



GOVERNMENT ARTS COLLEGE (AUTONOMOUS)

SALEM-7

NAAC REACCREDITED WITH B++

BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY

DEGREE COURSE

CHOICE BASED CREDIT SYSTEM (CBCS)

REGULATIONS AND SYLLABUS

(Effective from the Academic Year: 2017 – 2018 onwards)



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NAAC REACCREDITED WITH B++.
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(Effective from the Academic Year: 2017 – 2018 onwards)

1. CONDITIONS FOR ADMISSION:

A candidate who has passed Higher Secondary Examination, (Academic Stream) conducted by Department of School Education, Tamil Nadu or an examination accepted as equivalent to 10+2 courses including CBSE, that are recognised by Periyar University, are eligible for admission to B.Sc. Applied Geology Course. The candidates requesting admission to B.Sc Applied Geology Course 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 guidelines issued by the Government of Tamil Nadu through the Director of Collegiate Education, Chennai - 6, may be followed.

2. DURATION OF THE COURSE:

B.Sc. Applied Geology Course (Degree of Bachelor of Science) consists of three consecutive academic years composed of six semesters.

3. COURSE OF STUDY AND SCHEME OF EXAMINATION:

The detailed course of study and scheme of examination is provided in Table 1.

4. EXAMINATION:

The Theory Examination shall be of three hours duration conducted at the end of each semester. The Practical Examinations for UG Courses shall be of three hours duration and will be conducted only at the end of the even semester as II, IV, and VI Semesters along with the theory papers. The maximum mark for each theory paper and practical is 100. The candidate failing to get the minimum marks required for passing in any theory papers/subject(s) shall be permitted to appear for each failed theory papers/subject(s) in the subsequent semester/instant/supplementary examination. The candidate failing to get the minimum marks required for passing in any practical(s), may be permitted to appear for the same practical(s) in the next regular even semester only. There is no statutory provision to conduct instant or supplementary examination for the practical in the odd and even semesters. Regular candidates are mandatorily required to pay the examination fees for the semester in which they are appearing. Arrear candidates have to pay the fees for both regular and arrear papers for the semester in which they are appearing. Regular candidates and those with arrears shall be permitted to appear for the examinations strictly based on the attendance requirement regulations; condonation limits and semester redo/reappear conditions as given in section 9. The fee structure will be intimated by the COE.

5. PASSING MINIMUM:

For Theory Examination:

The breakup of marks shall be: 75 by written examinations [Semester External or S.E.] and 25 by Internal Assessment [I.A.]. The passing minimum for all theory papers (semester external) shall be 30 out of 75. The break up for internal assessment marks for theory papers will be as follows: Attendance: 5 + Assignment: 10 + Test: 10 = 25 Marks. There is no passing minimum for internal assessment. The passing minimum mark for all theory papers shall be 40 marks with both internal and external marks added together under the mandatory requirement that the candidate has secured not less than 30 out of 75 in the written examination. Candidates who score less than 30 out of 75 in the theory papers and secure more than 40 with internal assessment (out of 100), have NOT secured the passing minimum and are required to reappear for those papers in the subsequent semesters. Revaluation of theory papers, re-totalling of marks, supplementary and instant examination, and transparency of theory papers is allowed as per TANSCHC CBCS guideline, Government Arts College Autonomous and Periyar University norms. Candidates need to apply to the COE, through the Principal with proper endorsement and recommendation by the concerned tutor and head of department.

For Practical Examination:

The Practical Examinations for UG Courses will be conducted only at the end of the even semester as II, IV, and VI Semesters. The breakup of marks shall be Practical Examination (external) - 60 marks and Internal Assessment - 40 marks. The breakup for internal assessment marks shall be Practical class Attendance 5 marks + Practical Tests 10 marks + Field Training Programme 25 Marks. There is no passing minimum for internal assessment for the practical. The passing minimum mark for all practical papers shall be 40 marks with both internal and external marks added together under the mandatory requirement that the candidate has secured not less than 24 out of 60 in the written examination. Candidates who score less than 24 out of 60 in the theory papers and secure more than 40 with internal assessment (out of 100), have NOT secured the passing minimum and are required to reappear for those practical in the subsequent even semesters. The attendance and Participation for the Field Training Programme of a candidate pursuing B.Sc. APPLIED GEOLOGY Degree is mandatory and shall be a necessary criterion for the candidate to appear for the Practical Examinations. Revaluation of practical papers, re-totalling of marks, supplementary or instant examination, and transparency of any or all practical papers is NOT permitted as per TANSCHC CBCS guidelines for UG Science courses, Government Arts College Autonomous and Periyar University norms/guidelines. The candidate has to apply and re-appear for the practical examination at the next EVEN semester only.

6. CLASSIFICATION OF SUCCESSFUL CANDIDATE:

The performance of the student is indicated by the Grades and the corresponding Grade Point (GP), Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA). A student is deemed to have completed a course successfully and earned the appropriate credit, only if the candidate has earned a grade of C and above. RA denotes the candidate should Re-Appear for the examination.

CGPA - Cumulative Grade Point Average;

Range of Marks	90 - 100	80 - 89	75 - 79	70 - 74	60 - 69	50 - 59	0 - 49
CGPA	9.0 to 10	8.0 to 8.9	7.5 to 7.9	7.0 to 7.4	6.0 to 6.9	5.0 to 5.9	0
Grade	O	D+	D	A+	A	B	RA
Grade Description	Outstanding	Excellent	Distinction	Very Good	Good	Satisfactory	Re-appear
Class	First	First	First	First	First	Second	Re-appear

$GP = (\text{Marks obtained in a course} \times \text{Credit}) / 10$

$GPA = \text{Total Grade points earned in a semester} / \text{Total Credits registered in a semester}$

$CGPA = \text{Sum of Grade Points earned} / \text{Sum of Credits registered}$

The above classification is based on the marks secured by a candidate in Part – III Major and Allied and Part – IV including Non-major electives (NME) and Skill based elective courses (SBE).

7. QUESTION PAPER PATTERN:

The question paper pattern for theory papers shall be as follows:

Duration of examination: 3 Hours

Maximum Marks: 75

Part A: 10 x 2 = 20 Marks

Number of questions = 10 (without internal choice)

All questions will carry equal marks. All questions are compulsory

(Two questions will be set from each unit)

Each answer should be about 50 words.

Part B: 5 x 5 = 25 Marks

Number of questions = 5 [with internal choice: as (a) or (b)]

All questions will carry equal marks. All questions are compulsory

(One question will be set from each unit with internal choice)

Each answer should be about 300 to 500 words.

Part C: 3 x 10 = 30 Marks

No. of questions = 5 (without internal choice)

All questions will carry equal marks. Any three questions out of five are to be answered

(One question will be set from each unit)

Each answer should be about 1000 to 1200 words.

The question paper pattern/format for the practical will be based on the different components of the practical and will differ from the format for the theory examinations.

8. RANKING:

Candidates who have passed all the examinations prescribed for the course **in the first appearance only are eligible for ranking**. Candidates with arrear(s) are not eligible for ranking. A candidate who is **absent** for one or more papers in a semester examination and who later appears for the same paper or papers in the subsequent semester examination is **NOT eligible for ranking** even though he/she has completed the course within three academic years / six semesters from his/her year of admission. The maximum duration for the completion of UG programme shall not exceed twelve semesters. The scheme for completion shall be consecutive twelve semesters.

9. Attendance Requirement, Condonation of Attendance and Redo or repeat of lapsed semester(s).

For Theory Examinations

The attendance shall be calculated on the basis of 90 days / 450 instructional hours per semester. Candidates are mandatorily required to have 75% or above in attendance to apply and appear for their semester theory examinations without condonation of attendance. Those candidates whose attendance ranges from 65 to 74% may appear for the theory examination after payment of the appropriate condonation fee (Rs 500) through proper channel.

Candidates whose attendance percentage for theory papers is from 50 to 65% in a semester are NOT allowed to appear for the theory examinations and mandatorily have to pay the condonation fees and semester examination fees. They may be permitted to appear in the next semester.

Candidates whose attendance is below 50% will not be allowed to appear for the semester examinations and mandatorily have to redo or repeat the particular semester(s) in which they lack the necessary attendance. Redo or repeat candidates may be permitted to appear for the semester examination (s) only after they gain the necessary attendance for the lapsed semester(s). They shall be permitted to redo or repeat the lapsed semester(s) only after the completion of their third/final year of the course as per Government Arts College Autonomous and Periyar University norms/guidelines. Redo or repeat candidates have to apply through proper channel to the Principal and COE for permission to redo their lapsed semesters. A candidate who is absent for the theory examinations after paying the condonation fees has to repay the condonation fees for appearing in the next or subsequent semester.

For Practical examinations

The attendance for practical shall be calculated on the basis of 180 days / 900 instructional hours per year combining the odd and even semesters. Candidates are mandatorily required to have 75% or above in attendance to apply and appear for the practical examinations without condonation of attendance. Those candidates whose attendance ranges from 65 to 74% may appear for the practical examination after payment of the appropriate condonation fee (Rs 500) through proper channel. Candidates whose attendance percentage for practical papers is from 50 to 65% in a semester are NOT allowed to appear for the practical examinations and mandatorily have to pay the condonation fees and semester examination fees. They may be permitted to appear in the next semester.

Candidates whose attendance is below 50% will not be allowed to appear for the even semester practical examinations and mandatorily have to redo or repeat the particular even semester(s) in which they lack the necessary attendance. Redo or repeat candidates may be permitted to appear for the even semester practical examination (s) only after they gain the necessary attendance for the lapsed even semester(s). They shall be permitted to redo or repeat the lapsed even semester(s) only after the completion of their third/final year of the course as per Government Arts College Autonomous and Periyar University norms/guidelines. Redo or repeat candidates have to apply through proper channel to the Principal and COE for permission to redo their lapsed even semester(s). A candidate who is absent for the practical examinations after paying the condonation fees has to repay the condonation fees for appearing in the next even or subsequent even semester.

