the Gondwana group; Lithological characteristics, stratigraphic divisions, representative fossil content, areal distribution of the Triassic succession of Spiti; Jurassic succession of Kutch; Cretaceous succession of Trichinopoly and Narmada valley. Short account and stratigraphic succession of Lameta beds; Bagh beds;

UNIT V

Lithological characteristics, stratigraphic divisions, areal distribution, outline of equivalent formation, infra and intra-trappean beds, and mineral deposits of the Deccan Traps. Lithological characteristics, succession, structure, representative fossil content, and mineral deposits of the Siwalik system. Short account of the following Tertiary successions: Eocene of Assam, Tamil Nadu and Kerala; Brief account of Pleistocene Ice Ages in India; Karewa formation of Kashmir; and Holocene alluvial deposits.

REFERENCE BOOKS

1.Krishnan, M.S. (1986). Geology of India, Burma and Pakistan. CBS. New Delhi.

2.Weller, J.M.(1960).Stratigraphic Principles and Practice. University Book Stall. New Delhi.

3.Vaidyanadhan, R & M. Ramakrishnan. (2008). Geology of India. Geol. Soc. Ind. Bangalore.

4. Geological Survey India.(2005). Misc Pub. No.30. GSI. Kolkata. (several volumes).

TEXTBOOKS

1.Wadia, D.N. (1953). Geology of India. McMillan India. Delhi.

2.Kumar, R.(1988). Fundamentals of Historical Geology. Wiley. New Delhi.

3.Mehdiratta, R.C (1974). Geology of India, Pakistan, Bangladesh and Burma. AR & Sons. Delhi.

Web resources: The student can approach the Teacher concerned for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: Soft copies related study materials are available in the Department for access with proper permission from the Teacher concerned.

A**ssignments:** Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Supervised field visits are suggested with the submission of a field report.

S. No.	COURSE & LEARNING OUTCOMES	
CO1	The student is able to understand and describe the different principles and laws of stratigraphy, and how they work in field conditions with some examples based on simple successions of already worked out geological maps. Applicable knowledge with insight of the different subdivisions of stratigraphy and their applications including correlation, the geological time scale is gained by the student.	Remember, understand, apply, and assess.
CO2	The student acquires knowledge of the imperfections in the stratigraphic record; knowledge of India's physiographic, structural and tectonic divisions. The oldest rock succession is introduced with a template on how important stratigraphic successions have to be studied in detail.	Understand, apply, and assess.
CO3	The student is able to describe the different stratigraphic successions and their relevant details. These standard successions are useful in geological mapping for	Understand, apply, and assess.

	comparison in terms of age, fossil content, and others.	
CO4	The student is able to describe the different stratigraphic successions and their relevant details. These standard successions are useful in geological mapping for comparison in terms of age, fossil content, and others.	Understand, apply, and assess.
CO5	The student is able to describe the different stratigraphic successions and their relevant details. These standard successions are useful in geological mapping for comparison in terms of age, fossil content, and others.	Understand, apply, and assess.

MAPPING WITH PROGRAM OUTCOMES (S – Strong; M- Medium; L-Low)

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	M	S	S	M	M	S	M	M
CO2	S	M	M	S	S	M	M	S	M	M
CO3	S	M	M	S	S	M	M	S	M	M
CO4	S	M	M	S	S	M	M	S	M	M
CO5	S	M	M	S	S	M	M	S	M	M

Course Code	**Paper Title**	**Lectures**	**Tutorials**	**Practical**	**Credits**
21UGL08	**SEDIMENTARY PETROLOGY & ENVIRONMENTAL GEOLOGY**	**4**	**1**	**3**	**5**

Broad Objectives & Teaching Methodology:

The student is introduced to the fundamentals of sedimentary petrology. Sedimentary petrology is the study of sedimentary rocks generated on the earth's crust. The proper identification of sedimentary rocks in the laboratory or in the field, is a precursor to assess their mode of occurrence, association, expected economic mineralization, and others. Environmental geology is the application and role of geology in the environmental perspective. The teaching

methodology is done by class room lectures, use of physical models, multi media resources, interactive sessions, student involvement sessions with practical and laboratory demonstrations, field visits, microscopic techniques and others.

UNIT I **SEDIMENTARY PETROLOGY**

Definition and scope of Sedimentary Petrology. Sedimentary rocks: definition, origin, disintegration and decomposition of rocks. Transportation and deposition of sediments. Outline of compaction, lithification and diagenesis of sediments. Classification of sedimentary rocks: Megascopic classification. Textures of sedimentary rocks. Outline of size of sediments, phi scale and grain size parameters.

UNIT II

Structures of sedimentary rocks. Outline of methods to determine the top and base of sedimentary beds. Sedimentary residual deposits: soils, regolith, laterite, and terra rosa. Sedimentary mechanical deposits. Outline of different depositional sedimentary environments and their common sedimentary rocks.

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, classification, and types of : conglomerate, breccia, sandstone, shale and limestones.

UNIT IV **ENVIRONMENTAL GEOLOGY**

Definition and scope of environmental geology. Classification and types of natural resources. Renewable and non renewable resources. Impact of man on the environment. Groundwater pollution: definition, types and remedial measures. Geological factors in environmental health. Trace elements and human health. Chronic disease and geological environment.

UNIT V

Energy resources: definition, types, renewable and non-renewable energy resources. Environmental impact due to mining and mineral processing and its remediation. Coastal environments: definition, pollution in coastal areas, prevention of erosion along coasts. Types of human generated waste and outline of methods of disposal. Outline of Environmental law in India.

REFERENCE BOOKS

1. Tyrell,G.W. (1958). Principles of Petrology. B.I. Publications. New Delhi.

2. Haung,W.T. (1962). Petrology. McGraw Hill. New York.

3. Williams,H. et al. (1982). Petrography. CBS. New Delhi.

4. Keller,E.A.(1985). Environmental Geology. Merill. New York.

5. Coates,D.R. (1984). Environmental Geology. McGraw Hill. New York.

TEXT BOOKS

1. Greensmith,J.T. (1976). Petrology of the Sedimentary Rocks. CBS. Delhi.

2. Folk,R.L. (1974). Petrology of the Sedimentary Rocks. Hemphill. Texas.USA.

3. Miller,T.G.(2004). Environmental Science. Wadsworth Publishing. USA.

Web resources: The student can approach the Teacher concerned for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: Soft copies related study materials are available in the Department for access with proper permission from the Teacher concerned.

A**ssignments:** Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Supervised field visits are suggested with the submission of a field report.

S. No.	COURSE & LEARNING OUTCOMES	
CO1	The student is able to understand and describe the weathering and geomorphic processes involved in generating sediments, understand different sedimentary processes, classify sedimentary rocks, and assess the different sedimentary textures as related to geomorphic processes.	Remember, understand, apply, and assess.
CO2	The student is able to understand and describe different sedimentary depositional environments; understand different sedimentary structures, residual deposits, processes, assess the different sedimentary environments.	Understand, apply, and assess.
CO3	The student is able to understand and describe different chemical and organic sedimentary rocks; understand different sedimentary structures, residual deposits, processes, assess the petrographical features of sedimentary clastic rocks.	Understand, apply, and assess.
CO4	The student is able to understand and describe the types of natural, renewable, and non-renewable resources; understand how man impacts the environment in different ways and means; know and assess groundwater pollution, environmental health, and understand the role of how geology is related to human health and chronic disease.	Understand, apply, and assess.
CO5	The student is able to understand and describe the types of energy related renewable, and non-renewable resources; understand how mining impacts the environment in different ways and means; know and assess coastal erosion; human generated waste and its disposal; and an outline of relevant environmental laws in India.	Understand, apply, and assess.

MAPPING WITH PROGRAM OUTCOMES (S – Strong; M- Medium; L-Low)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	S	M	M	S	S	S
CO2	S	M	M	S	S	M	M	S	S	S
CO3	S	M	M	S	S	M	M	S	S	S
CO4	S	-	-	-	-	S	-	-	M	M
CO5	S	-	-	-	-	S	-	-	M	M

Course Code	Paper Title	Lectures	Tutorials	Practical	Credits
21UGL09	**ECONOMIC GEOLOGY**	**4**	**1**	**3**	**5**

Broad Objectives & Teaching Methodology:

Economic Geology is the study of mineral deposits. It is closely allied to mining and exploration geology. It is concerned with the origin and genesis, mode of occurrence, mineralogy, petrographic characters, host rock association, and tectonic association of mineral deposits. The student is introduced to the fundamentals, deposit generating processes, and applications of economic geology. The teaching methodology is done by class room lectures, use of physical models, multi media resources, interactive sessions, student involvement sessions with practical and laboratory demonstrations, field visits, microscopic techniques and others.

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 Lindgren and 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.

UNIT III

Processes of Ore Formation II: Hydrothermal: Cavity filling deposits and Replacement deposits. Outline of ore shoots. Contact Metasomatism – Sedimentation.

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. Mineralogy, association, mode of occurrence and distribution in India of the minerals used in the following Industries: abrasives – refractory – cement.

UNIT V

Ore mineralogy, association, genesis, mode of occurrence, and Indian distribution of the following metallic ore deposits: - Al, Pb & Zn, and Cr. Mineralogy, association, mode of occurrence and distribution in India of the minerals used in the following Industries: glass – ceramics – fertilizer – paints and pigments.

REFERENCE BOOKS

1. Bateman,A.M. & M.L.Jensen.(1981). Economic Mineral Deposits. 3rd ed. Wiley. New York.

2. Edwards,R. & K.Atkinson. (1986). Ore Deposit Geology. Chapman & Hall. UK.

3. Park,C.F. & M.A.MacDiarmid.(1970). Ore Deposits.Freeman.New York.

4. Craig,R.C & D.V.Vaughan.(1985).Ore Microscopy and Ore Petrography.Wiley.New York.

TEXT BOOKS

1. Aiyengar,N.K.N.(1964). Minerals of Madras. Dept. of Indus & Comm. Guindy, Madras.

2. Krishnan,M.S. (1951). Mineral Resources of Madras. Memoir V.80. Geol.Surv.Ind. Kolkata.

3. Prasad,U. (2003). Economic Mineral Deposits. CBS. Delhi.

4. Banerjee,D.K. (1998). Mineral Resources of India. World Press. Kolkata.

5. Deb,S.(1985). Industrial Minerals and Rocks of India. Oxford & IBH. Delhi.

6. Krishnasamy,S. (1988). India's Mineral Resources. Oxford & IBH. Delhi.

7. Sharma,N.L & R.K.Sinha. (1985), Mineral Economics. Oxford & IBH.Delhi.

8. Gokhale,K.V.G.K.&D.M.Rao.(1981).Ore Deposits of India. Oxford & IBH.Delhi.

Web resources: The student can approach the Teacher concerned for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: Soft copies related study materials are available in the Department for access with proper permission from the Teacher concerned.

