GOVERNMENT ARTS COLLEGE (AUTONOMOUS)

SALEM-7

NAAC REACCREDITED WITH B++

MASTER OF SCIENCE (M.Sc) APPLIED GEOLOGY DEGREE

COURSE

CHOICE BASED CREDIT SYSTEM (CBCS)
REGULATIONS AND SYLLABUS

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

GOVERNMENT ARTS COLLEGE (AUTONOMOUS) SALEM-7
NAAC REACCREDITED WITH B++
Master of Science (M.Sc) APPLIED GEOLOGY DEGREE COURSE
CHOICE BASED CREDIT SYSTEM (CBCS) – REGULATIONS AND SYLLABUS
(Effective from the Academic Year: 2017 – 2018 onwards)

1. CONDITIONS FOR ADMISSION:

A candidate, who has passed the B.Sc Degree Examination in Geology / Applied Geology of the Periyar University or an equivalent examination of any other Universities accepted by the Syndicate of the Periyar University as equivalent there to, shall be permitted to apply for admission and to appear and qualify for the Master of Science (M.Sc) Applied Geology Degree Examination. Candidates from other universities are required to apply with a valid eligibility certificate from Periyar University, Salem – 11.

2. DURATION OF THE COURSE:

The duration of the Degree of Master of Science in Applied Geology shall consist of two consecutive academic years composed of four semesters.

3. COURSE OF STUDY AND SCHEME OF EXAMINATION:

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

4. EXAMINATIONS:

The Theory Examination shall be of three hours duration conducted at the end of each semester. The Practical Examinations for M.Sc Applied Geology Course shall be of four hours duration and will be conducted only at the end of the even semester as II and IV 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 pass in any theory paper(s) shall be permitted to appear for each failed subject(s) in the subsequent semester/examination. Candidates may apply to appear for instant or supplementary examinations for theory paper(s) only. The candidate failing to get the minimum marks required for pass 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 8. 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 38 out of 75. The break up for internal assessment marks for theory papers will be as follows: Attendance: 5 + Assignment: 5 + Seminar: 10 + Test: 5 =

25 Marks. There is no passing minimum for internal assessment. The passing minimum mark for all theory papers shall be 50 marks with both internal and external marks added together under the mandatory requirement that the candidate has secured not less than 38 out of 75 in the written examination. Candidates who score less than 38 out of 75 in the theory papers and secure more than 50 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 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 M.Sc Applied Geology Course will be conducted only at the end of the even semester as II, and IV Semesters only. The breakup of marks shall be Practical Examination - 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 50 marks with both internal and external marks added together under the mandatory requirement that the candidate has secured not less than 30 out of 60 in the written examination. Candidates who score less than 30 out of 60 in the theory papers and secure more than 50 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. 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 Government Arts College Autonomous and Periyar University norms/guidelines. The candidate has to apply and re-appear for the practical examination at the subsequent EVEN semester only. The attendance and participation for the Field Training Programme of a candidate pursuing M.Sc Applied Geology Degree is mandatory and shall be a necessary criterion for the candidate to appear for the Examinations.

Project/Dissertation

A candidate shall be declared to have passed the Project / Dissertation Examination if he/she obtains not less 100 marks out of 200. A candidate who has not obtained the required minimum marks for a pass in his or her dissertation/project shall be required to appear for and pass the same at the next even or subsequent even semester only. Revaluation, re-totalling of marks, supplementary or instant examination, and transparency of Project/Dissertation is NOT permitted as per Government Arts College Autonomous and Periyar University norms/guidelines. The candidate has to apply and re-appear for the Project/Dissertation examination at the subsequent EVEN semester only.

6. CLASSIFICATION OF SUCCESSFUL CANDIDATES:

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 D and above. RA denotes the candidate should Re-Appear for the examination.

GP = Marks obtained in a course x Credits / 10

GPA = Total Grade points earned in a semester / Total Credits registered in a semester

CGPA = Sum of Grade Points earned / Sum of Credits registered

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

A student is deemed to have completed a course successfully and earned the appropriate credit, only if, the candidate has earned a grade of D and above. RA denotes that the candidate should Re-Appear for the examination.

GP = Marks obtained in a course x Credits / 10

GPA = Total Grade points earned in a semester / Total Credits registered in a semester

CGPA = Sum of Grade Points earned / Sum of Credits registered

The above classification is based on the marks secured by a candidate in the Major Subjects, Major Electives and Non Major Electives.

7. RANKING:

Candidates who have passed all the examinations prescribed for the course **in their first appearance,** within the period of two academic years / four semesters from their year of admission **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 two academic years / four semesters from their year of admission.

8. Attendance Requirement & Condonation of Attendance:

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 theory examinations **without** condonation of attendance. Those candidates whose attendance for the semester 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. They shall be permitted to redo or repeat the lapsed semester(s) only after the completion of their second/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 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 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. 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 practical(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 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 Rs 500 + 500 = 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.

9. QUESTION PAPER PATTERN:

The question paper pattern shall be as follows:

Time: 3 Hours - Maximum Marks: 75

Part A: 5 x 5 = 25 Marks

No. of questions = 5 (With internal choice)

All questions will carry equal marks. All questions are compulsory

Two questions will be set from each unit with internal choice

Each answer should be about 500 words.

Part B: 5 x 10 =50 Marks

No. of questions = 5 (With internal choice)

All questions will carry equal marks. All questions are to be answered

Two questions will be set from each unit

Each answer should be about 1000 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.

10. PROJECT/DISSERTATION:

(A) Topic:

The Project supervisor and the broad field for the project/dissertation shall be assigned to the candidate randomly by draw of lots before the end of first semester. The list of candidates and their supervisors shall be submitted to the Head of Department and Controller of Examinations.

(B) Plan of Work:

The student shall prepare the plan of work for the project/dissertation and get the approval of the Supervisor. He / She should start the project work from the end of the second semester and submit the dissertation at the time of viva-voce examination at the end of the fourth semester. The dissertation shall be duly certified by the Supervisor and the Head of the Department.

(C) Project/Dissertation work outside the College:

In case the student needs to avail facilities outside the college, (i.e.) from other University / Laboratory, they shall pursue the work with the permission of the Supervisor and acknowledge the outside facilities utilised by them. The student shall complete the dissertation work on or before 31st March, of a Calendar Year. Specific approval/permission of the College Principal / DCE shall be obtained when the student stays away for research work outside the college for a period exceeding two weeks.