A candidate whose attendance for theory and practical classes **calculated separately** is within 65 to 74%, has to pay condonation fees separately for theory and practical examinations as $\text{Rs } 500 + 500 = \text{Rs } 1000$. Condonation fees are separate for theory and practical examinations and are NOT to be combined as a single fee of Rs 500. The candidate will be allowed to appear for both theory and practical examinations under the condition that the condonation fees have been paid for both theory and practical examinations. Results of the candidate shall be withheld if the condonation fees have not been paid for that particular semester(s).

10. COMMENCEMENT OF THIS REGULATION:

This regulation shall take effect from the academic year 2017 -2018. The students admitted to the first year of the UG Applied Geology Course from 2017-2018 and thereafter shall follow these regulations.

11. TRANSITORY PROVISION:

Candidates who are admitted to the B.Sc Course of study are permitted to appear for the examination under

this regulation for a period of 6 years from their year of admission to the course (up to 2022-2023). Arrear candidates will be permitted to appear for the examination under this regulation up to three consecutive years or six consecutive semesters from their final or third year of their course. The maximum duration for the completion of UG programme shall not exceed twelve consecutive semesters. The scheme for completion of the course shall be consecutive twelve semesters. Thereafter they 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 papers after the transitory provision has lapsed in their case.

12. BREAK UP OF INTERNAL ASSESSMENT

For Theory Examinations

There is no passing minimum for internal assessment for theory examinations. The break up is as follows:

Attendance: 5 + Assignment: 10 + Test: 10 = 25 Marks.

The marks for attendance are given as follows:

Attendance percentage	Above 90	80 to 90	70 to 80	60 to 70	50 to 60	Below 50
Marks	5	4	3	2	1	0

The marks for assignments are given as follows:

Continuous Assessment I or CA I = 5; Continuous Assessment II or CA II = 5. The minimum number of assignments to be submitted for CA I & CAII separately is 3. The marks for tests are given as follows: Continuous Assessment I or CA I = 2; Continuous Assessment II or CA II = 2; Model Examinations (End semester) = 6. The minimum number of tests for CA I & CAII separately is 4. The test may be conducted as a unit test or for a prescribed set of marks (20/30/50) or particular question types (sections A, B or C).

For Practical Examinations

There is no passing minimum for internal assessment for practical examinations. The break up is as follows:

Attendance: 5 + Practical tests: 10 + Field Training Programme: 25 = 40 Marks.

The marks for attendance are given as follows:

Attendance percentage	Above 90	80 to 90	70 to 80	60 to 70	50 to 60	Below 50
Marks	5	4	3	2	1	0

The marks for practical tests are given as follows:

Continuous Assessment I or CA I = 5; Continuous Assessment II or CA II = 5; the minimum number of practical tests to be conducted for CA I & CAII separately is 2. The mark for full attendance in the Field Training Programme is 25. Candidates who are absent for all days in the Field Training Programme schedule will be awarded zero marks (0). Candidates who are absent for some days in the Field Training Programme schedule due to valid and verified reasons will be awarded marks under the discretion of the Field Programme Coordinators. The student should submit a report on the field training along with specimens collected from the field. There is no passing minimum for internal assessment for the practical.

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. Candidates who do not submit their record notebooks or submit incomplete record notebooks at the time of practical examination will be awarded zero (0) marks.

13. FACULTY ADVISOR:

For all UG Classes there will be a Faculty Advisor (Tutor – in – charge). Students shall consult them for their clarifications and guidance.

14. ACADEMIC COUNCIL RATIFICATION AND APPROVAL.

These guidelines and regulations will be effective from the academic year 2017 – 2018. 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.

**TABLE I Bachelor of Science (B.Sc) APPLIED GEOLOGY
COURSE OF STUDY & SCHEME OF EXAMINATION**

YEAR OF STUDY	SEMESTER	PART/PAPER No.	PAPER CODE	TITLE OF THE PAPER	CREDITS	INTERNAL MARKS (I.A.)	EXTERNAL MARKS (S.E.)	TOTAL MARKS
I B.Sc	I	Part-I	17FTL01	TAMIL PAPER-I	3	25	75	100
		Part-II	17FEL01	ENGLISH PAPER-I	3	25	75	100
		Part-III MAJOR PAPER-I	17UGL01	PHYSICAL GEOLOGY	4	25	75	100
		ALLIED PAPER-I	17ACH01	ALLIED CHEMISTRY PAPER-I	3	25	75	100
		MAJOR PRACTICAL- I	17UGLP1	STRUCTURAL GEOLOGY & SURVEYING	EXAMINATION AT END OF II SEMESTER			
		ALLIED PRACTICAL	17ACHP1	ALLIED CHEMISTRY PRACTICAL				
		Part-IV	17UVABE	VALUE BASED EDUCATION	2	25	75	100
						15		500
	II	Part-I	17FTL02	TAMIL PAPER-II	3	25	75	100
		Part-II	17FEL02	ENGLISH PAPER-II	3	25	75	100
		Part-III MAJOR PAPER-II	17UGL02	GEOMORPHOLOGY & STRUCTURAL GEOLOGY	5	25	75	100
		ALLIED PAPER-II	17ACH02	ALLIED CHEMISTRY PAPER-II	3	25	75	100
		MAJOR PRACTICAL- I	17UGLP1	STRUCTURAL GEOLOGY & SURVEYING	4	40	60	100
		ALLIED PRACTICAL	17ACHP1	ALLIED CHEMISTRY PRACTICAL	4	40	60	100
Part-IV		17UBENS	ENVIRONMENTAL STUDIES	2	25	75	100	
					24		700	
Continued in next page								

II B.Sc	III	Part-I	17FTL03	TAMIL PAPER-III	3	25	75	100
		Part-II	17FEL03	ENGLISH PAPER-III	3	25	75	100
		Part-III MAJOR PAPER-III	17UGL03	PALEONTOLOGY & CRYSTALLOGRAPHY – I	4	25	75	100
		ALLIED PAPER I	17APY01	ALLIED PHYSICS PAPER-I	3	25	75	100
		MAJOR PRACTICAL-II	17UGLP2	PALEONTOLOGY & CRYSTALLOGRAPHY PRACTICAL	EXAMINATION AT END OF IV SEMESTER			
		ALLIED PRACTICAL	17APYP1	ALLIED PHYSICS PRACTICAL				
		Part-IV	17UGLS1 (SBE 1)	FUEL GEOLOGY	2	25	75	100
	17UNME1 (NME1)		NON-MAJOR COURSE CHOSEN BY THE STUDENT –OFFERED BY OTHER DEPARTMENTS	2	25	75	100	
					17			600
	IV	Part-I	17FTL04	TAMIL PAPER-IV	3	25	75	100
		Part-II	17FEL04	ENGLISH PAPER-IV	3	25	75	100
		Part-III MAJOR PAPER-IV	17UGL04	PALEONTOLOGY , CRYSTALLOGRAPHY – II & OPTICAL MINERALOGY	5	25	75	100
		ALLIED II	17APY02	ALLIED PHYSICS PAPER-II	3	25	75	100
		MAJOR PRACTICAL – II	17UGLP2	PALEONTOLOGY & CRYSTALLOGRAPHY PRACTICAL	3	40	60	100
		ALLIED PRACTICAL	17APYP1	ALLIED PHYSICS PRACTICAL	4	25	25	100
		Part-IV	17UGLS2 (SBE2)	ENGINEERING GEOLOGY	2	25	25	100
			17UGNM2 (NME2)	NON-MAJOR COURSE CHOSEN BY THE STUDENT –OFFERED BY OTHER DEPARTMENTS	2	25	25	100
Part-V	17UEEXT	EXTENSION ACTIVITIES	2			100		
				27			900	

III B.Sc	V	PART-III MAJOR PAPER-V	17UGLO5	MINERALOGY	5	25	75	100	
		PART-III MAJOR PAPER-VI	17UGL06	STRATIGRAPHY & INDIAN GEOLOGY	5	25	75	100	
		PART-III MAJOR PAPER-VII	17UGL07	IGNEOUS & METAMORPHIC PETROLOGY	5	25	75	100	
		PART-III MBE PAPER-I	17UGLM1 (MBE 1)	EXPLORATION GEOLOGY	5	25	75	100	
		MAJOR PRACTICAL – III	17UGLP3	MINERALOGY & PETROLOGY		EXAMINATION AT END OF IV SEMESTER			
		Part-IV	17UGLS3 (SBE 3)	REMOTE SENSING	2	25	75	100	
			17UGLS4 (SBE 4)	FIELD GEOLOGY	2	25	75	100	
				24			600		
	VI	Part-III MAJOR PAPER-VIII	17UGL08	SEDIMENTARY PETROLOGY & ENVIRONMENTAL GEOLOGY	5	25	75	100	
		Part-III MAJOR PAPER-IX	17UGL09	ECONOMIC GEOLOGY	5	25	75	100	
		Part-III MAJOR PAPER-X	17UGL10	MINING GEOLOGY AND ORE DRESSING	5	25	75	100	
		MAJOR PRACTICAL- III	17UGLP3	MINERALOGY & PETROLOGY PRACTICAL	6	40	60	100	
		Part-III MBE PAPER – II	17UGLM2 (MBE2)	HYDROGEOLOGY	4	25	75	100	
		MBE-III	17UGLM3 (MBE3)	COMPUTER APPLICATIONS IN GEOLOGY & GEOSTATISTICS	4	25	75	100	
Part-IV		17UGLS5 (SBE5)	GEMMOLOGY	2	25	75	100		
	17UGLS6 (SBE6)	ECONOMIC MINERALS, GEOCHEMISTRY & FIELD GEOLOGY PRACTICAL	2	40	60	100			
			33			800			
TOTAL				CREDITS		140		4100	

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM (CBCS)
BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY
FIRST YEAR – I SEMESTER
PAPER I - PHYSICAL GEOLOGY

PAPER CODE – 17UGL01

CREDITS - 4

Broad Objectives & Methodology: Geology is the study of the Earth as a whole. Physical Geology introduces different topics which define geology as a branch of Physical Science. The teaching and learning methodology involves class lectures, practical and laboratory demonstrations. **Learning Outcomes:** The student gains useful insight into Geology as a branch of Physical Science.