A**ssignments:** Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Supervised field visits are suggested with the submission of a field report.

S. No.	COURSE & LEARNING OUTCOMES	
CO1	The student is able to understand and describe how economic minerals are formed in a mineral deposit. The classification scheme is the working template for different ore or mineral deposit forming processes. The relation of mineral deposits to particular periods of geological time and their distribution is discussed for application in exploration geology.	Remember, understand, apply, and assess.
CO2	The student is able to understand and describe how economic minerals are formed by specific processes of ore formation.	Understand, apply, and assess.
CO3	The student is able to understand and describe how economic minerals are formed by specific processes of ore formation.	Understand, apply, and assess.
CO4	The student is able to understand and describe the petrographic features of ores. Metallic ore deposits and some industrial mineral deposits are discussed in detail.	Understand, apply, and assess.
CO5	The student is able to understand and describe the petrographic features of ores. Metallic ore deposits and some industrial mineral deposits are discussed in detail.	Understand, apply, and assess.

MAPPING WITH PROGRAM OUTCOMES (S – Strong; M- Medium; L-Low)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	M	M	M	S	S	S
CO2	S	M	M	S	M	M	M	S	S	S
CO3	S	M	M	S	S	M	M	S	S	S
CO4	S	M	M	S	S	S	M	S	M	S
CO5	S	M	M	S	S	S	M	S	M	S

Course Code	Paper Title	Lectures	Tutorials	Practical	Credits
21UGL10	**MINING GEOLOGY**	**3**	**1**		**5**

Broad Objectives & Teaching Methodology:

Mining geology is the practical application of geological principles for the viable and cost effective extraction of ores and economic minerals from their host rocks. It is closely related to economic geology, mineral exploration, and ore petrology. The student is introduced to the basic and applied principles of mining geology. The role of a geologist in different stages of quarrying and mining is emphasized in the course. The teaching methodology is done by class room lectures, use of physical models, multi media resources, interactive sessions, student involvement sessions with practical and laboratory demonstrations, field visits to working quarries and mines, and others.

UNIT I

Definition and scope of mining geology. Methods of breaking over burden 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.

UNIT II

Drilling: definition and purpose. Drilling methods: rotary, percussion, and diamond. Geological logging of bore hole samples. Open cast mining methods: Parts of an open cast mine: over burden, surface adit, bench, slope, drop-cut, over-break. Open cast mining equipment: bull dozer, front end loader, poclain, drag line with bucket, and wheel excavators.

UNIT III

Strip mining and surface augering of coal beds and seams. Quarrying method for hard rocks. Glory hole mining. Alluvial mining of unconsolidated sediments and soft rocks. Hydraulicking method – panning and sluicing of sediments. Dredging of off shore unconsolidated sediments.

UNIT IV

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 stoping methods: open stope, level stoping, supported stopes, square set stopes, pillar supported stopes, and shrinkage stopes.

UNIT V

Subsurface coal mining methods: stope and pillar, long wall, room and pillar, and caving. Modes of transportation of broken ore in open cast and underground mines. Outline of subsurface mine ventilation. Groundwater problems and their management in open cast and under ground mines. Outline of the life cycle of a quarry or mine and a short account of quarry and mine reclamation for non-mining uses.

REFERENCE AND TEXTBOOKS

1. Arogyaswamy, R.N.P. (1988). Courses in Mining Geology, Oxford & IBH, New Delhi.

2. Singh, R.D. (1998). Coal Mining. New Age Publishers, Delhi.

3. Thomas, R.T. (1986). Introduction to Mining methods. McGraw Hill, New York.

4. Peters, W.C. (1978). Exploration and Mining Geology, Wiley, New York.

5. Hartman, H.L. (1992). SME Mining Engineering Handbook, SME Colorado, USA.

6. McKinstry, H.E.(1948). Mining Geology, Asia Publishing House, Delhi.

Web resources: The student can approach the Teacher concerned for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: Soft copies related study materials are available in the Department for access with proper permission from the Teacher concerned.

A**ssignments:** Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Supervised field visits are suggested with the submission of a field report.

S. No.	COURSE & LEARNING OUTCOMES

CO1	The student is able to understand and describe how overburden materials are removed to expose the economic deposit. Sampling of economic minerals for tenor or grade estimation in a working mine is discussed.	Remember, understand, apply, and assess.
CO2	The student is able to understand and describe the role of drilling in day to day mining operations and logging of bore hole samples done in the lease area for later mining. Open cast mining methods and the equipment used in a working mine are explained and assessed.	Understand, apply, and assess.
CO3	The student is able to understand, describe, and assess the mining applied to coal seams, hard rocks, alluvial deposits, hydraulicking, and dredging of economic minerals.	Understand, apply, and assess.
CO4	The student is able to understand, describe, and assess the underground mining methods applied to coal seams and hard rocks.	Understand, apply, and assess.
CO5	The student is able to understand, describe, and assess the subsurface coal mining methods, mine ventilation, groundwater problems, and modes of transportation of broken ore in mines, life cycle of a mine and reclamation of mined or quarried land after mining has effectively ceased.	Understand, apply, and assess.

MAPPING WITH PROGRAM OUTCOMES (S – Strong; M- Medium; L-Low)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	M	S	S	S	S
CO2	S	S	S	S	M	M	S	S	S	S
CO3	S	S	S	S	M	M	S	S	S	S
CO4	S	S	S	S	M	M	S	S	S	S
CO5	S	S	S	S	M	M	S	S	S	S

Course Code	Paper Title	Credits
21UGLP1	STRUCTURAL GEOLOGY AND SURVEYING	4

Practical Examination Maximum Marks: 50; Records: 10; Internal Assessment Maximum Marks: 40. Hours:

GEOLOGICAL MAPS

Study of Topographical maps: Identification of land forms, structures such as fold, fault, unconformities and intrusions.

Laboratory exercises in structural geology maps: contours – completion of outcrops, simple three point problems, fold maps, fault maps, unconformity maps. Complex maps with two structures such as fold and fault, fault and unconformity, and others.

Preparation of cross sections across the geological maps to bring out the structure, interpretation of structures, determining the order of superposition of beds and writing the geological history of the area.

Exercise on structural geology problems: Graphical determination of dip in gradient. Determination of true dip by simple calculation. Problems pertaining to determination of true thickness and depth of a bed by calculation on a level and sloping ground. Plotting of attitudinal data and poles to bedding or structures in a stereographic projection.

SURVEYING

Portable Compass surveying: Description and field applications of Clinometer and Brunton Compass. **Chain surveying**: Open traverse, closed traverse.

Prismatic Compass surveying: Determination of the distance between two inaccessible stations by the method of radiation and intersection.

Plane table surveying: Determination of the distance between two inaccessible stations by the method of radiation and intersection.

Leveling: Rise and fall method. Use of portable **GPS** receiver in the field and their applications in geological mapping.

FIELD TRAINING PROGRAMME

First Year of the course.

In part fulfillment of B.Sc Applied Geology Degree course, students are taken for **mandatory field training programs** to study the **geomorphological features and structural geology** of selected areas in and around Salem district, for a period of 3 to 4 days. Full attendance to the field training program concomitant with the submission of a field training report by the student is **mandatory** for internal assessment. Internal assessment marks for the practical are: **Practical Class Attendance = 5 marks; Practical Test = 10 marks; Field Training attendance and report submission = 25 marks; Total = 40 Marks.**

Course Code	Paper Title	Credits
21UGLP2	PALEONTOLOGY & CRYSTALLOGRAPHY	4

Practical Examination Maximum Marks: 50; Records: 10; Internal Assessment Maximum Marks: 40. Hours: 3

PALEONTOLOGY

Identification, biological position, and stratigraphic range in time of the following groups of fossils:

Pelecypods: Meretrix, Arca, Cardium, Cardita, Pecten, Venus, Unio, Pinna, Modiola, Lima, Inoceramous, Alectryonia, Gryphaea, Exogyra, Spondylus,Pectenculus,Radiolites, Trigonia, Ostrea.

Gastropods: Turritella,Cerithium,Turbo, Trochus,Natica,Conus,Fusus, Physa, Busycon, Voluta, Murex,Bellerophon, Helix, Cyprea,Euomphalus.

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.

Foraminifera : Textularia, Quinqueloculina, Globigerina, Lagena, Nummulites.

Porifera : Siphonia and Ventriculites.

Plant fossils: Glossopteris, Gangamoptris, Ptilophyllum, Lepidodentron, Sigillaria, Stigmaria, Calamites.

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. Description of forms present and determination of Miller indices of the following crystal models.

Cubic System: Galena, Garnet, Fluorite, Magnetite, Pyrite, Tetrahedrite, Boracite.

Tetragonal System: 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.

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: Cruciform, Aragonite – Staurolite.
Monoclinic: Mica, Orthoclase: Carlsbad, Manebach and Baveno type, Gypsum.
Triclinic: Albite – Simple Twin.

FIELD TRAINING PROGRAMME - Second Year of the course.

In part fulfillment of B.Sc Applied Geology Degree course, students are taken for mandatory field training programs to study the fossil bearing formations of Tamil Nadu for a period of 5 to 7 days to collect and study the modes of preservation of fossils. Full attendance to the field training program concomitant with the submission of a field training report at the time of Main Practical Examination by the student is mandatory for internal assessment. Internal assessment marks for the practical are: Practical Class Attendance = 5 marks; Practical Test = 10 marks; Field Training attendance and report submission = 25 marks; Total = 40 Marks.

Course Code	Paper Title	Credits
21UGLP3	MINERALOGY & PETROLOGY	4

Practical Examination Maximum Marks: 50; Records: 10; Internal Assessment Maximum Marks: 40. Hours: 3

MINERALOGY

A. MINERAL MEGASCOPY

Megascopic identification of rock forming silicates 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.

Feldspar 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, Glaucophane.

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.

B. 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,Spodumene, Muscovite, Biotite,Chlorite,Epidote, Hornblende, Sphene, Serpentine, Stilbite, Actinolite, Tremolite.

Triclinic Minerals: Microcline, Albite, Oligoclase, Andesine, Anorthite, Labradorite, Kyanite.

C. ROCK MEGASCOPY

Megascopic identification of rocks based on petrographic characters, mineralogy, and other diagnostic megascopic features.

I. Igneous Rocks:

Acid Igneous Rocks: Granites: graphic granite, aplite, 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: Gabbros: gabbro, norite, dolerite.

Ultrabasic Igneous Rocks: anorthosite.

Ultramafic Igneous Rocks: dunite, peridotite, pyroxenite.

Alkaline Igneous Rocks: lamphrophyre, carbonatite, kimberlite.

Volcanic Igneous Rocks: basalts: vesicular, amygdaloidal, vitrophyric basalt. pitchstone, scoria, pumice, obsidian, rhyolite, rhyodacite, trachyte.