(D) Submission of Project/Dissertation:

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

(E) Marks for Project/Dissertation:

The total marks for project/dissertation shall be 200, of which 150 marks are for dissertation work and 50 marks for Viva-Voce conducted as a part of the Main Practical examination in the IV semester. A candidate who has not obtained the required minimum marks for a pass in his or her dissertation/project shall be required to appear for and pass the same at the next or subsequent even semester only. A candidate who has not completed the project/dissertation or fails to complete or submit the project/dissertation before the main practical exam and viva voce will forfeit evaluation of the project/dissertation and will be awarded zero(0) marks. Revaluation of Project/Dissertation, re-totalling of Project/Dissertation marks, supplementary or instant viva voce for Project/Dissertation is NOT permitted as per Government Arts College Autonomous and Periyar University norms/guidelines. The candidate has to pay the condonation fee (Rs500) and resubmit the project/dissertation in the next or subsequent even semester only.

11. TRANSITORY PROVISION:

Candidates who were admitted to the M.Sc Applied Geology Course of study in the year 2017 – 2018 are **permitted to appear for the examination under this regulation for a period of 5 years or ten consecutive semesters from their of year of admission to the course.** Thereafter they shall be permitted to appear for examination only under the syllabus and regulations then in force.

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 + Seminar: 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 seminars are given as follows:

Continous Assessment I or CA I = 5; Continous 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:

Continous Assessment I or CA I = 2; Continous 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 or B).

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:

Continous Assessment I or CA I = 5; Continous 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 PG 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 – Master of Science (M.Sc) APPLIED GEOLOGY
COURSE OF STUDY AND SCHEME OF EXAMINATION

SEM No.	PAPER CODE	PAPER No.	TITLE OF THE PAPER	HOURS	CREDITS	MARKS		TOTAL
						IA	SE	
I	17PGL01	I	ADVANCED MINERALOGY,OPTICAL MINERALOGY AND ANALYTICAL TECHNIQUES	5	6	25	75	100
	17PGL02	II	APPLIED GEOMORPHOLOGY	5	5	25	75	100
	17PGL03	III	PALEONTOLOGY AND STRATIGRAPHY	5	5	25	75	100
	17PGLP1	PRACTICAL-I	STRUCTURAL GEOLOGY, STRATIGRAPHY, REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM	6	EXAMINATION AT THE OF II SEMESTER			
	17PGLP2	PRACTICAL-II	ADVANCED CRYSTALLOGRAPHY AND MINERALOGY	6				
	17PGLM1	MBE1	REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM	3	4	25	75	100
					20	Subtotal		400
II	17PGL04	IV	STRUCTURAL GEOLOGY & GEOTECTONICS	5	5	25	75	100
	17PGL05	V	ECONOMIC GEOLOGY AND ENGINEERING GEOLOGY	5	5	25	75	100
	17PGL06	VI	EXPLORATION GEOPHYSICS AND GEOCHEMISTRY	5	4	25	75	100
	17PGLP1	PRACTICAL - I	STRUCTURAL GEOLOGY, STRATIGRAPHY, REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM	6	4	40	60	100
	17PGLP2	PRACTICAL - II	ADVANCED CRYSTALLOGRAPHY AND MINERALOGY	6	4	40	60	100
	17PGLN1	NME1	HUMAN RIGHTS	3	3	25	75	100
					25	Subtotal		600
III	17PGL07	VII	IGNEOUS AND METAMORPHIC PETROLOGY	5	6	25	75	100
	17PGL08	VIII	SEDIMENTARY PETROLOGY AND MARINE GEOLOGY	5	6	25	75	100
	17PGL09	IX	HYDROGEOLOGY, GEOSTATISTICS AND COMPUTER APPLICATIONS IN GEOLOGY	5	5	25	75	100
	17PGLN2	NME2	GENERAL STUDIES FOR COMPETITIVE EXAMINATIONS	3	3	25	75	100
	17PGLP3	PRACTICAL - III	PETROLOGY	6	EXAMINATION AT THE OF IV SEMESTER			
	17PGLP4	PRACTICAL - IV	HYDROGEOLOGY AND MINING GEOLOGY	6				
					20	Subtotal		400
IV	17PGL10	X	MINING GEOLOGY, ORE BENEFICIATION AND ENVIRONMENTAL GEOLOGY	7	4	25	75	100
	17PGLM2	MBE2	PETROLEUM GEOLOGY,COAL GEOLOGY AND NUCLEAR GEOLOGY	5	3	25	75	100
	17PGLP3	PRACTICAL - III	PETROLOGY	6	4	40	60	100
	17PGLP4	PRACTICAL - IV	HYDROGEOLOGY AND MINING GEOLOGY	6	4	40	60	100
	17PGLPR	PROJECT	PROJECT/DISSERTATION	6	10	50	150	200
					25	Subtotal		600
			TOTAL FOR ALL SEMESTERS (4)		90			2000

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
Master of Science (M.Sc) APPLIED GEOLOGY
FIRST YEAR – I SEMESTER
PAPER I – ADVANCED MINERALOGY, OPTICAL MINERALOGY AND ANALYTICAL TECHNIQUES

PAPER CODE – 17PGL01 CREDITS - 5

Broad Objectives & Methodology

Mineralogy is the foundation of petrology. Advanced Mineralogy deals with the aspects of mineralogy related to experimental petrology, crystallographical aspects, mineral analysis, optical aspects and detailed study of mineral groups. 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 more understanding of the covered topics beyond basic mineralogy of the UG level.

UNIT I

Advanced Crystallography: Symmetry elements in crystals - Concept of Point & Space Groups- Space Lattice: Definition - Types - features - 14 Bravais lattices derivation. - Outline of derivation of 32 Classes of crystals - Short introduction to Schoenflies and Hermann- Maugin notation. Spherical and Stereographic projections - Application and utility in crystallography. Crystal defects: Different types of macro and micro scale surface and internal defects. Crystal Twins: Definition - symmetry elements: twin axes - twin planes - composition planes. Laws of Twinning. Types of Twins.

UNIT II

Crystal chemistry: Bonding - Coordination number and radius ratio - Brief account of Pauling's Rules. Polymorphism - Isomorphism: Principles of Ionic substituition - Pseudomorphism - Study of Silicate structures with appropriate mineral examples. Short account of metamict minerals and mineraloids.

Study of Mineral Groups I : Detailed description of: Physical, chemical and optical properties with a note on internal atomic structure and mineral paragenesis of the following rock forming silicates: Olivine Group - Garnet Group - Epidote Group - Scapolite Group - Feldspathoid Group - Spinel Group - Quartz Group.