UNIT I

Introduction to Geology – Branches and applications of Geology. **Solar System:** Definition – A brief 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.

Age of the Earth- Direct Methods: Introduction to radioactivity – Radioactive minerals - Radioactive decay and isotopes - Concept of half life - Parent and Daughter elements. Outline and application of: U - Pb method; K - Ar method; Rb - Sr method and 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. **Short account of Earth parameters:** Outline of size, shape, rotation, revolution – Milankovitch cycle - perigee and apogee positions.

UNIT II

Interior of the Earth: Internal structure based on travel time of seismic waves: Crust - Mantle - Core. Brief account of seismic boundaries and discontinuities - shadow zones. **Earthquakes:** Definition of Earthquake – Seismic waves: types – basic properties - generation of seismic waves in the earth. Location of EQs: focus (hypocentre) - epicentre. Magnitude and intensity of EQs – A brief introduction to seismogram and seismograph. The causes of EQs. The prediction of EQs and remedial measures. A brief introduction of Seismic zones and Indian EQs. - **Tsunamis & Seiche Waves:** Definition - Types - Generation - Remedial measures. A brief outline of Indian Tsunamis.

UNIT III

Continental Drift: Definition - Evidences - Mechanisms - Wegener's and Taylor's idea of continental drift. - **Sea floor spreading:** Definition - mechanism - evidences. **Plate Tectonics:** Concept of plate tectonics - Types of crustal plates - Major and Minor plates - plate movement and their causes - plate boundaries: convergent, divergent, & transform. Brief account of features related to plate tectonics: Island Arcs - Folded Mountain chains - Subduction zones - Trenches - Rift and ramp valleys - Ring of Fire. A Short account of volcanic and earthquake belts as related to plate tectonics.

UNIT IV

Volcanoes: Definition of volcano and lava – Types of volcanoes – Volcanic products – Causes of Volcanism – Styles of volcanic eruption – Types of volcanic eruption – Prediction of volcanic eruptions. Volcanic landforms: craters - lava flows – pillow lava – domes – columnar lava structures. Distribution of volcanoes - Examples of Indian volcanoes. **Atmosphere:** Definition - vertical extent - layers - composition - temperature variation - generation of wind on earth's surface. **Mountains:** Definition of Mountain – Types and classification of Mountains – Origin of Mountains – Distribution of mountains in Indian sub continent. **Isostasy:** Concept of Isostasy - Models of Isostasy: Airy's model - Pratt's model.

UNIT V

Plateaus and plains : Definition - characteristics and types of plateaus and plains – Short account of Deccan Plateau. **Weathering:** Definition - processes: erosion - transport - deposition. Agents of weathering. Types of weathering: physical - chemical - biological. Factors affecting weathering. Outline of products of weathering: sediments - soil - regolith. **Rivers:** Definition – origin – types of streams – stages of rivers – deltas and alluvial fans. **Lakes:** Definition – Types of Lakes – Formation of Lakes – Outline of lake

deltas and deposits.

REFERENCE BOOKS & TEXT BOOKS

1. Holmes,A & P.L.Duff. (1996). Principles of Physical Geology, 4th revised edition,ELBS,London
2. 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. Emiliani,C.(1992). Planet Earth, Cambridge University Press, Delhi.
6. Porter,S.C. & B.J. SkinnerJ. (1995). The Dynamic Earth, John Wiley & Sons, New York.
7. Leet,D & Judson,S (1987). Physical Geology, McGraw Hill. New Jersey.
8. Zumberge,J.(1980). Physical Geology, Freeman, New York.
9. Patwardhan,A.M. (1999). Dynamic Earth System,Prentice Hall, New Delhi.
10. Dasguptha,A.B. (1978). Physical Geography,CBS Publishers,Delhi.
11. Mukherjee,A.K. (1990). Principles of Geology,EW Press,Kolkata.
12. Reed,J.S. & T.H. Wicander. (2005). Essentials of Geology, McGraw Hill., New York.

Additional Resources: Physical 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.

Suggested Group Work/Tasks: Field excursion is suggested under proper supervision and with the submission of a field report.

**GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY
FIRST YEAR – II SEMESTER**

PAPER CODE – 17UGLP1

CREDITS - 4

PRACTICAL I - STRUCTURAL GEOLOGY AND SURVEYING

Practical Examination Maximum Marks: 50

Records: 10

Internal Assessment Maximum Marks: 40

Broad Objectives & Learning Outcomes

The student is introduced to the basic knowledge relevant to geological maps. Map drawing exercises emphasize the use of completed geological maps to decipher the underlying structure and the different methods of solving them. Practical exercises emphasize the use of compasses: Clinometer and Brunton. Survey Practical introduces the student to basic surveying relevant to geological mapping and mining geology.

SYLLABUS

GEOLOGICAL MAPS:

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

Utility of Clinometer and Brunton Compass.

Laboratory exercises in structural Geology maps: Contours – Completion of outcrops. Three point problems, Fold Maps. Fault

Maps, Unconformity maps. Complex maps with two structures such as fold and fault, fault and unconformity, etc. **Preparation of cross sections** across the geological maps to bring out the structure of the area, interpretation of structures, determining the order of superposition of beds and writing the geological history of the area. **Exercise on structural geology problems:** Graphical Determination of Dip in gradient. Determination of true dip by simple calculation. Determination of thickness of a bed by calculation on a level ground.

SURVEYING:

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

FIELD TRAINING PROGRAMME:

FIRST YEAR OF THE COURSE.

In part fulfilment of B.Sc Applied Geology Degree course, students should be taken on local field trips to study the geomorphology and structural geology of the area in and around Salem district, for a period of 3 to 5 days. The student should submit a report on the field training programme.

Internal assessment marks for the practical are: **Practical Class Attendance = 5 marks; Practical Test = 10 marks; Field Training Report = 25 marks; Total = 40 Marks.**

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY
FIRST YEAR – II SEMESTER
PAPER II - GEOMORPHOLOGY AND STRUCTURAL GEOLOGY

PAPER CODE – 17UGLO2

CREDITS – 5

Broad Objectives & Methodology: Geomorphology is the study of different landforms and their evolution on the earth's surface. Structural Geology is the study of different structures in crustal rocks derived from different forces active on and within the earth's crust. The teaching and learning methodology involves class lectures, practical and laboratory demonstrations with equipment available in the Department. **Learning Outcomes:** The student gains useful insight and understanding of the earth's surface and the structures it contains through geomorphology and structural geology.

GEOMORPHOLOGY

UNIT I

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

UNIT II

Land Forms Created By Rivers: Erosion processes, erosional features: Potholes, Waterfalls, River valleys, Gorges, Canyons, Escarpments, Hogback, Cuesta, Mesa, Butte, Peneplain, Pediments, River terraces, Badlands. Transportation – Deposition: Depositional features: Alluvial fans, and cones, Flood plains, Meanders, Ox – bow lakes, Braided rivers, and Delta. Cycle of erosion, River patterns, Drainage patterns. Outline of Rivers of India with special reference to Tamil Nadu. **Land Forms derived from Underground Water:** Definition and sources of groundwater. Erosional features of groundwater: dolines, sink, caverns, solution valley, stylolite, depositional features: stalactites, stalagmites, siliceous sinter and travertine, geode, and concretionary structures.

UNIT III

Land Forms Created By Glaciers: Definition of glaciers, formation of glaciers, movement of glaciers. Types: valley glaciers, piedmont glaciers, continental glaciers, Surface features of glaciers. Glacial action: Erosion: plucking, rasping, avalanche, erosional features produced by valley glaciers: cirque, horn, glacial trough, hanging valleys, truncated spurs, glacial boulders, glacial scars, roches moutonnees, fjords. Depositional Features produced by continental ice sheets: crescentic gorges; drumlins.

Land Forms Created by Ocean: Shore profile and shoreline development: continental shelf, continental slope, continental rise; Ocean floor-Marine erosion, Features formed by marine reefs – deep sea deposits, abyssal deposits, polygenic sediments, volcanogenic sediments, outline of mid oceanic ridges and submarine canyons.

STRUCTURAL GEOLOGY

UNIT IV

Introduction and scope of Structural Geology. Cardinal directions of a compass – whole circle and quadrant. Magnetic and true North. **Rock outcrops:** definition, types: sedimentary, igneous and metamorphic. **Orientation of rock outcrops:** strike – trend. **Tilt of rock outcrops:** Dip, apparent dip and plunge. **Sedimentary beds:** definition and types. Surficial structures of sedimentary beds: ripple marks, mud cracks, and rain imprints. Trends of outcrops – Contours - Topographic and Geological maps. **Concordant bodies:** Sills – Laccoliths – Lopoliths and Phacoliths. **Discordant bodies:** Dykes – Volcanic vents – Batholiths and stocks. Lava flows - Pillow lava structure.

UNIT V

Rock Joints: Definition – types – classification – outline of genesis. **Foliation and Lineation:** Definition of foliation and lineation - Brief account of common types of foliations and lineations. **Faults:** Definition and parts of a fault. Types – Geometric and genetic classification of faults – Horst and Graben – Criteria for recognition of faults in the field. **Folds:** Definition and parts of a fold - Geometry of folds – Classification – Plunging of folds – Anticlinorium - Synclinorium – outliers and inliers - recognition of folds in the field and on the map. **Unconformity:** Types and geological significance of unconformities – Recognition of unconformities in the field and on a map.