II. Metamorphic Rocks

Regional Metamorphic Rocks: slate: colored and porphyroblastic varieties; phyllite; schists: mica, kyanite, amphibole, and talc; gneisses: banded, garnetiferous, injection type, migmatite varieties; amphibolite; eclogite; granulites: charnockite types; khondalite;gondite; grodurite; leptynite. **Contact Metamorphic Rocks**: marble, quartzite, skarn,hornfels.

III Sedimentary Rocks

Clastic Rocks: sandstone and its varieties; breccias; conglomerate; shale and its varieties;greywackes.

Non-clastic rocks: limestone and its varieties; flint; chert; Coal: peat, lignite, bituminous, and anthracite.

D. ROCK MICROSCOPY

Petrographic identification of rock 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; lamphrophyre, carbonatite, kimberlite; basalts: vesicular, amygdaloidal, vitrophyric basalt. pitchstone, scoria, pumice, obsidian, rhyolite, rhyodacite, trachyte, phonolite.

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, quartzite, skarn,hornfels.

Sedimentary Rocks: Sandstone and its varieties; breccias; conglomerate; shale and its varieties; greywackes; limestone and its varieties; flint; chert;

FIELD TRAINING PROGRAMME - Third Year of the course.

In part fulfillment of B.Sc Applied Geology Degree course, students are taken for mandatory field training programs to study geological formations and geologically important places within Tamil Nadu or in other states of India for a period of 7 to 10 days to collect rocks, minerals, ores and others. Full attendance to the field training program concomitant with the proper display of collected specimens, and the submission of a field training report at the time of Main Practical Examination by the student is mandatory for internal assessment. Internal assessment marks for the practical are: Practical Class Attendance = 5 marks; Practical Test = 10 marks; Field Training attendance and report submission = 25 marks; Total = 40 Marks.

Course Code	Paper Title	Credits
21UGLP4	ECONOMIC MINERALS, GEOCHEMISTRY & FIELD GEOLOGY	4

Practical Examination Maximum Marks: 50; Records: 10; Internal Assessment Maximum Marks: 40. Hours: 3

1.Determination of strike, dip, trend and plunge of geological structures or features using Clinometer Compass and Brunton Compass; Simple problems in the use of stereographic projection in structural geology.

2.Identification of geomorphological features and major drainage patterns from scaled aerial photographs and satellite imageries.

3.Identification of the following gem stones: Diamond, ruby, sapphire, topaz, quartz, amethyst, agate, opal, jasper, diopside, moonstone, labradorite, sodalite, lazurite, beryl, garnet, kyanite.

4. Megascopic identification of ore and industrial minerals:

Ore minerals: Fe ores: magnetite, hematite, limonite, pyrite, marcasite and siderite. Cu ores: chalcopyrite, cuprite, bornite, malachite, azurite, native copper. Mn ores: pyrolusite, psilomelane, rhodochrosite,and rhodonite. Pb ores: galena, cerussite, anglesite. Zn ores: smithsonite, sphalerite. Sn ore: cassiterite. As and Sb ores: realgar,orpiment, stibnite. Other ores: wolframite, molybdenite, bauxite, chromite, ilmenite, rutile, cinnabar. Radioactive Ores: monazite, zircon, pitchblende, and pyrochlore.

Industrial Minerals: magnesite, gypsum, asbestos, fluorite, calcite, graphite, barite, talc, witherite, strontianite, anhydrite, halite, dolomite, aragonite, kaolin, garnet, corundum, phosphate nodule.

5. Qualitative Analysis of Ores using the method of Blow pipe.

Calcite, dolomite, magnesite, gypsum, bauxite, apatite, anhydrite, celestite, barite, magnetite, hematite, chromite, galena, pyrolusite, psilomelane, stibnite, sphalerite, cuprite, wolframite, malachite, and smithsonite.

6. Determination of pH value of groundwater samples.

FIELD TRAINING PROGRAMME - Third Year of the course.

In part fulfillment of B.Sc Applied Geology Degree course, students are taken for mandatory field training programs to study geological formations and geologically important places within Tamil Nadu or in other states of India for a period of 7 to 10 days to collect rocks, minerals, ores and others. Full attendance to the field training program concomitant with the proper display of collected specimens, and the submission of a field training report at the time of Main Practical Examination by the student is mandatory for internal assessment. **Internal assessment marks for the practical are: Practical Class Attendance = 5 marks; Practical Test = 10 marks; Field Training attendance and report submission = 25 marks; Total = 40 Marks.**

Course Code	Paper Title	Lectures	Tutorials	Practical	Credits
21UGLM1	**EXPLORATION GEOLOGY**	**3**	**1**		**5**

Broad Objectives & Teaching Methodology:

Exploration geology pertains to the combined principles of geology, geophysics, and geochemistry applied to the search and location of economic mineral deposits. Exploration geology is related to economic geology, mining geology, and mineral economics. It also provides some preliminary data on the type of deposit. The teaching methodology is done by class room lectures, use of physical models, multi media resources, interactive sessions, student involvement sessions with practical and laboratory demonstrations, instrument use, method of field data collection and others.

UNIT I

Geological methods: Guides to ore deposits: Mineralogic, lithologic, structural, stratigraphic, and physiographic. Controls of ore localization. Sampling of ores and minerals: definition and types of samples. Outline of sampling methodology. Geochemical classification of elements. Short account on geochemical cycles and elemental mobility. Outline of composition of the crust, mantle, and core.

UNIT II

Exploration Geochemistry: Outline of elemental abundance in different earth materials. Geochemical classification of elements. Fundamental Concepts: background values, threshold values, geochemical anomaly and geochemical province. Geochemical cycle. Dispersion of elements: Primary and Secondary. Controls of dispersion: Physical and Chemical controls. Mobility of elements. Elemental haloes: Types and their recognition. Utility of path finder elements and minerals in ore and mineral exploration. Geochemical surveys: Definition – Types – Sampling Methodology – Application to mineral deposits. Outline of analytical methods used in Exploration Geochemistry. Short account on geo-botanical prospecting.

UNIT II

Gravity Method: Definition of gravity. Newton's Law of Gravitation. Gravity field of the earth – surface gravity variation – size and shape of earth – geoidal and spheroidal surface. Gravity measurements: Absolute and relative. Gravity units. Gravimeters: Outline of Stable and Unstable gravimeters. Gravity Surveys. Applications and limitations of gravity methods.

UNIT III

Magnetic Methods: Earth's magnetic field and its components – origin and units of measurement. Types of magnetism observed in rocks and minerals. Outline of normal and reversed magnetic fields. Magnetometers: Types. Magnetic surveys. Applications and limitations of magnetic methods.

UNIT IV

Electrical Methods: Definition – Ohm's Law – true resistivity – apparent resistivity and conductivity – types of electrical conduction – Electrical properties of rocks and minerals - Units of measurement. Resistivity surveying equipment. Current paths in the subsurface: two and three layers. Electrode configurations: Wenner – Schlumberger. Applications and limitations of resistivity methods. Outline of Induced polarization and Self Potential methods.

UNIT V

Seismic Methods: General principles. Methods of generating artificial seismic waves. Geophones – types and their limitations. Recording equipment. **Refraction Methods:** Principle – Instruments and equipment – Field Methods: Fan, Arc, and Profile shooting. **Reflection Methods:** Principle – Instruments and equipment – Field Operations: Shot point and Detector spreads. Applications and limitations.

REFERENCE BOOKS

1. Banerjee, P.K,(1997).Elements of Prospecting for Non Fuel Mineral Deposits. Allied. Chennai.

2.Hawkes, H.E. (1959). Principles of Geochemical Prospecting. Bulletin 1000F.USGS.

3.Moon, C.J et al.(2006). Introduction to Mineral Exploration. Wiley Blackwell. New Delhi.

4.Kearey, P, et al.(2002). An Introduction to Geophysical Exploration. Wiley. Delhi.

5.Mussett,A.E.& Khan,M.A.(2000). Looking into the Earth. CUP. Delhi.

TEXT BOOKS

1.Arogyaswamy, R.N.P. (1980). Courses in Mining Geology. Oxford & IBH, New Delhi.

2. Ramachandra Rao,M.B.(1993).Outlines of Geophysical Prospecting. EBD. Dhanbad.

3. Sharma, P.V. (2005). Environmental and Engineering Geophysics. CUP. Delhi.

Web resources: The student can approach the Teacher concerned for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: Soft copies related study materials are available in the Department for access with proper permission from the Teacher concerned.

A**ssignments:** Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Supervised field visits are suggested with the submission of a field report.

S. No.	COURSE & LEARNING OUTCOMES

CO1	The student is able to describe the different geological guides to locate ore and mineral deposits. Sampling methods for different earth materials is emphasized.	Remember, understand, apply, and assess.
CO2	The student is able to describe the gravity method of geophysical prospecting with useful inputs for field application and data collection.	Understand, apply, and assess.
CO3	The student is able to describe the magnetic method of geophysical prospecting with useful inputs for field application and data collection.	Understand, apply, and assess.
CO4	The student is able to describe the electrical method of geophysical prospecting with useful inputs for field application and data collection.	Understand, apply, and assess.
CO5	The student is able to describe the seismic reflection and refraction methods of geophysical prospecting with useful inputs for field application and data collection.	Understand, apply, and assess.

MAPPING WITH PROGRAM OUTCOMES (S – Strong; M- Medium; L-Low)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	S	S	M	S	S	M
CO2	S	M	M	S	S	S	M	S	S	M
CO3	S	M	M	S	S	S	M	S	S	M
CO4	S	M	M	S	S	S	M	S	S	M
CO5	S	M	M	S	S	S	M	S	S	M

Course Code	Paper Title	Lectures	Tutorials	Practical	Credits

21UGLM2	**MARINE GEOLOGY**	**3**	**1**		**5**

Broad Objectives & Teaching Methodology:

Marine geology is the study of all geological features, structures, petrology, and others, of the oceanic crust which is overlain and obscured by a column of ocean or sea water. The student is introduced to marine geology and geomorphology, which will prove useful in structural and geophysical mapping, mineral exploration, drilling of oceanic crust, and others, of the varied domains present between the continental margins and mid oceanic ridges. The teaching methodology is done by class room lectures, use of physical models, multi media resources, interactive sessions, student involvement sessions with practical and laboratory demonstrations, and others.

UNIT I

Marine Geology: definition and scope. Morphological characters of the ocean floor. Methods of mapping the surface of ocean floor. Ocean sediments: types, sources, composition, genesis, age, erosion, and rates of sedimentation. Short account of the differences between continental and oceanic sediments.

UNIT II

Tectonic domains of the ocean floor. Oceanic crust: mineralogy, petrology, vertical section and seismic characters. Interaction of sea water and basalt along mid oceanic ridges and transform faults. Oceanic mantle plumes: origin, distribution, and volcanism in the oceanic crust. Coral reefs and atoll formation.