UNIT III

Study of Mineral Groups II :Detailed description of: Physical, chemical and optical properties with a note on internal atomic structure and mineral paragenesis of the following rock forming silicates: Feldspar Group - Pyroxene Group - Amphibole Group - Mica Group - Zeolite Group - Chlorite Group.

UNIT IV

Optical mineralogy: Characters of Isotropic minerals under the polarizing microscope. Characters of Uniaxial minerals: Definition - Birefringence - Indicatrix - Optic Axis - Properties observed under parallel & crossed nicol conditions. Conoscopic study of Uniaxial minerals: Interference Color & Figure - Optic sign.

Characters of Biaxial minerals: Definition - Optical directions - Indicatrix - Optic Axes - Properties observed under parallel & crossed nicol conditions. Conoscopic study of Biaxial minerals: Interference color & Figure - Optic sign. Use of Mica plate, Gypsum Plate and Quartz wedge. Application of Michel - Levi Interference Color Chart. Sign of elongation.

UNIT V

Mineral Analytical Techniques: Working principle and utility of the following Instrumental methods: AAS - Atomic Absorption Spectrometer. ICP - MS - Induced Couple Plasma - Mass Spectrometry. XRF - X Ray Fluorescence. XRD - X Ray Diffraction. EMPA - Electron Micro Probe Analysis & SEM - Scanning Electron Microscopy. Outline of rapid analysis of silicate rocks and minerals.

TEXT AND REFERENCE BOOKS

1. **Berry,L.G. & Mason,B.** (1983). Mineralogy. CBS Publishers, Delhi.
2. **Deer,W.A.,et al.**(1963,1996). Introduction to the Rock Forming Minerals. ELBS,London.
3. **Hutchinson,C.S.**,(1974) Laboratory Handbook of Petrographic Techniques.Wiley.Delhi.
4. **Kerr, P. F.,** (1977). Optical Mineralogy. McGraw Hill.New York.
5. **Nesse,W.** (2004).Introduction to Optical Mineralogy. Oxford University Press. New Delhi.
6. **Phillips, Wm, R. and Griffen, D.T.,** (1986). Optical Mineralogy. CBS Delhi.
7. **Phillips,Wm,R.** (1980). Mineral Optics, McGraw Hill,New York.
8. **Blackburn,W.H. & Dennen, W.H.** (1994). Principles of Mineralogy, William C Brown Publishers.USA.
9. **Gribble,C, & Read, H. H.,**(1986) Rutleys Elements of Mineralogy. CBS, New Delhi.
10. **Perkins,D.(**2002). Mineralogy. Prentice Hall,India.
11. **Perkins,D.** (2005). Mineral Thin Sections. Pearson Education,India.
12. **Senguptha,S.**(1980). Crystallography and Optical Mineralogy. EW Press. Delhi.
13. **Phillips,F.C.,** (1965). Crystallography. ELBS. London
14. **Bloss,F.D.** (1971). Crystallography & Crystal Chemistry. Holt, Rinehart & Winston. New York.
15. **Klein,C & Hurlbut,C.S,** (1985). Manual of Mineralogy. Wiley & Sons.
16. **Bishop,A.C.**(1967). An Outline of Crystal Morphology. Hutchinson. London.
17. **Whittaker,E.S.W.**(1981). Crystallography. Oxford University Press. London.
18. **Stoiber,R.E. & S.A. Morse.** (1994). Crystal Identification with the Polarizing Microscope.Springer.NY
19. **Skoog,D.A. et al.** (2005). Principles of Instrumental Analysis. Harcourt Brace Asia.Singapore.

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 (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks

Field visit to known ore deposit related mining areas and quarry sites are suggested. The samples collected may be sectioned or analysed for further study by the student.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
Master of Science (M.Sc) APPLIED GEOLOGY
FIRST YEAR – I SEMESTER
PAPER II – APPLIED GEOMOPRPHOLOGY

PAPER CODE – 17PGL02 CREDITS - 5

Broad Objectives & Methodology

Applied Geomorphology is the application of geomorphology to different surface systems and landform systems and their management. The teaching and learning methodology involves class lectures, practical and laboratory demonstrations. **Learning Outcomes:** The student gains useful insight into Applied Geomorphology which may be useful for both competitive exams and job prospects related to geomorphological mapping, hazards due to geomorphic features, and mineral exploration based on geomorphic guides.

UNIT I

Basic principles of Geomorphology: Classification of landforms - Geomorphic cycle - Davis and Penck's concept. **Denudational Geomorphology:** Scope of denudational geomorphology- Process of weathering - Types of landforms - Resources, Hazards and Environmental appraisals and Management in Denudational Geomorphic Systems.

UNIT II

Tectonic Geomorphology: Scope of Tectonic Geomorphology - Types of Landforms - Their origin - Resources, Hazards and Environmental Appraisals and Management in Tectono - Geomorphic Systems.

Volcanic Geomorphology: Scope of Volcanic Geomorphology - Origin of Volcanoes - Spatial Distribution of Volcanoes around the World – Different Volcanic Landforms - Resources, Hazards and Environmental Appraisals and Management of Volcanic Systems.

UNIT III

Coastal Geomorphology: Scope of Coastal Geomorphology - Coastal Zone Processes - Classification of Shorelines, - Constructional and Destructional Landforms (Emerging, Submerging, Neutral and Compound).Coasts: - Coastal Landforms - Resources, Hazards and Environmental Appraisals and Management of Coastal Systems.

Aeolian Geomorphology: Scope of Aeolian Geomorphology - Processes in Arid Region - Landform Types and Morphology, Aeolian Land Forms - Resources, Hazards and Environmental Appraisals and Management of Aeolian Systems.

UNIT IV

Fluvial Geomorphology: Streams: definition, scope, drainage classification, morphology and types. Life cycle of river systems – youthful, mature and old stages; migratory behavior of rivers. **Fluvial landforms**: - constructional and destructional landforms; Resources, hazards and environmental appraisals and management in fluvial systems. **Ground water generated landforms**: scope – landform types. **Biogenic landforms**: scope – landform types. **Glacial geomorphology**: scope – landform types - rocks & landforms: Characteristics of rocks and its influence in the evolution of landforms.

UNIT V

Outline of Geomorphic features of the Indian subcontinent. Geomorphology of Tamil Nadu - classification, relief features, geological significance, outline of rivers of Tamil Nadu. **Hill slopes**- forms in relation to lithology and structural weakness in rocks; control and mass movement, modification by overland flow of hill slopes. Slope stability studies. **Wetlands**- Geological significance, classification and mode of formation. Conservation and management of wetlands in India. Soils- formation, classification, soil profile, soils of Tamil Nadu.