REFERENCE AND TEXTBOOKS:

1. Worcester, P.G. (1960), A Text Book of Geomorphology, East West Press Ltd. Delhi.
2. Radhakrishnan, V. (1996), General Geology, V.V.P. Publications, Tuticorin.
3. Mahapatra, G.B. (1994), Text book of Physical Geology, CBS publications, Delhi.
4. Singh, S. (2007) Geomorphology. S. Chand & Co. Delhi.
5. Bloom, A. (1985), Principles of Geomorphology, Prentice Hall of India, Delhi.
6. Billings, M.P. (1974) Structural Geology. Prentice Hall of India Ltd. New Delhi.
7. Sathya Narayanaswami, B.S. (1994). Structural Geology. Dhanpat Rai & Sons. New Delhi.
8. Gokhale, N.W. (1995), Theory of Structural Geology, CBS, Delhi.
9. Davis, G.H. (1985). Structural Geology of Rocks and Regions. Elements of Structural geology, Wiley.
10. Hills, E.S. (1963). Elements of Structural Geology, Chapman & Hall. London.
11. Ragan, D.M., (2000). Structural Geology-An Introduction to Geometrical Techniques. Wiley. New York.
12. Park, P.G. (1983). Foundations of Structural Geology, Blackie. London.

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: Field visit to known areas is suggested under proper supervision and with the submission of a field report.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY
SECOND YEAR - III SEMESTER
PAPER III - PALEONTOLOGY AND CRYSTALLOGRAPHY- I

PAPER CODE – 17UGLO3

CREDITS - 4

Broad Objectives & Methodology: Paleontology is the study of entombed animal and plant remains in rocks. Crystallography is the foundation of mineralogy, inorganic chemistry and material science. Class lectures and practical, involving the study of representative fossils, crystal models and mineral examples. **Learning Outcomes:** The student gains insight into both subjects by combining theory with practical observation.

PALEONTOLOGY

UNIT I

Outline of Geological time scale. Definition of Fossils. Modes of preservation of fossils. Uses of fossils. Morphology and geological history of **Foraminifera**. Outline of uses of microfossils. **Phylum Porifera** – Sponges. **Phylum Brachiopoda**: Morphological characters – classification – geological and stratigraphical importance.

UNIT II

Phylum Mollusca: Pelecypods - morphological characters – classification – geological and stratigraphical importance. **Gastropods** - morphological characters – classification – geological and stratigraphical importance. **Cephalopods** - morphological characters – classification – geological and stratigraphical importance. **Phylum Hemichordata**: Morphological characters – classification – geological and stratigraphical importance.

UNIT III

Vertebrate Paleontology: A short account on the classification of vertebrates. Outline of evolution of vertebrates through geological time. Introduction to Dinosaurs. Short account of Indian dinosaurs: *Kotasaurus*, *Rajasaurus*, *Stegosaurus*, and *Ankylosaurus*. A brief account of *Archaeopteryx* and *Pterosaurs*. **Paleobotany:** Classification of plant fossils – modes of preservation of plant fossils. Short account of Gondwana flora; *Glossopteris*, *Gangamopteris*, *Calamites*, *Lepidodendron*, *Sigillaria* and *Ptilophyllum*.

CRYSTALLOGRAPHY

UNIT-IV:

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

UNIT-V:

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.

REFERENCE & TEXT BOOKS:**PALEONTOLOGY**

1. **Black, R.M.** (1972). Elements of Paleontology. Oxford University Press. 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. **Agashe, S.N.** (1995). Paleobotany. Oxford & IBH. Delhi.
6. **Jain, M.L. & P.C. Anantharaman.** (2013). An Introduction to Paleontology. Vishal Publications. Delhi.
7. **Sahni, A.** (2001). Dinosaurs of India. NBT. Delhi.
8. **Stewart, W.N. & G.W. Rothwell.** (2005). Paleobotany. Cambridge University Press. Delhi.
9. **Benton, M.J.** (1995). Vertebrate Paleontology. Wiley. New Delhi.
10. **Colbert, E.H. et al.** (2002). Evolution of the Vertebrates. Wiley. New Delhi.
11. **Richard, C.** (2000). History of Life. Wiley. New Delhi.

CRYSTALLOGRAPHY

1. **Ford, W.E.** (1988). Dana's Textbook of Mineralogy. Wiley. New Delhi. (Reprint).
2. **Hota, R.N.** (2011). Practical Approach to Crystallography and Mineralogy. CBS. New Delhi.
3. **Senguptha, S.** (1980). Crystallography and Optical Mineralogy. EW Press. Delhi.
4. **Phillips, F.C.** (1965). Crystallography. ELBS. London
5. **Bloss, F.D.** (1971). Crystallography & Crystal Chemistry. Holt, Rinehart & Winston. New York.
6. **Bishop, A.C.** (1967). An Outline of Crystal Morphology. Hutchinson. London.
7. **Blackburn, W.H. & W.H. Dennen.** (1994). Principles of Mineralogy. W.C. Brown. Dubuque. USA.

Additional Resources: Paleontology and Crystallography related materials is available in CD/DVD format in the Department.

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

Suggested Group Work/Tasks: Field collection of fossils and crystalline minerals of a known area under proper supervision and submission of a field report.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY
SECOND YEAR - III SEMESTER
PART – IV SKILL BASED ELECTIVE PAPER – SBE I - FUEL GEOLOGY

PAPER CODE – 17UGLS1

CREDITS – 2

Broad Objectives & Methodology

The student is introduced to petroleum, coal, and nuclear geology. The methodology of teaching involves class lectures and simple laboratory demonstrations. **Learning Outcomes:** The student gains insight into the different aspects coming under petroleum, coal, and nuclear geology.

PETROLEUM GEOLOGY

UNIT I

Petroleum: definition, physical and chemical properties. Outline of origin of petroleum. Mode of occurrence of petroleum: surface and subsurface occurrence. Outline of environment of petroleum formation. Migration of petroleum and natural gas: primary and secondary migration.

UNIT II

Properties of reservoir rocks: porosity, permeability, and reservoir fluids. Outline of types of reservoir rocks. Characteristics of traps and their classification: structural and stratigraphic and combination, and fluid traps. Outline of petroleum bearing basins of India. Short account of Natural Gas deposits in India. Natural gas hydrates: definition and outline of uses.

COAL GEOLOGY

UNIT III

Coal Geology: Physical properties, chemical composition and classification of coal: rank and grade. Origin of coal: transformation of plant – formation of peat, lignite, bituminous, and anthracite

UNIT IV

Occurrence of coal: coal forming epochs in the geologic past; Geological and geographical distribution of coal in India. Study of important coal fields of India; Neyveli lignite deposits;

NATURAL RADIOACTIVE FUELS

UNIT V

Mineralogy of the Nuclear elements and metals. Outline of host rocks for U and Th deposits. Radiometric prospecting and assaying: principles; instrumentation; phases of prospecting; Field and airborne surveys.

REFERENCE AND TEXTBOOKS

1. Prasad,U. (2003). Economic Mineral Deposits. CBS. Delhi.
2. Banerjee,D.K. (1998). Mineral Resources of India.World Press. Kolkata.
3. Deb,S.(1985). Industrial Minerals and Rocks of India. Oxford & IBH. Delhi.
4. Krishnasamy,S. (1988). India's Mineral Resources. Oxford & IBH. Delhi.
5. Sharma,N.L & R.K.Sinha. (1985), Mineral Economics. Oxford & IBH.Delhi.
6. Gokhale,K.V.G.K.&D.M.Rao.(1981).Ore Deposits of India. Oxford & IBH.Delhi.
7. Aswathanarayana,U. (1985). Principles of Nuclear Geology. NBT.Delhi.
8. Levorsen,A.A.(1967). Geology of Petroleum. CBS.Delhi.
9. Selley,R.C. (1998). Elements of Petroleum Geology. Academic Press. Delhi.

Additional Resources: Other resources related to the above subjects are available in the Department.

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

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7

CHOICE BASED CREDIT SYSTEM

BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY

SECOND YEAR - IV SEMESTER

PAPER IV – PALEONTOLOGY, CRYSTALLOGRAPHY - II AND OPTICAL MINERALOGY

PAPER CODE – 17UGL04

CREDITS – 5

Broad Objectives & Methodology: Paleontology is the study of animal and plant remains in rocks. Crystallography is the foundation of mineralogy,inorganic chemistry and material science. Optical mineralogy is the method of studying and observing features of minerals in thin sections for identification.Class lectures and practical, involving the study of representative fossils,

crystal models and mineral thin sections. **Learning Outcomes:** The student gains insight into the subjects by combining theory with practical observation.

PALEONTOLOGY

UNIT I:

Phylum Coelenterata: Class Anthozoa - Corals: Morphological characters – classification – geological and stratigraphical importance. **Phylum Echinodermata:** Morphological characters – classification – geological and stratigraphical importance. Morphological characters, geological and stratigraphical importance of Blastoids and Crinoids. **Phylum Arthropoda:** Morphological characters – classification – geological and stratigraphical importance.

CRYSTALLOGRAPHY

UNIT II:

Hexagonal system: Symmetry elements and forms. **A. Hexagonal division:** normal, hemimorphic, tripyrnidal, and trapezohedral classes with type minerals. **B. Rhombohedral division:** rhombohedral, rhombohedral-hemimorphic, trirhomboidal, and trapezohedral classes. **Orthorhombic system:** study of the symmetry element and forms of the normal, hemimorphic, and sphenoidal classes with type minerals.

UNIT III

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.