UNIT III

Drilling the oceanic crust: purpose, methods, and results. Sedimentation on continental margins. Processes affecting sediment transport and distribution on ocean floor. Vertical temperature distribution of water column. Role of CCD and SCD in sedimentation on the ocean floor.

UNIT IV

Chemistry of ocean water. Sampling of ocean floor sediment: Van veen grab, Peterson grab, La Fond & Dietz snapper, Phleger – corer sampler, sediment scoop and dredger. Environmental sensors: bathythermograph, reversing thermometer. Water sampler: Nansen bottle. Water depth indicators: Secchi disc.

UNIT V

Mineral resources of the ocean floor and their distribution. Short notes on massive sulphides and black smoker chimney deposits. Trench sediments and petroleum accumulation. Short account of natural gas hydrates. Ocean currents and tides. Eustasy and its impact on coasts. Short note on tsunamis and oceanic crust subduction.

REFERENCE & TEXT BOOKS

1. Kennett, J.P. (1982). Marine Geology. Prentice Hall. New Jersey;

2. Shepard, F.P. (1977). Geological Oceanography. Crane Russak. New York.

3. Radhakrishnan, V. (1996). General Geology. V.V.P. Publishers. Tuticorin.

4. Emiliani, C. (1992). Planet Earth. CUP. Delhi.

5. Seibold, E. & W.H.Berger. (1993). The Sea Floor. Springer. Delhi.

6. Weisberg, C.P. (1979). Oceanography. McGraw Hill. New York.

7. Anderson, R.N. (1986). Marine Geology. Wiley. New York.

Web resources: The student can approach the Teacher concerned for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: Soft copies related study materials are available in the Department for access with proper permission from the Teacher concerned.

A**ssignments:** Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Supervised field visits are suggested with the submission of a field report.

S. No.	COURSE & LEARNING OUTCOMES	
CO1	The student is introduced to marine geology with an understanding and discussion of: morphological characters, mapping, and ocean sediments. These topics are relevant to mineral exploration of the ocean floor.	Remember, understand, apply, and assess.
CO2	The student is introduced to the tectonic domains, salient features of the oceanic crust, interaction of sea water and basalt, oceanic mantle plumes and coral reefs and atoll formation. These topics are relevant to the relevant geophysical and geochemical phenomenon of the ocean crust.	Understand, apply, and assess.
CO3	The student is introduced to the drilling the oceanic crust, sedimentation on continental margins, sediment transport and distribution. These topics find relevance to geological exploration of the oceanic crust and stratigraphy. The vertical temperature distribution of water column, CCD and SCD influence sedimentation on the ocean floor. These topics are relevant to ancient marine stratigraphy to assess water depth.	Understand, apply, and assess.
CO4	The student is introduced to chemistry of ocean water; different types of sampling equipment, their uses, working mechanism, limitations and applications.	Understand, apply, and assess.
CO5	The student is introduced to the varied mineral resources of the ocean floor and their distribution, including massive sulphides and black smoker chimney deposits, petroleum accumulation, and natural gas hydrates. The role of ocean currents, tides, eustasy, and tsunamis are discussed.	Understand, apply, and assess.

MAPPING WITH PROGRAM OUTCOMES (S – Strong; M- Medium; L-Low)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	M	M	S	M	M

CO2	S	S	M	M	M	M	M	S	M	M
CO3	S	S	M	M	M	M	M	S	M	M
CO4	S	S	M	M	M	M	S	S	M	M
CO5	S	S	M	M	M	M	S	S	M	M

Course Code	Paper Title	Lectures	Tutorials	Practical	Credits
21UGLM3	**REMOTE SENSING**	**3**	**1**		**5**

Broad Objectives & Teaching Methodology:

Remote sensing is the observation of earth's surface features via scaled aerial photographs and imageries obtained from aircraft and satellites fitted with specifically manufactured sensors and camera equipment. The broad applicability of remote sensing in the geological sciences is emphasized in this course. The student is introduced to the basic elements and techniques of remote sensing along with their applications and limitations. The teaching methodology is done by class lectures, use of models, multimedia resources, practical demonstrations emphasizing: types of instruments used for viewing and interpreting aerial photographs, satellite images, and others.

UNIT-I

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

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. Satellite remote sensing: Principles of optical remote sensing: Satellite orbiting mechanisms – Brief account of multi spectral scanning – along track and across track scanning. Types of resolution – data acquisition and interpretation.

UNIT IV

Thermal Remote Sensing: Thermal radiation principles – thermal atmospheric windows – advantages and disadvantages. SLAR – principle and applications. A short account of LANDSAT, SPOT and India Remote Sensing satellites. Indian Space Missions.

UNIT V

A short account of the remote sensing techniques in the study of drainage patterns, major land forms, geological structures. Ground water exploration and mineral exploration.

REFERENCE & TEXTBOOKS

1. **Curran,P.B.** (1985). Principles of Remote Sensing. ELBS. London.

2. **Drury,S.D.** (1993). Image Interpretation in Geology. Allen & Unwin. London.

3. **Miller,V.C.** (1961). Photogeology. McGraw Hill. New York.

4. **Pandey,S.N.** (1989). Principles and Applications of Photogeology. Wiley Eastern. New Delhi.

5. **Sabins,F.F.** (1974). Remote Sensing Principles and Interpretation. Freeman. New York.

6. **Reddy,A.** (2010). Principles of Remote Sensing and GIS. CBS. Delhi.

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

8. Lillisand,T.M & R.W.Kiefer. (2000). Remote Sensing and Image Interpretation. Wiley. Delhi.

Web resources: The student can approach the Teacher concerned for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: Soft copies related study materials are available in the Department for access with proper permission from the Teacher concerned.

A**ssignments:** Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Supervised field visits are suggested with the submission of a field report.

S. No.	**COURSE & LEARNING OUTCOMES**	
CO1	The student is able to understand the basic elements of RS. He/she in introduced to different energy sources and their interaction with the atmosphere, spectral signatures, and atmospheric windows.	Remember, understand, apply, and assess.
CO2	The student is introduced to the types and classes of satellite RS and aerial RS.	Understand, apply, and assess.
CO3	The student is introduced to AP interpretation elements and their mosaics. He/she learns and understands the elements of satellite RS.	Understand, apply, and assess.
CO4	The student is introduced to thermal RS and SLAR. A short account of IRS satellites and Indian space missions is introduced.	Understand, apply, and assess.
CO5	A short account of the remote sensing techniques in the study of geomorphic features and geological structures relevant to ground water and mineral exploration is emphasized.	Understand, apply, and assess.

MAPPING WITH PROGRAM OUTCOMES (S – Strong; M- Medium; L-Low)

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	-	S	-	-	M	M	M
CO2	S	S	S	-	S	-	-	M	M	M
CO3	S	S	S	-	S	-	-	M	M	M

CO4	S	S	S	-	S	-	-	S	M	M
CO5	S	S	S	-	S	-	-	S	M	M

Course Code	Paper Title	Lectures	Tutorials	Practical	Credits
21UGLM4	**MINERAL RESOURCES OF TAMIL NADU**	**3**	**1**	**3**	**5**

Broad Objectives & Teaching Methodology:

This course introduces to the student the varied mineral resources of Tamil Nadu. The different ore, economic, and industrial mineral deposits are discussed in detail for understanding, application and assessment. This course will support field geology, exploration geology and mining geology as most of the deposits described here are being quarried and mined. The topics discussed in this course aims to aid the student to have a working knowledge for competitive exams and future employment in mineral based industries. The exploitation and extraction of these economic minerals directly influences the economy, employment potential, and higher returns to the treasury of the State. The teaching methodology is done by class room lectures, use of physical models, multi media resources, interactive sessions, student involvement sessions with practical and laboratory demonstrations, field visits, and others.

UNIT I

Mineralogy, association, mode of occurrence, reserves and distribution in Tamil Nadu of the minerals used in the following industries: abrasives, refractory, cement, glass, paints and pigments.

UNIT II

Mineralogy, association, mode of occurrence, reserves and distribution in Tamil Nadu of the minerals used in the following industries: ceramics and fertilizer. Ore mineralogy, association, genesis, mode of occurrence, reserves, and distribution in Tamil Nadu of the following metallic ore deposits: - Fe, Nb-Ta, W, and Mo.

UNIT III

Ore mineralogy, association, genesis, mode of occurrence, reserves, and distribution in Tamil Nadu of the following metallic ore deposits: - base metals (Cu, Pb, & Zn), Ni, PGE, Al, Cr, and Sn.

UNIT IV

Mode of occurrence, reserves and distribution in Tamil Nadu: lignite, natural gas, petroleum, mica, talc, and steatite deposits.

UNIT V

Mode of occurrence, reserves and distribution in Tamil Nadu: apatite, rock phosphate, barite, asbestos, evaporite salt, and vermiculite deposits. Building and dimension stones: petrological types, their commercial nomenclature, and distribution in Tamil Nadu.

REFERENCE & TEXT BOOKS

1. Aiyengar,N.K.N.(1964).Minerals of Madras.Dept. of Industries & Commerce. Guindy,Madras.

2. Krishnan,M.S. (1951). Mineral Resources of Madras. Memoir V.80. Geol.Surv.Ind. Kolkata.

3. Prasad,U. (2003). Economic Mineral Deposits. CBS. Delhi.

4. Banerjee,D.K. (1998). Mineral Resources of India. World Press. Kolkata.

5. Deb,S.(1985). Industrial Minerals and Rocks of India. Oxford & IBH. Delhi.

6. Krishnasamy,S. (1988). India's Mineral Resources. Oxford & IBH. Delhi.

7. Singanenjam,S. (2014). Misc. Pub. No. 30. Part.6. Geol. Surv. India. Kolkata.

Web resources: The student can approach the Teacher concerned for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: Soft copies related study materials are available in the Department for access with proper permission from the Teacher concerned.

A**ssignments:** Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Supervised field visits are suggested with the submission of a field report.

S. No.	COURSE & LEARNING OUTCOMES	
CO1	The student is introduced to the mineral deposits in Tamil Nadu relevant to the following industries: abrasives, refractory, cement, glass, paints and pigments.	Remember, understand, apply, and assess.
CO2	The student is introduced to the mineral deposits relevant to the following industries: ceramics and fertilizer, and of the following metallic ore deposits: Fe, Nb-Ta, W, and Mo.	Understand, apply, and assess.
CO3	The student is introduced to the following metallic ore deposits in Tamil Nadu: base metals (Cu, Pb, & Zn), Ni, PGE, Al, Cr, and Sn. Mode of occurrence, reserves and distribution in Tamil Nadu: lignite, natural gas, petroleum, mica, talc, and steatite deposits.	Understand, apply, and assess.
CO4	The student is introduced to the following economic deposits in Tamil Nadu: lignite, natural gas, petroleum, mica, talc, and steatite deposits.	Understand, apply, and assess.
CO5	The student is introduced to the following economic deposits in Tamil Nadu: apatite, rock phosphate, barite, asbestos, evaporite salt, vermiculite deposits, building and dimension stones.	Understand, apply, and assess.