REFERENCE AND TEXTBOOKS

1. **Thornbury,W.D**.(1985).Principles of Geomorphology.Wiley.New Delhi.
2. **Jha. V.C**.(2001).Geomorphology and Remote Sensing, ACB Publications. Delhi
3. **Verstappen,H.** (1977). Remote Sensing in Geomorphology.Elsevier.Amsterdam.
4. **Bloom,A**.(2005).Geomorphology. Pearson. Delhi.
5. **Spark,A.S.** (1976). Geomorphology. ELBS.London.
6. **Monkhouse,J.** (1987). Geomorphology. Blackie & Sons.
7. **Doehring,L.** (1980).Geomorphology in Arid Regions, Allen and Unwin, London.
9. **Verstappen, H**.(1984). Applied Geomorphology, Elsevier, Amsterdam.
10. **Hart,A.** (1985). Applied Geomorphology. CBS. New Delhi.
11. **Goudie,A.** (1990). Encyclopedia of Geomorphology. Van Nostrand Reinhold. New York.
12. **Goudie,A.** (1990). Geomorphological Techniques.Routledge. New Delhi.

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 (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks

Field visits are suggested under proper supervision and with the submission of a field report.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
Master of Science (M.Sc) APPLIED GEOLOGY
FIRST YEAR – I SEMESTER
PAPER III – STRATIGRAPHY AND PALEONTOLOGY

PAPER CODE – 17PGL03 CREDITS - 5

Broad Objectives & Methodology: Stratigraphy is a fundamental part of geology concerning the origin and evolution of the earth understood from different rocks which were formed during different stages of earth's history. The teaching and learning methodology involves class lectures, practical and laboratory demonstrations with fossil specimens and rock specimens available in the Department. Paleontology is the study of the remains of animals and plants entombed within the rocks of the earth's crust. It complements the study of sedimentary rocks, stratigraphy, coal and petroleum exploration, and biological evolution. **Learning Outcomes:** The student gains useful insight into Stratigraphy and Paleontology which may be useful for both job prospects related to mineral and oil and coal exploration industries as well as competitive examinations.

STRATIGRAPHY

UNIT I

Principles of Stratigraphy: Lithostratigraphy – Chronostratigraphy – Biostratigraphy. Correlation methods in Stratigraphy. Geological Time Scale – Indian Stratigraphical Scale. Brief account of Homotaxis, contemoporaneity, and syntaxis. Outline of Sequence Stratigraphy.

UNIT II

Archaean formations of Tamil Nadu. Proterozoic formations of Indian Peninsula and their mineral riches. Gondwana Group of India. Triassic, Jurassic Cretaceous, and Siwalik formations in India. Outline of Pleistocene ice ages in India.

UNIT III

Age problems in Indian Stratigraphy: 1. Saline Series. 2. Deccan Traps.

Stratigraphic boundary problems of India: 1. Precambrian - Cambrian; 2. Permian – Triassic; 3. Cretaceous – Tertiary; Brief account of the following: Caledonian, Hercynian and Alpine Orogeny.

PALEONTOLOGY

UNIT IV

Recent theories on the origin and evolution of life – fossil evidence. Taphonomy: principles – applications. Evolutionary trends and stratigraphic importance of the following invertebrate fossil groups: Trilobites, Cephalopods, Brachiopods and Graptolites. Micropaleontology: Types of Microfossils. General morphological characters, classification, Stratigraphic importance and evolution of Foraminifera and Ostracoda. Applications of Micropaleontological studies. Field and Laboratory techniques of micropaleontology.

UNIT V

Vertebrate Paleontology and Paleobotany: Origin of vertebrates. Outline of Important Indian dinosaurs and their extinction. Evolutionary history of Man and Horse. Study of important Gondwana flora of India. Applications of Paleobotany with reference to Paleoclimate, Oil and Coal exploration. Palynology: A brief study of spores and pollen grains.

REFERENCE AND TEXTBOOKS

1. **Moore, R.C.** et al. (1955). Invertebrate Fossils.CBS Delhi.

2. **Shrock,R.R.& W.H.Twenhofel,** (1953). Principles of Invertebrate Paleontology. CBS New Dehil.

3. **Swinnerton,H.H.**(1950). Outline of Paleontology. PHI India.

4. **Black, R.M.** (1972). The Elements of Paleontology. Cambridge University Press.Delhi.

6. **Clarkson, E.N.K.** (2004). Invertebrate Paleontology and Evolution. Blackwell Science.Delhi.

7. **Carroll, R.L. & C.W.Stearn.**(1989). Paleontology. W.H. Freeman. New York.

8. **Agashe, S.N.** (1995). Paleobotany. Oxford & IBH. Delhi.

9. **Krishnan. M.S.** (1989). Geology of India & Burma. CBS Delhi.

10.**Weller. A.K.** (1988). Principles of Stratigraphy. Asia Publishing House. Delhi.

11. **Ravindrakumar,S.** (1988). Historical Geology and Stratigraphy of India. EW Publications.Delhi.

12. **Boggs, S.** (1987). Principles of Sedimentology and Stratigraphy, Merill Publishing Co. New York.

13. **Sahni, A.** (1998). Dinosaurs of India. NBT Publications. Delhi.

14. **Jain,P.C. & M.S. Anantharaman.** (2013). An Introduction to Paleontology. Vishal Publications. Delhi.

15. **Benton,M.J.** (2002). Vertebrate Paleontology. Wiley Blackwell. New Delhi.

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 fossil bearing area is suggested under proper supervision and with the submission of a field report.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
Master of Science (M.Sc) APPLIED GEOLOGY
FIRST YEAR – II SEMESTER
PAPER IV – STRUCTURAL GEOLOGY AND GEOTECTONICS

PAPER CODE – 17PGL04 CREDITS - 5

Broad Objectives & Methodology

Structural Geology is the study of different small and large scale geological structures in the earth's crust. It is closely related to mineral exploration, mining geology, seismology, hydrogeology and others. Geotectonics is the extension of geoolocal structures to the global scale. 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 into Structural Geology and Geotectonics which may be useful for other related branches of geology and for competitive exams and job prospects related to mineral and oil exploration industries.

UNIT I

Deformation- Stress and strain –The concept of strain ellipse; finite and incremental strain; Strain in three dimensions; Strain ellipsoid, classification of strain ellipsoids (classification according to the absolute e values, Flinn diagram)- Strain rate, Elastic, ductile and brittle deformation, deformation mechanisms- Application of the strain ellipse concept to the geology; shear fractures, stylolites and pressure solution. Definition and description of dip and strike for planes, plunge and trend for linear structures. Theory behind the streographic projections, representation of planes and lines on the stereograms.