OPTICAL MINERALOGY

UNIT-IV:

Light: Corpuscular, electromagnetic and quantum theories. Ordinary light and plane polarized light. Refractive index and its determination: Relief method, Becke line, Central illumination, and Oblique illumination methods. Isotropism, isotropic minerals and isotropic ray velocity surface. Behaviour of light in isotropic minerals. Petrological Microscope and its parts-optical accessories and their uses: Quartz wedge, Gypsum plate and Mica plate. Study of Isotropic minerals using the petrological microscope: properties of isotropic minerals under parallel Nicol conditions.

UNIT-V:

Anisotropism and anisotropic minerals. Behaviour of ordinary light in uniaxial minerals: Double refraction - Indicatrix - Optic axes – Optic sign. Nicol prism and its construction. Behaviour of polarized light in uniaxial minerals. Pleochroism, retardation, birefringence, extinction, and interference colours in uniaxial minerals. Study of Uniaxial minerals using the petrological microscope: under parallel (PN) and crossed Nicol (XN) conditions. Uniaxial interference figure.

Behaviour of ordinary light in biaxial minerals. Behaviour of polarized light in biaxial minerals. Study of Biaxial minerals using the petrological microscope: under PN and XN conditions. Biaxial Indicatrix - optic axes and optical axial angles – biaxial extinction and extinction angles –Trichroism. Biaxial interference figure. Michel Levi interference colour chart and orders of interference colour.

REFERENCE & TEXT BOOKS:

PALEONTOLOGY

1. **Black, R.M.** (1972). Elements of Paleontology. Oxford University Press.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. **Jain,M.L.& P.C.Anantharaman.**(2013). An Introduction to Paleontology. Vishal Publications. Delhi.

CRYSTALLOGRAPHY & OPTICAL MINERALOGY

1. Ford, W.E. (1988). Dana's Textbook of Mineralogy. Wiley. New Delhi. (Reprint).
2. Hota, R.N. (2011). Practical Approach to Crystallography and Mineralogy. CBS. New Delhi.
3. Senguptha, S. (1980). Crystallography and Optical Mineralogy. EW Press. Delhi.
4. Phillips, F.C. (1965). Crystallography. ELBS. London
5. Bishop, A.C. (1967). An Outline of Crystal Morphology. Hutchinson. London.
6. Kerr, P.F. (1977). Optical Mineralogy, 4th ed. McGraw Hill New York.
7. Gribble, C.D. & A.J. Hall. (1985). A Practical Introduction to Optical Mineralogy. Springer. London.
8. MacKenzie, W.S. & C. Guilford. (1993) Atlas of Rock-Forming Minerals in Thin Section, Longman, UK.
9. Perkins, D. & K.R. Henke. (2003). Minerals in Thin Section, Prentice Hall, New Delhi.
10. Raith, P.M. (2011). Optical Mineralogy. Mineralogical Society of America. Virginia. USA. (free e-book)

Additional Resources: Paleontology and Crystallography related materials is available in CD/DVD format in the Department.

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

Suggested Group Work/Tasks: Field work involving collection of fossils and crystalline minerals of known areas under proper supervision and submission of a field report. Preparation of a thin section of a mineral under proper supervision.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY
SECOND YEAR - IV SEMESTER
PRACTICAL II - PALAEOLOGY AND CRYSTALLOGRAPHY

PAPER CODE – 17UGLP2

CREDITS – 3

Practical Examination Maximum Marks: 60

Practical Examination Marks :50

Records :10

Marks for Internal Assessment :40

PALEONTOLOGY:

Identification of fossils on the basis of morphological characters. Fixing the biological position and range in time of the following classes of fossils:

Gastropods: Turritella, Cerithium, Turbo, Trochus, Natica, Conus, Fusus, Physa, Busycon, Voluta, Murex, Bellerophon,

Helix, Cypraea, Euomphalus. **Cephalopods:** Orthoceras, Nautilus, Goniatites, Ceratites, Acanthoceras, Schloenbachia, Scaphites,

Perisphinctes, Turritites, 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:** Echinus 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, Gangamoptis, Ptilophyllum,

Lepidodendron, Sigillaria, Stigmara, 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: II Year of the Course.

In part fulfilment of the B.Sc Applied Geology degree course, the students should be taken to areas with outcrops of fossil bearing rocks for a period of 5 to 7 days, to collect and study modes of preservation of fossils. They should present the collected fossils and submit a report on the field training at the time of the Main Practical Examination.

Internal Assessment Marks for the practical are given below:

Attendance in Practical Classes: 5 marks; **Practical Tests:** 10 marks. **Full Attendance during field training, collection, and submission of field report:** 25 marks. **Total: 40 marks.**

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY
SECOND YEAR - IV SEMESTER
PART- IV -SKILL BASED ELECTIVE PAPER – 2
SBE II – ENGINEERING GEOLOGY

PAPER CODE – 17UGLS2

CREDITS – 2

Broad Objectives & Methodology: The student is introduced to engineering and medical geology. The methodology of teaching involves class lectures with discussion of case studies relevant to India. **Learning Outcomes:** The student gains insight to the different aspects of engineering and medical geology.

ENGINEERING GEOLOGY**UNIT I**

Definition and scope of Engineering Geology. Engineering properties of rocks. Soils: definition and engineering properties. Genetic and engineering classification of soils. 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. Reservoirs: definition, selection of reservoir sites, and groundwater conditions. Problems in reservoirs: sedimentation, slope control, leakage and seismicity. 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 AND TEXT BOOKS:

1. Bell, F.G. (2005). Fundamentals of Engineering Geology. B.S. Publications. Hyderabad.
2. Krynine, P.D. & W.R. Judd. (1956). Principles of Engineering Geology & Geotechnics. CBS. Delhi.
3. Legget, R.F. & A.W. Hatheway. (1988). Geology and Engineering. 3rd ed. McGraw Hill. New York.
4. Blyth, F.G.H. & M.H. De Freitas. (1984). A Geology for Engineers. 7th ed. Elsevier. New Delhi.
5. Parbin Singh, B. (2005). A Textbook of Engineering and General Geology. S.K. Kataria & Sons. Delhi.

Additional Resources: Natural disaster management 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.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY
THIRD YEAR – V SEMESTER
PAPER V – MINERALOGY

PAPER CODE – 17UGL05

CREDITS – 5

Broad Objectives & Methodology: Mineralogy is the foundation for petrology and field geology. The student is introduced to the different mineral groups emphasizing their properties for megascopic and thin section identification and their distribution in different earth materials. The teaching and learning methodology involves class lectures and practical, field identification demonstrations, and microscopic techniques. **Learning Outcomes:** The student gains useful insight into the methods of mineral identification. This expertise may be used in field geology and laboratory studies of minerals.

UNIT-I:

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

UNIT-II:

Physical, chemical, optical properties, association, mode of occurrences and uses of the following mineral groups: Quartz Group - Feldspar Group – Feldspathoids Group. Short note on twinning in feldspars.

UNIT-III:

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

UNIT-IV:

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

UNIT-V:

Physical, chemical, optical properties, association, mode of occurrences and uses of the following mineral groups: Olivine Group – Epidote Group - Spinel Group. Descriptive study of the following minerals: Andalusite, kyanite, sillimanite, scapolite, apatite, tourmaline, cordierite, sphene, beryl, rutile, and fluorite.

REFERENCE & TEXT BOOKS:

1. Gribble, C.D. (1988). Rutley's Elements of Mineralogy. CBS, New Delhi.
2. Deer, W.A., R.A. Howie & J. Zussman (1992). An Introduction to the Rock-Forming Minerals. ELBS. London.
3. Blackburn, W.H. & W.H. Dennen. (1994). Principles of Mineralogy, 2nd ed. William C. Brown, Dubuque, IA.
4. Klein, C. & C.S. Hurlbut, Jr. (1993) Manual of Mineralogy, 21st ed. John Wiley and Sons, New York.
5. Wenk, H.R & A. Bulakh. (2006). Minerals. Cambridge University Press, New Delhi.
6. Perkins, D. (2010). Mineralogy, 3rd ed. Prentice Hall India, New Delhi.
7. Battey, M. (1978). Mineralogy for Students, Oxford University Press, UK.
8. Berry, L.G., B. Mason & R.V. Dietrich. (1985). Mineralogy, CBS New Delhi.
9. Hota, R.N. (2011). Practical Approach to Crystallography and Mineralogy, CBS, New Delhi.
10. Haldar, S.K. & J. Tisjar. (2014). Introduction to Mineralogy and Petrology, Elsevier, Netherlands.
11. Kerr, P.F. (1977). Optical Mineralogy, 4th ed. McGraw Hill New York.
12. MacKenzie, W.S. & C. Guilford. (1993) Atlas of Rock-Forming Minerals in Thin Section, Longman, UK.
13. Heinrich, E.W. (1965). Microscopic Identification of Minerals. McGraw-Hill. New York.
14. Gribble, C.D. & A.J. Hall. (1985). A Practical Introduction to Optical Mineralogy. Springer. London.
15. Perkins, D. & K.R. Henke. (2003). Minerals in Thin Section, Prentice Hall, New Delhi.

Additional Resources: Mineralogy related materials are available in CD/DVD format in the Department on written request.

Web resources: Mineralogical Society of America: <http://www.minsocam.org>

Mineralogy Databases: <http://webmineral.com>. <http://www.mindat.org>.

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

Suggested Group Work/Tasks: Field excursion to a known area under proper supervision and submission of a field report.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY
THIRD YEAR – V SEMESTER
PAPER VI-STRATIGRAPHY AND INDIAN GEOLOGY

PAPER CODE – 17UGL05

CREDITS – 5

Broad Objectives & Methodology: The student is introduced to the basic principles of Stratigraphy and Indian Geology. The

methodology of teaching involves class lectures with relevant multimedia materials: digital charts, rocks, and others.

Learning Outcomes: The student gains insight into the principles of Stratigraphy and Indian Geology. This knowledge is useful for field geology, mineral exploration, oil exploration, and tectonics.