MAPPING WITH PROGRAM OUTCOMES (S – Strong; M- Medium; L-Low)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	M	S	S	M	M
CO2	S	S	S	M	S	M	S	S	M	M
CO3	S	S	S	M	S	M	S	S	M	M
CO4	S	S	S	M	S	M	S	S	M	M

CO5	S	S	S	M	S	M	S	S	M	M

Course Code	Paper Title	Lectures	Tutorials	Practical	Credits
21UGLM5	**FIELD GEOLOGICAL TECHNIQUES**	**3**	**1**	**3**	**5**

Broad Objectives & Teaching Methodology:

Field Geology introduces the student to the significance of field training in geology, explain and demonstrate the different field techniques, enable the student to prepare a field plan and execute mapping of an area, and to prepare a geological report based on the geological mapping and related field work. The student gains insight into the methods of geological mapping and can gain expertise by proper practice with feedback. This expertise may be useful in the particular field of geology the student wishes to pursue for future employment. The teaching methodology is done by class lectures, use of models, multimedia resources, with practical and

field demonstrations emphasizing: proper method of instruments handling and safety, use of field note book, information on personal safety, camping, and field visits to working quarries and mines.

UNIT I

Definition and scope of Field Geology – Prior planning – Basic equipment required for field work – Types of field investigations. 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 surficial 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: Techniques of mapping: Traverse methods: Compass and Contact traverse, Exposure mapping, Variable lithology mapping, Line maps. Preparation of field note based data sheet.

UNIT III

Field Equipments: Clinometer compass: different parts and their functions. Measuring attitude of linear structures – determination of bearings – advantages and limitations. Brunton Compass: different parts and their functions - measuring attitude and trends – determination of bearings – adjustments – magnetic declination in topographic sheets - advantages and limitations. Brief account on the utility of Prismatic Compass and Plane Table in mapping open cast mines and quarries.

UNIT IV

Brief account of the following: 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. Outcrop structural features common to all rock types. Outline of use and applications of GPS in field geology. Sample location techniques in digital base maps.

UNIT V

Field geological report: parts and 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.

REFERENCE &TEXTBOOKS

1. Compton, R.R. (1985). Geology in the Field. Wiley. New Delhi.

2. McClay, K.R. (2003) The Mapping of Geological Structures, 2nd ed., Wiley. New Delhi.

3. Compton, R.R. (1966). Manual of Field Geology. 2nd ed., New York, Wiley.

4. Lahee,F (1987). Field Geology, CBS Publishers, New Delhi.

5. Mathur,S.M. (2001). Guide to Field Geology. PHI. New Delhi.

6. Gokhale,N.W. (2001). A Guide to Field Geology. CBS Publishers, New Delhi.

7. Coe,A.L. (ed). (2010). Geological Field Techniques. Open University Press, Milton Keynes, UK.

8. Barnes,J.W. (2004). Basic Geological Mapping. John Wiley & Sons Inc., New Delhi.

9. Freeman,T. (1999). Procedures in Field Geology. John Wiley & Sons Inc., New Delhi.

Web resources: The student can approach the Teacher concerned for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: Soft copies related study materials are available in the Department for access with proper permission from the Teacher concerned.

A**ssignments:** Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Supervised field visits are suggested with the submission of a field report.

S. No.	COURSE & LEARNING OUTCOMES	
CO1	The student is able to understand all aspects of prior planning necessary and apply them judiciously for future field work. He/she in introduced to topographic sheets for preparing a base map for the field work.	Remember, understand, apply, and assess.
CO2	The student is introduced to basic concepts in geological mapping and their applications. Rock outcrops are discussed with a view to use their features mapping. Different types of field mapping are discussed and assessed.	Understand, apply, and assess.
CO3	The student is able to understand, describe, assess and use the Brunton and Clinometer compass as essential devices in geological mapping. The use or plane table and prismatic compass in mapping is also emphasized.	Understand, apply, and assess.
CO4	The student is able to understand, describe, assess and utilize aerial photographs, and hand held GPS units in geological mapping. Themed mapping methodology is discussed. Digital base maps devised for use in sample location is also discussed.	Understand, apply, and assess.
CO5	The student is able to understand, describe, and assess the significance in preparing a field geological report and its parts. Map symbols and field indicators are discussed. Methods of handling different types of geological samples are discussed and assessed.	Understand, apply, and assess.

MAPPING WITH PROGRAM OUTCOMES (S – Strong; M- Medium; L-Low)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	M	S	S	S	S
CO2	S	S	S	S	M	M	S	S	S	S
CO3	S	S	S	S	M	M	S	S	S	S
CO4	S	S	S	S	M	M	S	S	S	S
CO5	S	S	S	S	M	M	S	S	S	S

Course Code	Paper Title	Lectures	Tutorials	Practical	Credits
21UGLM6	**MINERAL ECONOMICS**	**3**	**1**		**5**

Broad Objectives & Teaching Methodology:

Mineral economics is the application of basic economic principles, laws, and regulations related to the exploration, extraction, mining, environmental aspects, and others. This course supports exploration and mining geology. The teaching methodology is done by class room lectures, multi media resources, interactive sessions and student involvement sessions and others.

UNIT I

Mineral economics: definition and scope. Concept of strategic, critical and essential minerals. Sustainable development of mineral resources: concepts, depletion of reserves and long term supply.

UNIT II

Minerals in national and global economy: classification of reserves and resources. Demand and supply of minerals. Mineral conservation and substitution. Water as an economic resource: conservation and sustainable development, desalination of seawater to meet demand.

UNIT III

Mineral industry in India: present situation, evolution of mining industry in India, outline of artisanal mining. Mine regulations: State and Union list.

UNIT IV

National Mineral Policy: objectives, regulation, and strategy development. MMDR Act of 2015: outline of regulations. Mineral concession rules. Environmental Impact Assessment Act: outline of project categorization, stages in EIA process.

UNIT V

EIA: acts related air pollution control, forest protection, land acquisition, and tribal protection. River linking: advantages and practical limitations. UNCLOS and Law of the Sea: outline of laws and India's EEZ.

REFERENCE & TEXT BOOKS

1. Deb,M & S.C. Sarkar (2017). Minerals and Allied Natural Resources. Springer. Delhi.

2. Sinha, R.K, & N.L.Sharma. (1985). Mineral Economics. Oxford & IBH.Delhi.

3. Banerjee,D.K. (1998). Mineral Resources of India.World Press. Kolkata.

4. Deb,S.(1985). Industrial Minerals and Rocks of India. Oxford & IBH. Delhi.

Web resources: The student can approach the Teacher concerned for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: Soft copies related study materials are available in the Department for access with proper permission from the Teacher concerned.

A**ssignments:** Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Supervised field visits are suggested with the submission of a field report.

S. No.	COURSE & LEARNING OUTCOMES	
CO1	The student is introduced to mineral economics and its scope; strategic, critical, essential minerals, and sustainable development of mineral resources.	Remember, understand, apply, and assess.
CO2	The student is introduced to the role of minerals in national and global economy, demand, and supply, mineral conservation and substitution. The role of water as an economic resource and desalination of seawater is discussed.	Understand, apply, and assess.

CO3	The student is introduced to the mineral industry in India with a discussion of mine regulations.	Understand, apply, and assess.
CO4	The student is introduced to the significance of National Mineral Policy, MMDR Act, and Environmental Impact Assessment Act, and their role in mining of minerals.	Understand, apply, and assess.
CO5	The student is introduced to EIA acts related air pollution control, forest protection, land acquisition, and tribal protection with a discussion of river linking, UNCLOS, Law of the Sea, and India's EEZ.	Understand, apply, and assess.

MAPPING WITH PROGRAM OUTCOMES (S – Strong; M- Medium; L-Low)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	L	L	L	L	L	M	L	M	M
CO2	S	L	L	L	L	L	M	L	M	M
CO3	S	L	L	L	L	L	M	L	M	M
CO4	S	L	L	L	L	L	M	L	M	M
CO5	S	L	L	L	L	L	M	L	M	M

Course Code	Paper Title	Lectures	Tutorials	Practical	Credits
21UGLM7	**WATERSHED MANAGEMENT**	**4**	**1**		**5**

Broad Objectives & Teaching Methodology:

Watershed management is the application of hydrogeology, well development, drainage characteristics, morphometry, water wells, and others for the conservation, recharge, and continued sustenance of groundwater for the future. The student is introduced to the fundamentals of hydrogeology, well development, and others so as to relate to and understand water shed management relevant to India in general and to Tamil Nadu in particular. The teaching methodology is done by class room lectures, use of physical models, multi media resources, interactive sessions, student involvement sessions with practical and laboratory demonstrations, field visits, and others.

UNIT I

Basic Hydrogeology: definition of hydrogeology; distinction between surface and ground water; detailed outline of hydrological and hydrogeological cycle; concept related to surface run-off and infiltration; rock properties related to infiltration and subsurface storage; vertical

distribution of groundwater; concepts of specific yield and specific retention; D'Arcy's law of subsurface water flow; laminar, turbulent flow and permeability.

UNIT II

Aquifers: definition, types, types of confining layers in aquifers; aquifer properties: transmissivity, storativity, compressibility; aquifer types based on hydraulic conductivity; Methods to determine subsurface water flow; Drainage basins: definition, types of stream drainage patterns; Outline of resistivity methods of ground water exploration.

UNIT III

Water wells: definition, types of water wells; well construction in hard and soft rock terrains; drilling in hard rock and soft rock; Rotary drilling: definition and techniques. Economic uses of water: agriculture, domestic, and industrial uses. Water law: objectives and key features.

UNIT IV

Water shed management: definition, physiographic features of a watershed: geometrical characteristics, surface area, shape, relief and hypsometric curves, drainage network, typology of flow and drainage,. Recharge of groundwater: natural and artificial methods.

UNIT V

Groundwater provinces of Tamil Nadu. Outline of groundwater basins in Tamil Nadu. Conservation of water: Rainwater harvesting: definition, methods and techniques, maintenance, periodic assessment, remedial measures. Governance in water conservation: village level and block level user groups to oversee water conservation.