Foliation (cleavage, foliation, schistosity), axial planar cleavage, relation between bedding and cleavage. Relation between the foliation and the strain ellipsoid, crenulation cleavage, Definition and description of plunge and trend for linear structures. Representation of lines on the stereograms. Lineation: slickensides, mineral lineation, intersection lineation, boudinage and folding. Relation between the lineation and the strain ellipsoid;

UNIT II

Folds I: Fold geometry - fold limbs, hinge, inflexion points, fold hing and fold axis, fold axial plane, monocline, vertical and neutral folds, anticline-antiform, syncline-synform; facing direction of folds; cyclindrical folds; depressions and culminations, domes and saddles, profile of a fold; fold tightness. Folds II: Polyharmonic folding; parasitic folds, S, Z and M-folds, chevron and kink folds; conjugate folds; box folds, parallel and similar folds; symmetrical and asymmetrical folds, fold vergence, sheath folds.

Faults I. Normal faults, representation of normal faults on the block diagrammes; Faults II. Listric faults, reverse faults and thrusts. Stratigraphic differences between normal and reverse faults. Nappe, klippe and tectonic window, flat and steeps of the reverse faults, autochthonous and allochthonous units, imbricate and dublex structures, horse.

UNİT III

Faults III. Strike-slip faults and minor structures associated with such faults; fault rocks: cataclasites and mylonites; introduction to stress, principles of stress, Anderson's theory of faulting. Joints: types; genesis; relation to major structures; field data collection and preparation of rose diagrams.

Shear zones: ductile and brittle-Recognition of shear zones and faults in field, mechanics of shearing and faulting. Geometry of thrust sheets: Block faulted and rifted regions. Wrench faults and associated structures.- Prophyroclasts- mica fish- quartz ribbons- Tectonic mélanges.

Petrofabric analysis (microfabrics): Data collection, plotting, symmetry and interpretation, concept of symmetry of fabric of tectonites.

UNİT IV

Geotectonics: Introduction-tectonic framework of earth's crust- Isostasy, convection currents, Wilson Cycle. Continental Drift: geological and palaeontological evidences in support of continental drift and in-situ theories. Sea-floor spreading: Hess's concept and evidences of sea-floor spreading. Concept of neotectonism-evidences. Outline of tectonic framework of İndia.

UNİT V

Plate tectonics: Concept of crustal plate and plate movements- plate model of Morgan, nature of convergent, divergent and conservative plate margins- transpression and transtension. Plate tectonics in relation to igneous, sedimentary and metamorphic processes and economic mineralization. Triple junctions- aulocogens- plume theory- rift valleys-island arcs. Nature and origin of earth's magnetic field. Heat flow in the Earth:concept of geotherm: continental and oceanic.Outline of supercontinents in earth history: - Ur-Rodinia-Pangea-Gondwana.

REFERENCE AND TEXTBOOKS

1.**Ramsay, J.G. and M.I.Huber.**(1983).The Techniques of Modern Structural Geology, Vol 1:Strain Analysis. Academic Press, London.

2.**Ramsay, J.G. and M.I.Huber** (1987).The Techniques of Modern Structural Geology, Vol 2:Folds And Fractures. Academic Press, London.

3.**Davis, G.H., and S.J.Reynolds.**(1996). Structural Geology of Rocks and Regions, 2nd ed.Wiley. New York.

4.**Ragan, D.M.,**(1973).Structural Geology-An Introduction to Geometrical Techniques,2nd ed.Wiley.New York.

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

6.**Price, N.J. and J.W.Cosgrove.**(1990). Analysis of Geological Structures. Chapman & Hall. UK.

8.**Bayly, B.**(1992). Mechanics in Structural Geology. Springer.Delhi.

9.**Moore,E. and R.J.Twiss.** (1995). Tectonics. Freeman. New York.

10. **Keary,P and F.J.Vine.** (1990); - Global Tectonics. Cambridge University Press. Delhi.

11. **Valdiya,K.S.** (1998): - Dynamic Himalaya. Universities Press. Hyderabad.

12. **Santhosh,M & J.J.W.Rogers**. (2010). Continents and Supercontinents. Oxford University Press.Delhi.

13. **Lowrie,W.** (2007). Fundamentals of Geophysics. 2nd ed. Cambridge University Press,New Delhi.

14. **Mussett,A.E. & Khan,M.A.** (2000). Looking into the Earth: An introduction to Geological Geophysics. Cambridge University Press,New Delhi.

Additional Resources: The student may consult the Class Teacher for additional web resources and related materials. Soft copies of related study materials are available. **Assignments:** Any two assignments (within the five units) may be suggested by the Teacher. **Suggested Group Work/Tasks :** Field visits are suggested under proper supervision and with the submission of a field report.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
Master of Science (M.Sc) APPLIED GEOLOGY
FIRST YEAR – II SEMESTER
PAPER V – ECONOMIC GEOLOGY AND ENGINEERING GEOLOGY

PAPER CODE – 17PGL05 CREDITS - 5

Broad Objectives & Methodology

Economic Geology is the study of mineral deposits. It complements the methods of geological exploration, mining geology, and different end uses of minerals. **Engineering Geology** is the application of geology to engineering projects. 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 into economic geology and engineering geology which may be useful for both competitive exams and job prospects related to mineral and oil exploration industries.

ECONOMIC GEOLOGY

UNIT- I

Processes of ore formation and their petrological association: - **Magmatic deposits**: Chromite deposits; Nickel sulphide deposits; Kimberlite diamond deposits. **Magmatic Hydrothermal deposits**: Porphyry base metal deposits – Volcanogenic Massive Sulphide deposits. **Ores deposits generated by weathering**: bauxite, laterite, kaolin, manganese and supergene base metal sulphides. **Ore deposits generated by metamorphism**: Skarns – definition, classification, and genesis.

UNIT- II

Processes of ore formations and their petrological association:-

Hydrothermal Vein deposits: Definition – Classification of vein deposits – Hydrothermal gold deposits. **Placer deposits**: Definition – Classification – Beach sand, Marine, and Placer deposits. **Sediment hosted Cu-Pb-Zn deposits**: Sedimentary exhalative deposits – Mississippi Valley type deposits. Physico-chemical controls of ore deposition and post depositional changes. Crustal evolution and metallogeny of the Indian shield. Distribution of ore deposits with reference to plate tectonics settings. Outline of classification of ore deposits.