STRATIGRAPHY

UNIT-I:

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

INDIAN GEOLOGY

UNIT-II:

Physiographic divisions of India. Structure and Tectonic divisions of India: Peninsular India, Extra-Peninsular India and Indo-Gangetic alluvial plains. -Study of Archaean Group: Dharwar system of Karnataka - mineral riches – Dharwar formations in Tamil Nadu.

UNIT-III:

Study of the following geological formations of India: Proterozoic Group: Cuddapah System; Delhi System; Vindhyan System; Kurnool System. Paleozoic Group: Paleozoic of Spiti; Permo – Carboniferous of Salt Range.

UNIT-IV:

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

UNIT-V:

Study of the following geological formations of India: Deccan Traps: distribution – structure - Lameta beds – Inter-trappean and Infra-trappean beds - Bagh beds; Tertiary Group : Eocene of Assam, Cuddalore sandstone of Tamil Nadu and Quilon beds of Kerala; Siwalik System; Outline of Pleistocene Ice Ages in India. Karewa formation; Recent: Placer deposits of Tamil Nadu. Rise of Himalayas.

REFERENCE & TEXTBOOKS:

1. **Krishnan, M.S.** (1986). Geology of India, Burma and Pakistan. CBS. New Delhi.
2. **Wadia, D.N.** (1953). Geology of India. McMillan India. Delhi.
3. **Kumar, R.** (1988). Fundamentals of Historical Geology and Stratigraphy of India, Wiley. New Delhi.
4. **Weller, J.M.** (1960). Stratigraphic Principles and Practice. University Book Stall. New Delhi.
5. **Mehdiratta, R.C.** (1974). Geology of India, Pakistan, Bangladesh and Burma. Atma Ram & Sons. Delhi.
6. **Vaidyanadhan, R & M. Ramkrishnan.** (2008). Geology of India. Geological Society of India. Bangalore.
7. **GSI.** (2005). Geology & Mineral Resources of the States of India. Misc Pub. No.30. Geological Survey of India. Kolkata. (Several individual volumes available online at GSI portal).

Additional Resources: Web resources related to Stratigraphy and Indian Geology related materials are available in the Department. **Assignments:** Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Field visits to stratigraphically significant areas within Tamil Nadu under proper supervision.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY
THIRD YEAR – V SEMESTER
PAPER VII – IGNEOUS AND METAMORPHIC PETROLOGY

PAPER CODE – 17UGL07

CREDITS – 5

Broad Objectives & Methodology: Petrology is the foundation for field geology, stratigraphy, mineral exploration and others. The student is introduced to the basics of igneous and metamorphic petrology emphasizing processes, field geology, classification and others. The teaching and learning methodology involves class lectures and practical, field identification demonstrations, and microscopic techniques. **Learning Outcomes:** The student gains useful insight into igneous and metamorphic petrology. This expertise may be used in field geology and laboratory studies of rocks.

IGNEOUS PETROLOGY

UNIT-I:

Igneous Petrology: definition and scope. Magma: definition, composition and constituents of magma. Crystallization of a unicomponent magma: Augite system. Crystallization of binary magma: Diopside-Anorthite system – simple eutectic. Albite – Anorthite system – solid solution series. Forsterite – Silica system – incongruent melting. Crystallization of a ternary system: Diopside – Anorthite – Albite. Bowen's Reaction Series. Mechanism and processes of magmatic differentiation.

UNIT-II:

Field configurations of igneous rocks: intrusive forms and extrusive forms. Assimilation of host rocks by magmas. Classification of igneous rocks based on: mode of occurrence, silica and alumina saturation, chemical and mineralogical schemes and Tyrell's tabular classification.

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. Short account of Harker's variation diagram.

METAMORPHIC PETROLOGY

UNIT-IV:

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

UNIT-V:

Regional metamorphism of argillaceous, calcareous, and impure calcareous rocks and their products. Plutonic metamorphism and its products. Short notes: retrograde metamorphism, anatexis and palingenesis. Descriptive petrography of the following metamorphic rocks; slate, phyllite, quartzite, schist, gneiss, migmatite, granulite, charnockite, amphibolite, eclogites, hornfels, and marble.

REFERENCE AND 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. Winter, J.D. (2010). Principles of Igneous and Metamorphic Petrology. PHI. New Delhi.
4. Williams, H. et al. (1982). Petrography. CBS. New Delhi.
5. McBirney, A.R. (1993). Igneous Petrology. CBS. New Delhi.

6. Best, M.G. (2005). Igneous Petrology. Wiley. New Delhi.
7. Best, M.G. (2003). Igneous and Metamorphic Petrology. Wiley. New Delhi.
8. Hatch, F.H. et al. Petrology of the Igneous Rocks. CBS. Delhi.
9. Hyndman, D.W. (1985). Petrology of the Igneous and Metamorphic Rocks. McGraw Hill. New York.
10. Middlemost, E.A.K. (1985). Magmas and Magmatic Rocks. Longman. UK.
11. Winkler, H.G.F. (1970). Petrology of the Metamorphic Rocks. Springer. New Delhi.
12. Turner, F.J. (1968). Metamorphic Petrology. McGraw Hill. New York.

Additional Resources

Igneous and metamorphic petrology related materials are available in CD/DVD format in the Department on written request. Web related materials are also available in the Department.

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

Suggested Group Work/Tasks: Field excursion to a known area under proper supervision and submission of a field report.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7 CHOICE BASED CREDIT SYSTEM

BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY THIRD YEAR – VI SEMESTER

III YEAR - V SEMESTER - PART –III MAJOR BASED ELECTIVE 1 - MBE 2 – HYDROGEOLOGY

PAPER CODE 17UGLM2

CREDITS - 4

Broad Objectives & Methodology: The student is introduced to the basic principles of hydrogeology. The methodology of teaching involves class lectures and simple laboratory demonstrations. **Learning Outcomes:** The student gains insight into the basic principles of hydrogeology.

UNIT: I

Definition and scope of Hydrogeology. Concise account of the hydrologic and hydro-geological cycle. Origin and sources of groundwater: meteoric water, connate water and juvenile water. Vertical distribution of groundwater. Rock properties affecting groundwater occurrence in rocks: porosity: primary and secondary, factors controlling porosity.

UNIT: II

Specific yield and specific retention. D'Arcy's Law and its limitations. Laminar and turbulent flow. Permeability and permeameters. Coefficient of permeability. Water springs and their types.

UNIT III

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

UNIT: IV

Groundwater exploration: Outline of field geological, remote sensing, and resistivity methods. Outline of drilling techniques for groundwater. Artificial and natural recharge of groundwater. Brief account of rain water harvesting. Fluctuations of groundwater levels.

UNIT V

Groundwater Quality and Chemistry: Physical criteria of water quality. Chemical analyses of groundwater and units used. TDS and hardness of ground water. Biological analysis of groundwater. Outline of groundwater provinces of Tamil Nadu.

REFERENCE AND 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.

Additional Resources: Web resources related to the above subjects are available in the Department.

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

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY
III YEAR - V SEMESTER

PART – IV SKILL BASED ELECTIVE PAPER – 3 - SBE III - REMOTE SENSING

PAPER CODE 17UGLS3

CREDITS - 2

Broad Objectives & Methodology: The student is introduced to the principles and methods of Remote Sensing relevant to Geology with applications. The methodology of teaching involves class lectures, practical, study of aerial photos and digital imageries for geological applications. **Learning Outcomes:** The student gains insight of the applications and uses of Remote Sensing.

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 – 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.

REFERENCES AND 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. Gupta, R.P. (2003). Remote Sensing Geology. Springer. New Delhi.
8. Lillisand, T.M & R.W.Kiefer. (2000). Remote Sensing and Image Interpretation. Wiley. Delhi.

Additional Resources: Remote Sensing 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.

Suggested Group Work/Tasks: Interpretation of selected imageries and their field verification is suggested.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY
THIRD YEAR - V SEMESTER
PART IV SKILL BASED ELECTIVE PAPER 4
FIELD GEOLOGY

PAPER CODE 17UGLS4

CREDITS - 2

Broad Objectives & Methodology: To introduce 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. Class lectures and practical, field demonstrations emphasizing: proper method of instruments handling and safety, use of field note book and information on personal safety and camping. **Learning Outcomes:** The student gains insight into the methods of geological mapping and can gain expertise by proper practice. This expertise may be useful in the particular field of geology the student wishes to pursue for employment.

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 AND TEXTBOOKS

1. **Compton, R.R.** (1985). *Geology in the Field*, John Wiley & Sons Inc., New Delhi.
2. **McClay, K.R.** (2003) *The Mapping of Geological Structures*, 2nd ed., John Wiley & Sons Ltd, 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*. Prentice Hall India. 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.

Additional Resources: Field Geology related animations available in CD/DVD format in the Department.

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

Suggested Group Work/Tasks: Field Mapping of a known area under proper supervision and submission of a field report.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY
III YEAR - VI SEMESTER
PAPER VIII - SEDIMENTARY PETROLOGY AND ENVIRONMENTAL GEOLOGY

PAPER CODE 17UGL08

CREDITS - 5

Broad Objectives & 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. Environmental geology is the application and role of geology in the environmental perspective. The methodology of teaching involves class lectures, practical, and laboratory work.

Learning Outcomes: The student gains insight and understanding of sedimentary petrology and environmental geology.

SEDIMENTARY PETROLOGY

UNIT-I

Definition and scope of Sedimentary Petrology. Sedimentary rocks: definition, origin, disintegration and decomposition of rocks. Transportation and deposition of sediments. Outline of sedimentary processes. Classification of sedimentary rocks: Tyrell's classification, Megascopic classification. Textures of sedimentary rocks.

UNIT-II

Outline of depositional sedimentary environments. Structures of sedimentary rocks. Sedimentary residual deposits: soils, regolith, laterite, and terra rosa. Sedimentary mechanical deposits. Outline of different sedimentary environments.