REFERENCE & TEXTBOOKS

1. Todd, D.K. (2008). Groundwater Hydrology. 5th ed. Wiley. New Delhi.

2. Davis, S.N. & R.J.M. DeWiest. (1966). Hydrogeology. Wiley. Delhi.

3. Freeze, R.A. & J.A.Cherry. (1979).Groundwater. Prentice Hall. New York.

4. Raghunath, H.M. (1988). Groundwater. East West Pub. Delhi.

5. Raghunath,H.M. (1985).Hydrology. East West Pub. Delhi.

6. Fetter, G.W. (1989). Applied Hydrogeology. CBS. Delhi.

7. Ramakrishnan, S. (2011). Ground Water. Scitech Publications. Chennai.

8. Garg,S.P. (1982). Groundwater and Tube Wells. Oxford & IBH. Delhi.

Web resources: The student can approach the Teacher concerned for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: Soft copies related study materials are available in the Department for access with proper permission from the Teacher concerned.

A**ssignments:** Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Supervised field visits are suggested with the submission of a field report.

S. No.	COURSE & LEARNING OUTCOMES	
CO1	The student is able to understand and apply the basic elements of hydrogeology as a base for watershed management.	Remember, understand, apply, and assess.
CO2	The student is introduced to the types of aquifers and their properties, subsurface water flow, drainage basins, and groundwater exploration for application to watershed management.	Understand, apply, and assess.
CO3	The student is introduced to water wells and drilling methods for the extraction of groundwater. Economic uses of water and water laws are outlined.	Understand, apply, and assess.
CO4	The student is introduced to water shed management and recharge of GW.	Understand, apply, and assess.
CO5	Groundwater provinces and GW basins of Tamil Nadu are outlined for understanding. Conservation of water by rain water harvesting and governance in water conservation at different levels is discussed for application and assessment.	Understand, apply, and assess.

MAPPING WITH PROGRAM OUTCOMES (S – Strong; M- Medium; L-Low)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	-	S	-	-	-	M	M
CO2	S	S	S	-	S	-	-	-	M	M
CO3	S	S	S	-	S	-	-	-	M	M
CO4	S	S	S	-	S	-	-	-	M	M
CO5	S	S	S	-	S	-	-	-	M	M

Course Code	Paper Title	Credits
21UGLPR	**PROJECT WORK (Individual or Group)**	**5**

PROJECT WORK (Individual or Group)

Topic:

The broad field for the project shall be assigned to the candidate or group of candidates and their supervisors before the end of fourth semester and a copy of the same shall be submitted to the Head of Department. The list finalized and approved by the Head of Department is final and binding.

Plan of Work:

The student(s) shall prepare a feasible plan of work for the dissertation and get the approval of the Supervisor(s). The student(s) should start the project work from the end of the fourth semester and submit the project report at the time of viva-voce examination at the end of the sixth semester. The project report shall be duly certified by the Supervisor and the Head of the Department.

Dissertation work outside the College:

In case the student(s) needs to avail facilities outside the college, (i.e.) from other University / Laboratory, they shall pursue the work with the permission of the Head of Department and acknowledge the outside facilities utilized by them. The student shall complete the project work on or before the commencement of the Main Practical examinations or 31st March of the calendar year, which ever comes first. Mandatory approval/permission of the College Principal/DCE shall be obtained when the student stays away for project work outside the college for a period exceeding two weeks.

Submission of Dissertation:

The student shall prepare 2 copies of the project work and submit the same at the time of viva – voce, for evaluation by the Examiners. After evaluation a soft copy of the dissertation is to be submitted to COE and Department Library.

Marks for Dissertation:

The total marks for dissertation shall be 100, of which 75 marks are for project work and 25 marks for viva-voce.

Course Code	Paper	Lectures	Tutorials	Credits
21UGLS1	**FUEL GEOLOGY**	1	**1**	**2**

Broad Objectives & Teaching Methodology:

Fuel Geology as a skill based elective introduces to the student, the different types of coal, petroleum, natural gas, radioactive and nuclear mineral deposits; their geological characteristics, mode of occurrence, stratigraphic significance, origin, suggested genesis, and their Indian distribution. Fuel geology is related to stratigraphy, geophysical exploration methods, exploration geology, well logging and others. The teaching methodology is a combination of class room lectures, use of physical models, pictures, multi media resources, interactive sessions, student involvement sessions with practical and laboratory demonstrations, field visits and others.

UNIT I

Petroleum: definition, physical and chemical characteristics. Detailed outline on the models proposed to explain the origin of petroleum and natural gas. Descriptive study of the surface and subsurface occurrence of petroleum. Outline of the environment of petroleum formation and generation. Detailed account of primary and secondary migration of petroleum and natural gas.

UNIT II

Detailed study of properties of reservoir rocks: porosity, permeability, reservoir fluids and chemistry of oil field waters. Concept of and oil window and indicators of petroleum formation. Descriptive account of types of reservoir rocks. Petroleum traps: definition, characteristics, and classification into structural, stratigraphic, combination, and fluid types. Outline of petroleum bearing basins in India.

UNIT III

Natural gas hydrates: definition, composition, origin, mode of occurrence, uses, exploitation, and Indian distribution. Short account of natural gas deposits of India. Coal: definition, physical, chemical characteristics, classification into rank and grade. Detailed outline on the genesis of coal classification of coal bearing depositional environments. and formation of peat, lignite, bituminous, and anthracite.

UNIT IV

Occurrence of coal: coal bearing epochs in the geologic past. Distribution of coal deposits in India and their stratigraphical and geological significance. Descriptive study of important coal fields of India. Short account of coal deposits of Tamil Nadu.

UNIT V

Natural radioactive fuels: Introduction to radioactive elements and minerals. Brief study of metals used in nuclear reactors. Detailed study of host rocks and deposits related to radioactive elements and minerals. Prospecting for radioactive elements and minerals: principles, instrumentation, phases of prospecting, field and airborne surveys. Radioactive mineral deposits of Tamil Nadu.

REFERENCE BOOKS

1. Levorsen, A.A. (1967). Geology of Petroleum. CBS. New Delhi.

2. Selley, R.C. (1998). Elements of Petroleum Geology. Academic Press. Delhi.

3. North, F.K. (1990). Petroleum Geology. Unwin Hyman. Delhi.

4. Chapman, R.E. (1983). Petroleum Geology. Elsevier. Delhi.

5. Thomas, L. (2013). Coal Geology. Wiley Blackwell. New Delhi.

TEXT BOOKS

1. Prasad, U. (2003). Economic Mineral Deposits. CBS. New Delhi.

2. Banerjee, D.K. (1998). Mineral Resources of India. World Press. Kolkata.

3. Deb, S. (1985). Industrial Minerals & Rocks of India. Oxford & IBH India. Delhi.

4. Krishnasamy, S. (1988). India's Mineral Resources. Oxford & IBH India. Delhi.

5. Sharma, N.L. & R.K.Sinha. (1985). Mineral Economics. Oxford & IBH India. Delhi.

6. Aswathanarayana, U. (1985). Principles of Nuclear Geology. NBT. Delhi.

Web resources: The student can approach the Teacher concerned, for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: Soft copies related study materials are available in the Department for access with proper permission from the Teacher concerned.

A**ssignments:** Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Supervised field visits are suggested with the submission of a field report.

S. No.	COURSE & LEARNING OUTCOMES	
CO1	The student is able to understand the salient facts relevant to petroleum deposits, including their origin, migration and others.	Remember ,understand, and apply.
CO2	The student is introduced to reservoir rock properties, oil window, trap rocks, and petroleum resources of India.	Understand, analyze and apply
CO3	The student is introduced to natural gas hydrates which may prove to be an exploitable resource in the future.	Understand and apply
CO4	The student is able to understand the salient facts relevant to coal deposits including their origin, composition, uses and others.	Understand, recognize and apply
CO5	The student is able to understand the salient facts relevant to natural radioactive fuels, their host rocks and deposits, including their origin, exploration, and others.	Understand, recognize and apply

MAPPING WITH PROGRAM OUTCOMES (S – Strong; M- Medium; L-Low)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	L	L	M	M	M	L	S	S	M
CO2	S	L	L	M	L	M	M	S	S	M
CO3	S	L	L	M	L	M	M	S	S	M
CO4	S	L	L	M	M	M	M	S	S	M
CO5	S	L	L	M	M	M	M	S	S	M

Course Code	Paper	Lectures	Tutorials	Credits
21UGLS3	**ENGINEERING GEOLOGY**	1	**1**	**2**

Broad Objectives & Teaching Methodology:

Engineering geology is the application of relevant geological principles, procedures, and investigations in civil and military engineering projects. Engineering geology aims to introduce the student to the role of a geologist in the engineering planning and execution of dams, tunnels, foundations, bridges, roads, and landslide safety and stability. The teaching methodology is done via class room lectures, use of physical models, pictures, multi media resources, interactive sessions, student involvement sessions with practical and laboratory demonstrations, field visits and others.

UNIT I

Definition and scope of Engineering Geology. Detailed account of the different engineering properties of rocks. Soils: definition, engineering properties, genetic and engineering classification, soil erosion and their remedial measures.

UNIT II

Dams: definition, types, geological conditions, and site investigations. Short note on dam foundations and geological conditions. Outline of important Indian Dams and their role in maintaining water supply. Reservoirs: definition, selection of reservoir sites, and groundwater conditions. Detailed outline of the following: sedimentation, slope control, leakage and seismicity in reservoirs. Short account of Indian reservoirs.

UNIT III

Tunnels: definition, parts of a tunnel, types, tunnelling in hard and soft rocks, geological investigations, and groundwater conditions. Outline of tunnel support structures: rods, bolts, anchors, arches, rings, linings, and retaining walls.

UNIT IV

Landslides: definition, classification, natural landslides in soils and rocks. Types and modes of slope failure. Stability of slopes. Zonation mapping of landslide prone areas. Slope failure and safety factor of landslides. Remedial measures for stabilizing slopes. Slope stability problems in opencast mines.

UNIT V

Foundations: definition, types, settlement of foundations, geological conditions, and site investigations. Bearing capacity and pile foundations. Short note on bridge foundations and geological conditions.

REFERENCE BOOKS

1. Bell,F.G.(2005).Fundamentals of Engineering Geology. B.S.Publications. Hyderabad.

2. Krynine,P.D. (1956). Principles of Engineering Geology & Geotechnics. CBS. Delhi.

3. Legget,R.F. (1988). Geology and Engineering. McGraw Hill. New York.

TEXTBOOKS

1. Blyth,F.G.H.(1984).A Geology for Engineers. 7th ed. Elsevier. New Delhi.

2.Singh,B.P(2005). A Textbook of Engineering and General Geology. S.K.K & Sons.Delhi.

Web resources: The student can approach the Teacher concerned, for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: Soft copies related study materials are available in the Department for access with proper permission from the Teacher concerned.

A**ssignments:** Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Supervised field visits are suggested with the submission of a field report.