UNIT- III

Ore Microscopy:-

Polishing and mounting of ores - Study of Textures and structures of ore minerals- Applications of ore microscopy. Geological thermometry and barometry as applied to ore minerals. **Metallic Ore Deposits**: Mineralogy, modes of occurrence, genesis, and distribution of the following metallic ore deposits in India: Tin, Platinum Group Elements (PGE), Titanium and Vanadium, Uranium & Thorium, Rare Earth Elements (REE). **Mineral economics**: - Significance of minerals in national economy-demand and supplies-substitutes-market economy-critical – essential and strategic minerals - mineral conservation policy-India's status in mineral production.

ENGINEERING GEOLOGY

UNIT-IV

Engineering properties of rocks: - Compressive strength- Tensile strength-Flexural strength-Young's Modulus and Poisson's ratio- Residual stresses in rocks. Geotechnical significance of fault & folds in engineering geology.

Soils:-Engineering properties of soils-soil profile-soil moisture-size of soil particles- gradation-shape-structure-cohesion. Alteration of clay structure. Engineering problems in loess areas. Engineering significance of alluvial deposits- Engineering significance of swamps- Residual soil.

UNIT-V

Geological and geotechnical investigation for the construction of bridges, and highways, and excavation sites. Role of geology in foundation engineering. Groundwater problems in engineering structures. An introduction to shore line engineering. Earthquake resistant structures and an introduction to aseismic design. Geological and geotechnical investigations for reservoirs, and irrigation canals.

REFERENCE BOOKS AND TEXT BOOKS:

1. **Edwards,R & K. Atkinson**. (1986). Ore Deposit Geology, Chapman & Hall, London.
2. **Bateman, A.M & M.L.Jensen** (1981). Economic mineral Deposits, John Wiley, New York.
3. **Craig,R.C & D.V.Vaughan. (**1985).Ore Microscopy and Ore Petrography. John Wiley, New York.
4. **Gokhale, K.V.G.K. & D.M. Rao,** (1977), Ore Deposits of India,Oxford & IBH,Delhi.
5. **Iyengar, N.K.N**. (1964).Minerals of Madras,Dept of Industries & Commerce,Guindy,Madras.
6. **Deb,S.** (1985). Industrial Minerals and Rocks of India. Oxford & IBH,Delhi.
7. **Krishnan, M.S**. (1964). Mineral Resources of Madras, Geological Survey of India,Kolkata.
8. **Krishnaswamy, S.**(1980). India's Mineral Resources. Oxford & IBH. Delhi.
9. **Lindgren, W.** (1942), Mineral Deposits, McGraw Hill. New York.
10. **Prasad, U**. (2003). Economic Geology, CBS Delhi.
11. **Park,C.F. & M.A.MacDiarmid** (1970).Ore Deposits. William Freeman,New York.
12. **Stanton, R.L.** (1972), Ore petrology, McGraw Hill.New York.
13. **Sharma, N.L. & R.K. Sinha.** (1985). Mineral Economics.Oxford & IBH. Delhi.
14. **Bell, F.G.** (2005). Fundamentals of Engineering Geology. B.S. Publications, Hyderabad.
15. **GSI**, Geology and Mineral resources of Tamil Nadu & Pondicherry, Misc Pub. No.30, Geological Survey of India,Kolkata.
16. **Krynine,P.D. & W.R.Judd**.(1956). Principles of Engineering Geology and Geotechnics. CBS,Delhi.
17. **Legget,R.F. & A.W.Hatheway.** (1988). Geology and Engineering. 3rd ed. McGraw Hill, New York.
18. **Parbin Singh,B.** (2005). A Textbook of Engineering and General Geology. S.K.Kataria & Sons,Delhi.
19. **Blyth,F.G.H. & M.H. De Freitas.** (1984). A Geology for Engineers. 7th ed. Elsevier, New Delhi.
20. **Gokhale, K.V.G.K. & D.M. Rao**.(1981), Experiments in Engineering Geology, Tata Mc Graw Hill.

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 (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks

Field visit to known ore deposit related mining areas and engineering sites is suggested under proper supervision and with the submission of a field report.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
Master of Science (M.Sc) APPLIED GEOLOGY
FIRST YEAR – II SEMESTER
PAPER VI – EXPLORATION GEOPHYSICS & EXPLORATION GEOCHEMISTRY

PAPER CODE – 17PGL06 CREDITS - 5

Broad Objectives & Methodology

Exploration Geophysics and Exploration Geochemistry constitutes the application of geophysics and geochemistry in mineral exploration. These subjects complement the methods of geological exploration for mineral deposits. The student is introduced to the different methods and their field applications with appropriate Indian examples where necessary. 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 into Exploration Geophysics and Exploration Geochemistry which may be useful for both competitive exams and job prospects related to mineral and oil exploration industries.

EXPLORATION GEOPHYSICS

UNIT I

Gravity Method: Definition of gravity. Newton's Law of Gravitation. Gravity measurements: Absolute and relative. Gravity units. Gravimeters: Stable and Unstable gravimeters – calibration. Corrections to raw gravity data. Gravity Surveys - preparation of gravity contour maps – gravity anomalies - separation of regional and residual gravity anomalies. Gravity profiles and half width anomalies. Interpretation of gravity anomalies using model shapes and masses. Applications and limitations of gravity methods. Brief outline of mineral and rock densities.

UNIT II

Magnetic Methods: Components of earth's magnetic field. Magnetic character of rocks and minerals. Units of measurement. Magnetometers: Types and Survey procedures. Raw magnetic data and their corrections Preparation of magnetic contour maps – magnetic anomalies - separation of regional and residual magnetic anomalies – magnetic profiles and half width anomalies. Interpretation of magnetic anomalies using model shapes and masses. Applications and limitations of magnetic methods. **Electromagnetic Methods:** Principle of EM method - depth penetration. Field Instruments for EM surveys. Frequency domain methods – Time domain methods - Units of measurement – Interpretation of EM data – Application and limitations. Brief outline of telluric and magneto telluric fields.

UNIT III

Electrical Methods: Definition – Ohm's Law – Resistivity and conductivity – Electrical properties of rocks and minerals - Units of measurement - Apparent resistivity – Resistivity surveying equipment – Sounding and profiling methods – Electrode configurations: Wenner – Schlumberger – Gradient – Pole – Dipole and Dipole – dipole methods. Interpretation of resistivity data. Applications and limitations of resisitivity methods. **Self Potential Methods:** Definition – origin and types – surveys – data reduction and interpretation. **Induced Polarization Method:** Definition – origin and types – surveys – data reduction and interpretation.