UNIT-III

Sedimentary deposits of chemical origin: evaporite, siliceous, carbonate, ferruginous, and clay rich deposits. Sedimentary deposits of organic origin: calcareous, phosphatic, iron rich, and silica rich deposits. Petrographic description of: conglomerate, breccia, sandstone, shale and limestones.

ENVIRONMENTAL GEOLOGY

UNIT-IV

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 AND TEXTBOOKS

1. Tyrell, G.W. (1958). Principles of Petrology. B.I. Publications. New Delhi.
2. Haug, W.T. (1962). Petrology. McGraw Hill. New York.
3. Williams, H. et al. (1982). Petrography. CBS. New Delhi.
4. Greensmith, J.T. (1976). Petrology of the Sedimentary Rocks. CBS. Delhi.
5. Folk, R.L. (1974). Petrology of the Sedimentary Rocks. Hemphill. Texas. USA.
6. Keller, E.A. (1985). Environmental Geology. Merrill. New York.
7. Miller, T.G. (2004). Environmental Science. Wadsworth Publishing. USA.
8. Flawn, P.T. (1970). Environmental Geology. Harper. New York.
9. Coates, D.R. (1984). Environmental Geology. McGraw Hill. New York.

Additional Resources: Sedimentary Petrology and Environmental 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. **Suggested Group Work/Tasks:** Field excursion is suggested under proper supervision and with the submission of a field report.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY
THIRD YEAR - VI SEMESTER
PAPER IX – ECONOMIC GEOLOGY

PAPER CODE 17UGL09

CREDITS - 5

Broad Objectives & Methodology: The student is introduced to the basic principles of economic geology and mineral economics. The methodology of teaching involves class lectures with mineral sample study and simple laboratory demonstrations.

Learning Outcomes: The student gains insight into the basic principles of economic geology and mineral economics.

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 – Bacteriogenic.

UNIT III:

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

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.

UNIT V:

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

REFERENCE AND TEXT BOOKS:

1. Aiyengar, N.K.N. (1964). Minerals of Madras. Dept. of Industries & Commerce. Guindy, Madras.
2. Bateman, A.M. & M.L. Jensen. (1981). Economic Mineral Deposits. 3rd ed. Wiley. New York.
3. Edwards, R. & K. Atkinson. (1986). Ore Deposit Geology. Chapman & Hall. UK.
4. Krishnan, M.S. (1951). Mineral Resources of Madras. Memoir V.80. Geol. Surv. Ind. Kolkata.
5. Park, C.F. & M.A. MacDiarmid. (1970). Ore Deposits. Freeman. New York.
6. Prasad, U. (2003). Economic Mineral Deposits. CBS. Delhi.
7. Banerjee, D.K. (1998). Mineral Resources of India. World Press. Kolkata.
8. Deb, S. (1985). Industrial Minerals and Rocks of India. Oxford & IBH. Delhi.
9. Krishnasamy, S. (1988). India's Mineral Resources. Oxford & IBH. Delhi.
10. Sharma, N.L & R.K. Sinha. (1985), Mineral Economics. Oxford & IBH. Delhi.

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

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

Additional Resources: Web resources related to the above subjects are available in the Department.

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

Suggested Group Work/Tasks: Field visit to metallic ore deposit mines with proper permission is suggested with proper permission.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY
THIRD YEAR - VI SEMESTER
PAPER X - MINING GEOLOGY AND ORE DRESSING

PAPER CODE 17UGL10

CREDITS - 5

Broad Objectives & Methodology:The student is introduced to the basic principles of mining geology and ore dressing. The methodology of teaching involves class lectures with problem solving exercises and simple laboratory demonstrations. **Learning Outcomes:** The student gains insight into the basic principles of mining geology.

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. Drilling: definition and purpose. **Drilling methods:** rotary, percussion, and diamond. Geological logging of bore hole samples.

UNIT II

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. Strip mining and surface augering of coal beds and seams. Quarrying method for hard rocks. Glory hole mining.

UNIT III

Alluvial mining of unconsolidated sediments and soft rocks. Hydraulic method – panning and sluicing of sediments. Dredging of off shore unconsolidated sediments.

Subsurface and underground mining methods: Components of an underground mine: adit, shaft, level, cross cut,drift, tunnel, winze,raise,stoep, and foot-wall and hanging wall. Mine stoping methods: open stoep, level stoping, supported stopes, square set stopes, pillar supported stopes, and shrinkage stopes.

UNIT IV

Outline of subsurface mine ventilation. Groundwater problems and their management in open cast and underground mines. Modes of transportation of broken ore in open cast and underground mines. **Subsurface coal mining methods:** stoep and pillar, long wall, room and pillar, and caving.

UNIT V

Ore Dressing

Definition and scope of ore dressing in mining. Properties of minerals used in ore beneficiation processes.

Manual crushing of ores. Types of crushers: jaw, gyratory, and cone types; Types of grinders: tumbling, ball, and rod mills. Sizing and screening of crushed ores: purpose of screening, types of screens: outline of fixed types and moving types. Outline of ore classifiers. Concentration of ores by jigging, floatation and magnetic separation. Outline of flows charts used in ore dressing.

REFERENCE AND TEXTBOOK

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.

Additional Resources: Web resources related to the above subjects are available in the Department.

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

Suggested Group Work/Tasks: Field visit to opencast or underground mines with proper permission.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY
THIRD YEAR – VI SEMESTER
PART –III MAJOR BASED ELECTIVE – 1 - MBE 1 - EXPLORATION GEOLOGY

PAPER CODE 17UGLM1

CREDITS - 5

Broad Objectives & Methodology: The student is introduced to the basic principles of exploration geology. The methodology of teaching involves class lectures with simple laboratory demonstrations. **Learning Outcomes:** The student gains insight into the basic principles of exploration geology.

I. Exploration Geology: Geological and Geochemical Exploration

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

Geochemical Exploration: definition and scope. Basic principles: Concepts of background, threshold, and anomalous values. Indicator elements and minerals. Pathfinder elements and minerals. Distribution of elements around ore bodies: primary, secondary, and leakage haloes. Outline of lithogeochemical, pedogeochemical, biogeochemical, and hydrogeochemical methods. Short account of geobotanical indicators with Indian examples.

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. **Radioactive Minerals:** definition, radioactive minerals and their host rocks. Outline of Geiger Muller Counter. Distribution of radioactive minerals in India with special reference to Tamil Nadu.

REFERENCE AND TEXTBOOKS

1. Banerjee, P.K. & S.Ghosh. (1997). Elements of Prospecting for Non Fuel Mineral Deposits. Allied. Chennai.
2. Arogyaswamy, R.N.P. (1980). Courses in Mining Geology. Oxford & IBH, New Delhi.
3. Hawkes, H.E. (1959). Principles of Geochemical Prospecting. Bulletin 1000F. USGS.
4. Moon, C.J et al. (2006). Introduction to Mineral Exploration. Wiley Blackwell. New Delhi.
5. Ramachandra Rao, M.B. (1993). Outlines of Geophysical Prospecting. EBD Publishers, Dhanbad.
6. Kearey, Pet al. (2002). An Introduction to Geophysical Exploration. Wiley. Delhi.
7. Mussett, A.E. & Khan, M.A. (2000). Looking into the Earth. Cambridge University Press, New Delhi.
8. Sharma, P.V. (2005). Environmental and Engineering Geophysics. Cambridge University Press. Delhi.
9. Prasad, U. (2003). Economic Mineral Deposits. CBS. Delhi.
10. Banerjee, D.K. (1998). Mineral Resources of India. World Press. Kolkata.
11. Deb, S. (1985). Industrial Minerals and Rocks of India. Oxford & IBH. Delhi.
12. Krishnasamy, S. (1988). India's Mineral Resources. Oxford & IBH. Delhi.
13. Sharma, N.L & R.K. Sinha. (1985), Mineral Economics. Oxford & IBH. Delhi.
14. Gokhale, K.V.G.K. & D.M. Rao. (1981). Ore Deposits of India. Oxford & IBH. Delhi.

Additional Resources & Assignments: Web resources related to the above subjects are available in the Department. Any two assignments (within the five units) may be suggested by the Teacher.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY
THIRD YEAR - VI SEMESTER
PART – III MAJOR BASED ELECTIVE: MBE III – GEOLOGICAL METEORITICS, COMPUTER APPLICATIONS IN GEOLOGY,
AND GEOSTATISTICS

PAPER CODE 17UGLM3

CREDITS - 4

Broad Objectives & Methodology: The student is introduced to the basic principles of meteoritics applied to geology, computer application in geology, and geostatistics. The methodology of teaching involves class lectures with simple laboratory demonstrations.

Learning Outcomes: The student gains insight into the basic principles of geological meteoritics, computer application in geology, and geostatistics.

GEOLOGICAL METEORITICS

UNIT I

Meteorites: definition, types, outline of classification of meteorites. Meteorite craters: definition, formation on earth's surface, outline of geological evidences of impact. Basic differences between volcanic and meteorite craters.

UNIT II

Geological and geophysical features of impact sites. Outline of Indian meteorites and impact craters. Brief account of extinction events related to meteorite impacts in the geological record. Meteorite craters and mineral deposits. Outline of meteorite falls in Tamil Nadu.

COMPUTER APPLICATIONS IN GEOLOGY

UNIT III

Introduction to flow charts and algorithms. Outline of application and uses of the following geologically oriented software: A short account of: Arc GIS, Stereoplot, 'R' software, Surfer, and Rock ware. Components of a computer: hardware – input and output devices. Use of Excel spread sheets in Petrology, Hydrogeology and Geostatistics.