S. No.	COURSE & LEARNING OUTCOMES	
CO1	The student is able to understand the salient facts and application of engineering geology. The discussion on engineering properties of rocks and soils have field and practical applications.	Remember ,understand, and apply.
CO2	The student is introduced to dams and water reservoirs with a discussion on their role in maintaining water supply to all. The inherent problems relevant to dams and reservoirs are also discussed.	Understand, analyze and apply
CO3	The student is introduced to tunnels and their support structures with future	Understand and

	applications based on the purpose of the tunnel construction.	apply
CO4	The student is introduced to natural and man-made landslides along with applications relevant to remediation and safety.	Understand, recognize and apply
CO5	The student is introduced to the role of foundations in different engineering structures.	Understand, recognize and apply

MAPPING WITH PROGRAM OUTCOMES (S – Strong; M- Medium; L-Low)

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	M	S	M	M	S	S	S
CO2	S	S	M	M	S	M	M	S	S	S
CO3	S	S	M	M	S	M	M	S	S	S
CO4	S	S	M	M	S	M	M	S	S	S
CO5	S	S	M	M	S	M	M	S	S	S

Course Code	Paper	Lectures	Tutorials	Credits
21UGLS3	**GEMMOLOGY**	1	**1**	**2**

Broad Objectives & Teaching Methodology:

Gemmology is the broad study of gemstones and is an extension of crystallography and mineralogy. This course aims to introduce to the student the skills necessary to identify and appraise raw gemstones, formulate gemstone exploration strategies, gemstone processing and grading for later cutting and polishing, and lastly to the marketing of finished gems. The topics emphasize the significance of gemmology as an avenue for future self employment. The teaching methodology is done via class room lectures, use of physical models, pictures, multi media resources, interactive sessions, student involvement sessions with practical and laboratory demonstrations, field visits and others.

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 simulants, proxies, and synthetic gemstones and 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.

UNIT IV

Cutting and polishing techniques applied to different gemstones. Small scale gemstone cutting and polishing industries in Tamil Nadu. Feasibility and economics of gemstone related industries in India (with emphasis on Tamil Nadu).

UNIT V

Outline of important gemstone provinces in India. Gemstone areas of Tamil Nadu: Karur – Kangeyam belt, Sittampundi Area, Samalpatti Area, Pakkanadu – Mulakkadu Area, and Edappadi Area. Brief outline of mining regulations relevant to gemstone mining in India.

REFERENCE BOOKS

1. **Sinkankas,J.J.** (1964). Mineralogy: A first Course, Van Nostrand Reinhold, New York.

2.**Read, P.G.** (1984). Beginner's Guide to Gemmology, Heinemann. London.

3. **O'Donoghue, M.** (2006). Gems. Elsevier, Singapore.

4. **Keller, P.C.** (1990). Gemstones and their origins, Van Nostrand Reinhold, New York.

5. **Herbert Smith, G.F** (1912). Gemstones. Metheun, London.

6. **Read, P.G.** (2005). Gemmology, 3rd ed. Elsevier, Singapore.

TEXTBOOKS

1. **Karanth,R.V.** (2000). Gem and gem industry in India, Memoir 45, Geol. Soc. India, Bangalore.

2. **Babu,T.M.** (1998). Diamond in India, Economic Geology Series 1, Geol. Soc. India, Bangalore.

3. **Krishnan,M.S.** (1964). Mineral Resources of Madras, Memoir Vol. 80, GSI, Kolkata

4. **Prasad,U.** (2003). Economic Mineral Deposits, CBS Publishers, New Delhi.

Web resources: The student can approach the Teacher concerned, for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: Soft copies related study materials are available in the Department for access with proper permission from the Teacher concerned.

A**ssignments:** Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Supervised field visits are suggested with the submission of a field report.

S. No.	COURSE & LEARNING OUTCOMES	
CO1	The student is able to understand the facts and applications of on how a raw mineral can be assessed for possible use as a gemstone.	Remember ,understand, and apply.
CO2	The student is able to understand the salient facts and apply skills in gemstone identification via mineralogical properties and gem testing equipment.	Understand, analyze and apply
CO3	The student is introduced to gemstone prospecting, their mining methods, and post mining processing for selection, grading for later cutting polishing, and finishing.	Understand and apply
CO4	The student is introduced to different cutting and polishing techniques. Some emphasis on gemstone processing industries relevant to Tamil Nadu is discussed.	Understand, recognize and apply
CO5	The student is introduced to the varied gemstone provinces of Tamil Nadu for future field visits and collection of gemstones. A short discussion on mining regulations relevant to gemstone mining is introduced for information.	Understand, recognize and apply

MAPPING WITH PROGRAM OUTCOMES (S – Strong; M- Medium; L-Low)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	L	M	S	S	S
CO2	S	S	M	M	S	L	M	S	S	S
CO3	S	S	M	M	S	L	M	S	S	S
CO4	S	S	M	M	S	L	M	S	S	S
CO5	S	S	M	M	S	L	M	S	S	S

Course Code	Paper	Lectures	Tutorials	Credits
21UGLS4	**ORE DRESSING**	1	**1**	**2**

Broad Objectives & Teaching Methodology:

Ore dressing is related to mining geology. The main aim of ore dressing is to enhance the extractable metal content of ore minerals or increase the purity of an industrial mineral after mining. This is done by physically removing the unwanted matrix and gangue materials. Ore dressing is done prior to metal extraction or manufacture of end materials by the factory. The teaching methodology is done via class room lectures, use of physical models, pictures, multi media resources, interactive sessions, student involvement sessions with practical and laboratory demonstrations, field visits and others.

UNIT I

Definition and scope of ore dressing. Ore sorting methods: manual, mechanical, and electronic. Mineral liberation by size reduction: aims, purposes, and outline of equipment used to crush ores: jaw, gyratory, cone, and roll crusher.; rod, grinding, and hammer mills. Outline of flow charts for comminution practice.

UNIT II

Screening of ores: aims and purposes of screening; types of screening; Screening equipment: stationary and moving screens. Outline of flow charts for screening practice.

UNIT III

Particle separation from fluids: application of Stoke's law and Newton's law. Size separating equipment: Classifiers: definition, mechanism of separation, and types – rake, spiral, and centrifugal equipment; Gravity concentration processors: definition, mechanism of separation, and types – tabling, jigging, spiralling, and sink-float equipment.

UNIT IV

Froth floatation: definition, applicability to ores; ore size limits, process of froth generation, reagents: collectors, frothers, modifiers: activators, depressants, pH moderators, amalgamators, and dispersing agents.

UNIT V

Flotation practice: definition, mechanical and pneumatic flotation; Outline of flow charts for flotation practice. Separation of solids from fluids: thickening or pulping; filtration methods; magnetic and electrostatic separation;

REFERENCE & TEXTBOOKS

1. Arogyaswamy, R.N.P. (1988). Courses in Mining Geology. Oxford & IBH. Delhi.

2. Gaudin, A.M. (1939). Principles of Mineral Dressing. Tata McGraw Hill. Delhi.

3. Wills, B.A. (2006). Mineral Processing technology. Elsevier. Delhi.Gems. Elsevier, Singapore.

4. Peters, W.C. (1978). Exploration & Mining Geology. Wiley. New York.

5. Gokhale, K.V.G.K. & D.M.Rao.(1981). Ore Deposits of India. Oxford & IBH. Delhi.

6. McKinstry, H.E. (1948). Mining Geology. APH. Delhi.

Web resources: The student can approach the Teacher concerned, for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: Soft copies related study materials are available in the Department for access with proper permission from the Teacher concerned.

A**ssignments:** Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Supervised field visits are suggested with the submission of a field report.

S. No.	COURSE & LEARNING OUTCOMES	
CO1	The student is able to understand the facts and applications of on how a raw ore or industrial mineral needs to be prepared prior to factory manufacture.	Remember ,understand, and apply.
CO2	The student is able to understand the salient facts and apply skills in screening and sizing of broken ores with flow chart examples of screening practice done in quarries or factories.	Understand, analyze and apply
CO3	The student is introduced to particle separation methods and equipment used.	Understand and apply
CO4	The student is introduced to froth flotation methods, reagents used, and equipment.	Understand, recognize and apply

CO5	The student is introduced to methods relevant to ore or industrial mineral particle separation from fluids.	Understand, recognize and apply

MAPPING WITH PROGRAM OUTCOMES (S – Strong; M- Medium; L-Low)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	-	-	M	-	M	M	M	S	S
CO2	S	-	-	M	-	M	M	M	S	S
CO3	S	-	-	M	-	M	M	M	S	S
CO4	S	-	-	M	-	M	M	M	S	S
CO5	S	-	-	M	-	M	M	M	S	S

Course Code	Paper	Lectures	Credits
21UGLN1	**NATURAL RESOURCES MANAGEMENT**	2	**2**

Broad Objectives & Teaching Methodology:

Anything in nature that is physical, chemical, biological or social that has limited availability and consumed to support life and its activities on earth is a resource. The classification, availability, sustainable use and management are discussed in this paper. The teaching methodology is a combination of class room lectures, use of physical models, pictures, multi media resources, interactive sessions, student involvement sessions and others.

Learning outcomes:

The student is made to understand the types of natural resources, their classification, importance, availability and sustainable uses. He/she understands the management methodologies for prudent use of the resources.

UNIT I

Types of resources – biotic – abiotic - perpetual – classification of natural resources - renewable – living renewable – non living renewable – continuous flow renewable resources - Non renewable resources – recyclable – non-recyclable resources.

UNIT II

Water as a resource – causes of depletion – availability – over consumption – consumptive and conjunctive use – aquifer depletion – pollution and management.

UNIT III

Soil as a resource – causes of pollution – mining – waste management – point source elimination-safe use practices.

UNIT IV

Fossil fuels – minerals and metals of economic importance – availability – safe mining – sustainable uses.

UNIT V

Management of resources – adaptability to changes – livelihood security – prudent use of renewable energy. Man as a guard of management of natural resources.

REFERENCE & TEXT BOOKS:

1. Krishnasamy, S. (1998). India`s Mineral Resources. Oxford and IBH. Delhi.

2. Prasad.U. (2003). Economic mineral deposits. CBS.Delhi.

3. Keller, E.A. (1985). Environmental Geology. Merill. New York.

4. Fetter, G.W. (2001). Applied Hydrogeology. CBS New Delhi.

5. Coates, D.R. (1984). Environmental Geology. McGraw Hill. New York.

Web resources: The student can approach the Teacher concerned, for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: The student may consult the Class Teacher for additional web resources and related materials. Other related materials are available in CD/DVD format in the Department.

Assignments: Any two assignments may be suggested by the Teacher.

Suggested Group Work/Tasks: Identification of Pollution around the student's living places. Short description on the causes, sources and remedial measures.

Course Code	Paper	Lectures	Credits
21UGLN2	NATURAL DISASTER MANAGEMENT	2	2

Broad Objectives & Methodology

The student is introduced to the dangers, problems, effects of natural disasters and their mitigation measures. The teaching methodology is a combination of class room lectures, use of physical models, pictures, multi media resources, interactive sessions, student involvement sessions and others.