Geophysical Well Logging of Bore holes: Bore hole environment – Logging equipment – Types of Logging: Electrical (resisitivity, induction) – Radiometric (γ - ray, neutron - γ ray) – Sonic – Magnetic – Temperature – Calipher – Gravity – Cement. Applications and limitations of the different logging methods.

UNIT IV

Seismic methods: General principles – refraction and reflection of seismic waves. Elastic properties of rocks. 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. Data reduction and corrections. Interpretation methodology for vertical layers – horizontal layers: two and three layers – dipping layers. Applications and limitations. **Reflection Methods:** Principle - Instruments and equipment – Field Operations: Shot point and Detector spreads: Split spread shooting – Common depth point spread.Data processing and corrections. Interpretation methodology for reflecting layers: single and multiple reflectors – dipping reflectors - faulted reflectors.

EXPLORATION GEOCHEMISTRY

UNIT V

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

REFERENCE BOOKS & TEXT BOOKS

EXPLORATION GEOPHYSICS

1. **Ramachandra Rao, M.B.** (1993). Outlines of Geophysical Prospecting. EBD, Dhanbad. 400pp.

2. **Kearey, P., Brooks, M & Hill .I.** (2002). An Introduction to Geophysical Exploration, 3rd ed. Blackwell Science.281pp.

3.**Mussett,A.E. & Khan,M.A.** (2000). Looking into the Earth: An introduction to Geological Geophysics. Cambridge University Press,New Delhi. 493pp.

4.**Lowrie,W.** (2007). Fundamentals of Geophysics. 2nd ed. Cambridge University Press,New Delhi.393pp

5.**Sharma,P.V.** (1997). Environmental and Engineering Geophysics.Cambridge University Press,New Delhi.475pp.

6.**Telford,W.M; Geldart,L.P & Sheriff,R.E.** (1990). Applied Geophysics. 2nd ed. Cambridge University Press,New Delhi.760pp.

7.**Dobrin,M.B. & Savit,C.H.** (1988). Introduction to Geophysical Prospecting. 4th ed. McGraw Hill. New Delhi. 870pp.

8.**Parasnis,D.S.** (1975). Principles of Applied Geophysics. Chapman & Hall. New York. 270pp.

9. **Banerjee,P.K. & Ghosh,S.** (1997). Elements of Prospecting for Non Feul Mineral Deposits. Allied Publishers,Chennai. 320pp.

10. **Arogyaswamy,R.N.P.** (1980). Courses in Mining Geology.Oxford & IBH,New Delhi. 927pp.

11. **Hawkes,H.E.** (1959). Principles of Geochemical Prospecting. Bulletin 1000F.USGS. 133pp.

12.**Moon,C.J;Whateley,M.K.G. & Evans,A.M.** (2006). Introduction to Mineral Exploration.Wiley Blackwell.New Delhi. 481pp

13. **Hartman,H.L. et al.** (1992). SME Mining Engineering Handbook.SMME Inc.Colorado. 2268pp.

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 (within the five units) may be suggested by the Teacher. **Suggested Group Work/Tasks:** Field demonstration is suggested under proper supervision and with the submission of a field report.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
Master of Science (M.Sc) APPLIED GEOLOGY
SECOND YEAR – III SEMESTER
PAPER VII – IGNEOUS AND METAMORPHIC PETROLOGY

PAPER CODE – 17PGL07 CREDITS 6

Broad Objectives & Methodology

Petrology is the study of rocks. **Igneous Petrology** is the study of rocks derived from magmas and lavas. **Metamorphic Petrology** is the study of rocks which have been subjected to heat and pressure within the earth's crust. Both branches of petrology involves field geology, megascopy and thin section studies along with experimental petrology. The teaching and learning methodology involves class lectures, practical and laboratory demonstrations with equipment available in the Department. **Learning Outcomes:** The student gains a working knowledge of Igneous and Metamorphic Petrology for use in field geology related jobs, mineral prospecting, oil geology, and others.

IGNEOUS PETROLOGY

UNIT I

Magma: definition and types of magmas. Physical properties of magmas: viscocity – concept of Bingham and Newtonian liquids as applied to magmas; temperature; density; pressure and volatile content. Generation of magma: causes of melting; tectonic environments of melting in the lithosphere. Short account of mantle plumes. Application of phase rule in igneous petrology and petrological significance of the following synthetic systems : Forsterite – Fayalite system; Leucite – Silica system; Diopside – Anorthite – Forsterite system; Quartz – Nepheline – Kalsilite system; Outline of Quarternary System for Basalt.

UNIT II

Magmatic differentiation: definition and mechanisms. Assimilation: definition and processes, evidences and field recognition. Bowen's Reaction Series and its petrological significance. Classification of Igneous rocks: IUGS Scheme for plutonic rocks, volcanic rocks and fragmental volcanic rocks; TAS scheme; CIPW Normative Scheme; Petrography,nomenclature,classification and petrogenesis of the following rocks or rock groups: Basalts; Ophiolites; Alkaline Rocks; Ultramafic Rocks.

UNIT III

Petrography,nomenclature,classification and petrogenesis of the following rocks or rock groups: Anorthosites; Lamprophyres; Granite; Pegmatite; Carbonatite; Kimberlite; Variation Diagrams in igneous petrology : definition, types and their utility.

METAMORPHIC PETROLOGY

UNIT IV

Metamorphism: definition, agents, and types of metamorphism. Basic differences between prograde and retrograde metamorphism. Outline of protoliths that undergo metamorphism. Distribution of metamorphic rocks with respect to plate tectonic environments. Paired Metamorphic Belts and its characteristic features. Textures and structures of metamorphic rocks. Crystalloblastic Series and interpretation of metamorphic rock textures. Barrovian zones and Isograds. Burial metamorphic zones.