GEOSTATISTICS

UNIT IV

Definition and scope of statistics in Geology. Measures of central tendency. Distributions – Scales – population. Brief introduction to sampling methods. Outline of errors in sampling. Variables; Tabulation;

UNIT V

Introduction to probability. Simple correlation and linear regression. Outline of graphical methods in statistics: bar chart, pie diagram, and XY graph. Outline of application of statistics in geology.

REFERENCE AND TEXT BOOKS:

1. French, B. (1998). Traces of Catastrophe. Lunar & Planetary Institute. Houston.
2. Wasson, J.T. (1974). Meteorites: Classification & Properties. Springer Verlag. Berlin.
3. Mason, B. (1985). Principles of Geochemistry. Wiley Eastern. New Delhi.
4. Greely, R. (1994). Planetary Landscapes. Chapman & Hall. New Delhi.
4. Ravichandran, D. (2001). Introduction to Computers and Communication. Tata McGraw Hill. Delhi.
5. Gupta, S. (2004). Basic Statistics. S.Chand & Sons. Delhi.
6. Davis, J.C. (1985). Statistical and Data Analysis in Geology. Wiley. Delhi.

7. **Guptha, S.**(1990). Statistical Methods. S.Chand & Sons. Delhi.

Additional Resources: Web resources related to the above subjects are available in the Department.

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

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY
THIRD YEAR - VI SEMESTER
PART – IV SKILL BASED ELECTIVE PAPER: SBE 5 - GEMMOLOGY

PAPER CODE 17UGLS5

CREDITS - 2

Broad Objectives & Methodology: To introduce the student to the basics of gemmology, gemstone exploration and its exploitation, gemstone processing and cutting techniques, and to the marketing of finished gems. The topics emphasize the significance of gemmology as an avenue for future self employment. Class lectures and practical, field identification demonstrations, and laboratory techniques. **Learning Outcomes:** The student gains insight into the methods of gemstone identification and exploration. This expertise may be useful in the particular field of gemmology the student wishes to pursue for employment.

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 – 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 AND TEXTBOOKS

1. **Karant, R.V.** (2000). Gem and gem industry in India, Memoir 45, Geological Society of India, Bangalore.
2. **Babu, T.M.** (1998). Diamond in India, Economic Geology Series 1, Geological Society of India, Bangalore.
3. **Hall, C.** (2005). Gemstones, Dorling Kindersley, London.
4. **Sinkankas, J.J.** (1964). Mineralogy: A first Course, Van Nostrand Reinhold, New York.
5. **Krishnan, M.S.** (1964). Mineral Resources of Madras, Memoir Vol 80, Geological Survey of India, Kolkata
6. **Prasad, U.** (2003). Economic Mineral Deposits, CBS Publishers, New Delhi.

7. Read, P.G. (1984). *Beginner's Guide to Gemmology*, Heinemann Professional Publishing Ltd, London.
8. O'Donoghue, M. (2006). *Gems*. Elsevier, Singapore.
9. Keller, P.C. (1990). *Gemstones and their origins*, Van Nostrand Reinhold, New York.
10. Herbert Smith, G.F (1912). *Gemstones*. Methuen, London.
11. Read, P.G. (2005). *Gemmology*, 3rd ed. Elsevier, Singapore.
12. Walton, L. (2004). *Exploration Criteria for Colored Gemstones*, Open File – 2004 – 10. Canada.

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

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

Suggested Group Work/Tasks: Field excursion to a known gemstone bearing area under proper supervision and submission of a field report.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY
THIRD YEAR - VI SEMESTER
PRACTICAL III - MINERALOGY AND PETROLOGY

PAPER CODE 17UGLP3

CREDITS - 6

Practical Examination Maximum Marks: 60

Practical Examination Marks: 50

Records: 10

Marks for Internal Assessment: 40

MINERALOGY:

A. MEGASCOPIY

Megascope Identification of rock forming silicate on the basis of their physical properties, chemical composition and determination of system of crystallization of the following groups of minerals:

Quartz Group: Rock Crystal, Blue quartz, Smoky quartz, Chalcedony, Opal, Agate, Flint, Jasper, Amethyst.

Feldspars Group: Orthoclase, Microcline, Albite, Oligoclase, Labradorite, Anorthite, Perthite.

Feldspathoid Group: Nepheline, Sodalite, Lazurite.

Pyroxene Group: Enstatite, Bronzite, Hypersthene, Augite, Diopside, Rhodonite, Wollastonite.

Amphibole Group: Anthophyllite, 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 MEGASCOPIY

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: lamprophyre, 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; gneiss; 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; lamprophyre, 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; gneiss; 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: III Year of the Course.

In part fulfilment of the B.Sc Applied Geology degree course, the students should be taken to areas of geological importance for a period of 5 to 7 days, to collect rock and mineral samples for megascopic and microscopic study in the laboratory. They should present the collected specimens and submit a report on the field training at the time of the Main Practical Examination.

Internal Assessment Marks for the practical are given below:

Attendance in Practical Classes: 5 marks; **Practical Tests:** 10 marks. **Full Attendance during field training, collection, and**

submission of field report: 25 marks.

Total: 40 marks.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
BACHELOR OF SCIENCE (B.Sc) APPLIED GEOLOGY
THIRD YEAR - VI SEMESTER

PART- IV SKILL BASED ELECTIVE PAPER

SBE6 - ECONOMIC MINERALS, GEOCHEMISTRY, & FIELD GEOLOGY PRACTICAL

PAPER CODE 17UGLS6

CREDITS - 2

Practical Examination Maximum Marks: 60

Practical Examination Marks: 50

Records: 10

Marks for Internal Assessment: 40

Broad Objectives & Methodology: The student is introduced to the different laboratory based methods and techniques relevant to field and geology and geological mapping. The methodology of teaching involves class lectures with problem solving exercises and simple laboratory demonstrations. **Learning Outcomes:** The student gains some expertise by using the different laboratory based methods and techniques relevant to field and geology and geological mapping.

Syllabus:

1. Determination of strike, dip, trend and plunge of geological structures or features using Clinometer Compass and Brunton Compass.

2. Identification of geomorphologic features and major drainage patterns from scaled Aerial Photographs.

3. Identification of the following gem stones:

Diamond, ruby, sapphire, topaz, quartz, amethyst, agate, opal, jasper, cats-eye, diopside, moonstone, labradorite, sodalite, lazurite, beryl, garnet, kyanite.

4. Megascope identification of industrial and ore minerals:

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

Ore minerals: **Fe ores:** magnetite, hematite, limonite, pyrite, marcasite and siderite. **Cu ores:** chalcopryite, 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.

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.

GOVERNMENT ARTS COLLEGE (Autonomous), SALEM – 7
CBCS (For students admitted from 2017 – 2018 onwards)
Bachelor of Science (B.Sc) DEGREE COURSE
II YEAR – III SEMESTER
ALLIED GEOLOGY THEORY PAPER I

PAPER CODE: 17AGC01

CREDITS 3

Broad Objectives & 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.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.

GOVERNMENT ARTS COLLEGE (Autonomous), SALEM – 7
CBCS (For students admitted from 2017 – 2018 onwards)
Bachelor of Science (B.Sc) DEGREE COURSE
II YEAR – III SEMESTER
ALLIED GEOLOGY THEORY PAPER I

PAPER CODE 17AGC02

CREDITS 3

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

An outline of the following processes of ore formation: magmatic – hydrothermal – placer – marine evaporites. 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

GOVERNMENT ARTS COLLEGE (Autonomous), SALEM – 7
CBCS (For students admitted from 2017 – 2018 onwards)
Bachelor of Science (B.Sc) DEGREE COURSE
II YEAR – III SEMESTER
ALLIED GEOLOGY PRACTICAL

PAPER CODE: 17UGLACP

CREDITS 4

Practical Exams: 60 Marks (Exam – 50; Records – 10)

Internal Assessment 40 marks (Attendance – 10, Laboratory Observation – 10, Tests – 20)

Crystallography

Simple forms of the Normal classes of the different crystal systems and models representing the following minerals: Cubic system: galena, fluorite, and garnet. Tetragonal system: zircon, cassiterite. Hexagonal system: beryl. Orthorhombic system: barite, sulfur, staurolite. Monoclinic system: gypsum. Triclinic system: axinite.

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.

GOVERNMENT ARTS COLLEGE (Autonomous), SALEM – 7
CBCS (For students admitted from 2017 – 2018 onwards)
Bachelor of Science (B.Sc) DEGREE COURSE
II YEAR – III SEMESTER
ALLIED GEOLOGY THEORY PAPER I

PAPER CODE: 17AGC01

CREDITS 3

Broad Objectives & 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.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.

GOVERNMENT ARTS COLLEGE (Autonomous), SALEM – 7
CBCS (For students admitted from 2017 – 2018 onwards)
Bachelor of Science (B.Sc) DEGREE COURSE
II YEAR – III SEMESTER
ALLIED GEOLOGY THEORY PAPER I

PAPER CODE 17AGC02

CREDITS 3

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

An outline of the following processes of ore formation: magmatic – hydrothermal – placer – marine evaporites. 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

GOVERNMENT ARTS COLLEGE (Autonomous), SALEM – 7
CBCS (For students admitted from 2017 – 2018 onwards)
Bachelor of Science (B.Sc) DEGREE COURSE
II YEAR – III SEMESTER
ALLIED GEOLOGY PRACTICAL

PAPER CODE: 17UGLACP

CREDITS 4

Practical Exams: 60 Marks (Exam – 50; Records – 10)

Internal Assessment 40 marks (Attendance – 10, Laboratory Observation – 10, Tests – 20)

Crystallography

Simple forms of the Normal classes of the different crystal systems and models representing the following minerals: Cubic system: galena, fluorite, and garnet. Tetragonal system: zircon, cassiterite. Hexagonal system: beryl. Orthorhombic system: barite, sulfur, staurolite. Monoclinic system: gypsum. Triclinic system: axinite.

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.