Learning Outcomes

The student gains insight and is made to understand the types of natural disasters with an informed awareness for future safety measures and preparedness.

UNIT-I

An introduction to Natural disasters: floods- cyclones – earthquakes – volcanoes – landslides- tsunamis. Monsoons: North East and South West monsoon – cyclones and storms – surface water flows and river flows. Flooding – flood control measures: check dams. Precautionary measures: warning systems and cyclonic shelters. Failure of monsoons and droughts. Remedial measures and preparedness.

UNIT-II

Earth quake: Definition – Type of shock waves: Body waves: P waves, S waves. Surface waves: P waves, L waves – Causes of earth quakes. Destructions due to earthquake – Richter scale – Major earthquakes in India. Prediction of Earthquakes and warning systems. Earthquake monitoring and disaster management measures.

UNIT-III

Volcanoes: type of volcanoes – causes of volcanoes – products of volcanoes. Destruction due to volcanic eruptions. Major volcanic eruptions in India. Submarine volcanoes. Prediction of volcanic eruptions and early warning systems. Active volcano monitoring and disaster management measures.

UNIT-IV

Landslides: definition – terminology – classification. Causes of landslides: slope changes – tectonic activity – rock structures – role of water in landslides – effects of Human activity. Destruction due to landslides – precautionary measures. Glaciers and its avalanches. Major landslides in India. Landslides warning systems and early detection. Landslide disaster management measures.

UNIT-V

Tsunamis: definition – causes of tsunami: submarine earthquakes and tsunamis – Impact of tsunamis – Major Tsunamis. Advance warning systems for Tsunamis – Tsunamis disaster management measures – seiche waves in lakes.

REFERENCES AND TEXTBOOKS

1. Radhakrishnan,V. (1996). General Geology, V.V.P. Publishers,Tuticorin.

2. Mahapatra,G.P. (1994). Physical Geology,CBS Publishers,New Delhi.

3. Mahapatra,G.P. (1992). Textbook of Geology, CBS Publishers,New Delhi.

4. Patwardhan,A.M. (1999). Dynamic Earth System, Prentice Hall, New Delhi.

5. Mukherjee,A.K. (1990). Principles of Geology,EW Press,Kolkata.

6. Miller,T.G. (2004). Environmental Science. Wadsworth Publishing. USA.

Web resources: The student can approach the Teacher concerned, for relevant and recommended web resources including Inflibnet and NLIST resources available in the Department.

Additional Resources: The student may consult the Class Teacher for additional web resources and related materials. Other related materials are available in CD/DVD format in the Department.

Assignments: Any two assignments may be suggested by the Teacher.

Suggested Group Work/Tasks: Identification of Pollution around the student's living places. Short description on the causes, sources and remedial measures.

Course Code	Paper	Lectures	Credits
21AGL01	**ALLIED GEOLOGY I**	5	**4**

Broad Objectives & Teaching Methodology:

Geology is the study of earth as a whole. The student is introduced to the general geology, structural geology, crystallography and mineralogy which constitute a portion of the basic components of geology. The topics chosen aims to provide a working knowledge of geology for use in their own discipline or for competitive examinations. The teaching and learning methodology involves class lectures and practical/laboratory classes.

Learning Outcomes: The student gains an introduction to Geology and its usefulness in their major discipline.

Unit I General Geology

Definition and scope of Geology. Origin of solar system: Nebular and Planetesimals hypotheses. Introduction and outline of constitution and composition of earth's interior. Brief account of the important methods of determining the age of the earth. Earthquakes and their effects. Short note on seismograph and seismogram. Richter's scale of earthquake intensity. Brief account of volcanoes.

Unit II Structural Geology

Definition and scope of Structural Geology. Concept of rock outcrop - definition of dip and strike of rock formations. Folds: definition and parts of a fold. Brief description of the following fold types: anticline, syncline, symmetrical, asymmetrical, isoclinal and recumbent folds. Brief description of the following fold systems: anticlinorium and synclinorium. Faults: definition and parts of a fault. Brief description of the following types of faults: normal, reverse, strike, dip, oblique, parallel and step faults. Brief outline of joints and unconformities.

Unit III Crystallography

Definition of crystallography and crystals. Morphological characters of crystals: faces – forms – edges. Symmetry elements of crystals: Axis, plane and center of symmetry. Miller's Indices. Study of the following crystal systems: normal classes of the cubic, tetragonal, hexagonal, orthorhombic, monoclinic and triclinic systems.

Unit IV Mineralogy I

Definition of mineralogy and mineral. Outline of physical properties of minerals: color,form,luster, hardness, cleavage,fracture,and specific gravity. Description of the following minerals: Quartz. Orthoclase – Microcline – Albite – Labradorite - Anorthite. Nepheline – Leucite – Sodalite. Enstatite -Hypersthene – Augite – Diopside.

Unit V Mineralogy II

Description of the following minerals: Hornblende – Actinolite – Tremolite. Muscovite – Biotite – Chlorite. Topaz -Olivine – Serpentine – Talc. Tourmaline – Beryl – Apatite – Corundum. Garnet – Diamond – Apatite – Staurolite – Sillimanite – Epidote.

REFERENCE AND TEXTBOOKS

1. Parbin Singh,B. (2005). A Textbook of Engineering and General Geology. S.K.K & Sons,Delhi.

2. Mukherjee,P.K. (1984). A Textbook of Geology. World Press, Kolkata.

3. Mahapatra,G.B. (1994). Textbook of Physical Geology. CBS Publishers, Delhi.

4. Mahapatra,G.B. (2000). General Geology. CBS Publishers, Delhi.

Additional Resources: Geology related materials are available in CD/DVD format in the Department.

Assignments: Any two assignments (within the five units) may be suggested by the teacher.

Course Code	Paper	Lectures	Credits
21AGC02	**ALLIED GEOLOGY II**	5	**4**

Broad Objectives & Methodology:

Geology is the study of earth as a whole. The student is introduced to paleontology, stratigraphy, petrology and economic geology which are core components of geology. The topics chosen aims to provide a working knowledge of geology for use in their own discipline or for competitive examinations. The teaching and learning methodology involves class lectures and practical/laboratory classes.

Learning Outcomes: The student gains an introduction to Geology and its usefulness in their major discipline.

Unit I Paleontology

Definition of Paleontology and fossils. Outlines of modes of preservation in sedimentary rocks. Brief account of the uses of fossils. Study of the morphological characters and geological age of the following fossil groups: pelecypods, gastropods, cephalopods, brachiopods, corals, and trilobites.

Unit II Stratigraphy

Definition and scope of Stratigraphy. Outline of the Geological Time Scale. Brief account of the following geological formations in India: Dharwar Group, Cuddapah Group, Vindhyan Group, Gondwana Group, Cretaceous formations of Tiruchirapalli, and Karewa Formation.

Unit III Igneous Petrology

Definition of igneous petrology and igneous rocks. Forms of igneous rocks: sill, lopolith, laccolith, phacolith, dyke, and batholith. Brief description of the following igneous rocks: dunite, pyroxenite, gabbro, dolerite, syenite, granite, pegmatite, aplite, andesite, and basalt.

Unit IV Sedimentary and Metamorphic Petrology

Sedimentary Petrology

Definition of sedimentary rocks and sedimentary petrology. Primary structures of sedimentary rocks: common bedding, cross-bedding, current-bedding, graded-bedding. Surface structures: ripple marks, mud-cracks, and rain prints. Brief description of the following sedimentary rocks: sandstone, arkose, grit, shale, and limestone.

Metamorphic Petrology

Definition of metamorphic rocks. Metamorphism and metamorphic process. Agents of metamorphism. Brief description of the following metamorphic rocks: slate, phyllite, schist, gneiss, marble, quartzite, granulite, and amphibolite.

Unit V Economic Geology

Brief description of the physical properties and Indian occurrences of the following ore and industrial minerals: graphite, bauxite, magnesite, hematite, magnetite, chromite, gold, pyrolusite, pyrite, galena, asbestos, gypsum, chalk, calcite, dolomite, barite, and kaolin. Brief description

of the following coal types: peat, lignite, bituminous, and anthracite. Brief introduction to petroleum, its origin and occurrence in India.

REFERENCE AND TEXTBOOKS

1. Parbin Singh,B. (2005). A Textbook of Engineering and General Geology. S.K.Kataria & Sons,Delhi.

2. Mukherjee,P.K. (1984). A Textbook of Geology. World Press, Kolkata.

3. Mahapatra,G.B. (1994). Textbook of Physical Geology. CBS Publishers, Delhi.

4. Mahapatra,G.B. (2000). General Geology. CBS Publishers, Delhi.

Additional Resources: Geology related materials are available in CD/DVD format in the Department.

Assignments: Any two assignments (within the five units) may be suggested by the Teacher

Course Code	Paper	Lectures	Credits

21AGCP1	**ALLIED GEOLOGY PRACTICAL**	6	**3**

Practical Exams: 60 Marks (Exam – 50; Records – 10)
Internal Assessment 40 marks (Attendance – 10, Laboratory Observation – 10, Tests – 20)

Mineralogy

Identification and physical description of the following minerals: Quartz Group: rock crystal, chalcedony, agate, jasper, flint. Feldspar Group: orthoclase, microcline, albite, perthite. Pyroxene Group: augite, hypersthene. Amphibole Group: hornblende, tremolite, actinolite. Mica Group: muscovite, biotite, chlorite. Other silicate minerals: olivine, garnet, beryl, tourmaline, staurolite. Non silicates: corundum, apatite. Ore minerals: magnetite, chromite, bauxite, pyrolusite, pyrite, galena, hematite. Industrial Minerals: talc, asbestos, magnesite, barite, gypsum. Coal varieties: peat, lignite, bituminous, and anthracite.

Petrology

Identification and physical description of the following rocks: Igneous rocks: granite, pegmatite, syenite, diorite, gabbro, dolerite, dunite, pyroxenite. Metamorphic rocks: slate, mica schist, chlorite schist, hornblende gneiss, garnet-mica gneiss, granulite, marble. Sedimentary rocks: sandstone, conglomerate, arkose, grit, shale, limestone.

Fossils

Identification and morphological description of the following fossils: Pelecypods: Meretrix, Arca, Pecten, Ostrea. Gastropods: Turritella, Natica, Turbo, Conus. Cephalopods: Nautilus, Acanthoceras. Brachiopods: Terebratula, Spirifer. Trilobites: Calymene, Paradoxides. Corals: Calceola, Lithostrotion. Plant Fossils: Glossopteris, Ptilophyllum.

Geological Maps

Geological map drawing exercises: drawing strike lines and determining dip amounts. Outcrop completion geological maps with conformable series of beds. Preparation of geological sections for conformable series of beds.