UNIT V

Classification schemes of metamorphic rocks. Outline of different metamorphic reactions. Application of phase rule in metamorphic systems. Utility of Pressure – temperature – time paths. Metamorphic facies: definition, types, and graphical representation of metamorphic rocks in ACF,AKF, and AKFM diagrams. Petrography,nomenclature,classification and genesis of the following rocks or rock groups: Eclogites; Migmatites; Amphibolites; Granulites: Charnockite. Khondalites; Gondites;

REFERENCE AND TEXTBOOKS

1. **Winter,J.D.**(2010).Principles of Igneous and Metamorphic Petrology. PHI.New Delhi.
2. **Haung,W.T.** (1962). Petrology. McGraw Hill. New York.
3. **Williams,H.** et al. (1982). Petrography. CBS. New Delhi.
4. **McBirney, A.R.** (1993). Igneous Petrology. CBS. New Delhi.
5. **Best,M.G.** (2005). Igneous Petrology.Wiley. New Delhi.
6. **Best,M.G.** (2003). Igneous and Metamorphic Petrology. Wiley.New Delhi.
7. **Hatch,F.H.** et al. Petrology of the Igneous Rocks. CBS. Delhi.
8. **Hyndman,D.W.** (1985). Petrology of the Igneous and Metamorphic Rocks. McGraw Hill. New York.
9. **Middlemost,E.A.K.** (1985). Magmas and Magmatic Rocks.Longman. UK.
10. **Winkler,H.G.F.** (1970). Petrology of the Metamorphic Rocks. Springer. New Delhi.
11. **Turner,F.J.** (1968). Metamorphic Petrology. McGraw Hill. New York.
12. **Bose,M.K.** (1997). Igneous Petrology. World Press. Kolkata.
13. **K.G.Cox et al.** (1979). The Interpretation of Igneous Rocks. Springer.New Delhi.
14. **Chatterjee,S.C.** (1974). Petrography of the Igneous & Metamorphic Rocks of India.Macmillan.Delhi.

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.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
Master of Science (M.Sc) APPLIED GEOLOGY
SECOND YEAR – III SEMESTER
PAPER VIII – SEDIMENTARY PETROLOGY AND MARINE GEOLOGY

PAPER CODE – 17PGL08 CREDITS 6

Broad Objectives & Methodology: Sedimentary Petrology is the study of sedimentary rocks and the processes from which they were derived, including their composition,occurrence and origin. It involves field geology, megascopy and thin section studies along with experimental petrology. **Marine Geology** is the study of ocean floor geomorphology, oceanic sediments, tectonics, and mineral resources. The teaching and learning methodology involves class lectures, practical and laboratory demonstrations with equipment available in the Department. **Learning Outcomes:** The student gains a working knowledge of sedimentology, sedimentary petrology and marine geology for use in field geology related jobs, mineral prospecting, petroleum geology, and others.

SEDIMENTARY PETROLOGY

UNIT I

Sedimentary Petrology: definition and scope. Outline of weathering processes and cycle of sedimentation. Generation of sediment by geomorphic agencies and their processes. Textures and structures of sedimentary rocks. Classification of sedimentary rocks. Lithification and diagenesis of sediments. Outline of mineralogy of sedimentary rocks and chemical composition of common sedimentary rocks.

UNIT II

Field collection and analysis of paleocurrent data. Grain size determination:sample preparation,direct measurements,dry and wet sieving.Grain size analysis and graphical representation.Provenance of sedimentary rocks.Heavy minerals: separation techniques, identification and interpretation. Analysis of sedimentary rocks: XRF and SEM methods. Sedimentary basins and sedimentary depositional environments. Role of colloids in sedimentation.

UNIT III

Petrography,nomenclature,classification,depositional environment and genesis of the following sedimentary rocks: Clastic sedimentary rocks: Sandstones; Shales; Breccias; Conglomerates. Non-clastic sedimentary rocks: Limestones; Dolomites; Flint; Chert; and Evaporites.

MARINE GEOLOGY

UNIT IV

Marine Geology: definition and scope. Morphology and tectonic domains of the ocean floor. Techniques of mapping the surface of ocean floor. Ocean sediments: types,composition,genesis and rates of sedimentation. Oceanic crust: mineralogy, petrology, seismic properties. Vertical section of oceanic crust. Sea – water basalt interaction along mid-oceanic ridges. Coral reefs and atoll formation.

UNIT V

Marine geological instruments: Sediment samplers: Van Veen grab; Peterson grab; La Fond & Dietz snapper; Phleger – corer sampler; Surficial sediment scoop; Sediment dredger. Water samplers: Nansen water sampler.

Environmental sensors: bathythermograph; reversing thermometer. Depth indicators: Secchi disc; Mineral resoureces of the ocean floor and their distribution. Eustasy and its impact on coasts. Chemistry of sea water. Ocean currents and tides.

REFERENCE AND TEXTBOOKS

1. **Haung,W.T.** (1962). Petrology. McGraw Hill. New York.
2. **Williams,H.** et al. (1982). Petrography. CBS. New Delhi.
3. **Greensmith,J.T.** (1976). Petrology of the Sedimentary Rocks. CBS.Delhi.
4. **Folk,R.L.** (1974). Petrology of the Sedimentary Rocks. Hemphill. Texas.USA.
5. **Hota,R.N.** (2011). Practical Approach to Petrology.CBS.New Delhi.
6. **Gokhale,N.W.** (1998).Fundamentals of Sedimentary Rocks.CBS.New Delhi.
7. **Lindholm,R.** (1987). A Practical Approach to Sedimentology. CBS.New Delhi.
8. **Nichols,G.** (1999). Sedimentology and Stratigraphy. Wiley. Delhi.
9. **Collinson,J.D & D.B.Thompson.** (1986). Sedimentary Structures. CBS.Delhi.
10. **Senguptha,S.M.** (2007). Introduction to Sedimentology. CBS. Delhi.
11. **Sukhtankar,R.K.** (2004). Applied Sedimentology. CBS.Delhi.
12. **Prothero,R.P. & F.Schwab.** (1996). Sedimentary Geology. Freeman. New York.
13. **Kennett,J.P.** (1982). Marine Geology. Prentice Hall. New Jersey.
14. **Shepard,F.P.** (1977). Geological Oceanography. Crane Russak.New York.
15. **Holmes,A & P.L.Duff.** (1996). Principles of Physical Geology, 4 th revised Edition,ELBS,London
16. **Radhakrishnan,V.** (1996). General Geology, V.V.P. Publishers,Tuticorin.
17. **Emiliani,C.(1992).** Planet Earth, Cambridge University Press, Delhi.
18. **Porter,S.C. & B.J. SkinnerJ.** (1995). The Dynamic Earth, John Wiley & Sons, New York.
19. **Seibold,E & W.H.Berger.**(1993). The Sea Floor. Springer.Delhi.
20. **Weisberg,C.P.** (1979). Oceanography. McGraw Hill. New York.

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.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
Master of Science (M.Sc) APPLIED GEOLOGY
SECOND YEAR – III SEMESTER
PAPER IX - HYDROGEOLOGY, GEOSTATISTICS AND COMPUTER APPLICATIONS IN GEOLOGY

PAPER CODE – 17PGL09 CREDITS 6

Broad Objectives & Methodology: Hydrogeology is the study of water in the different geological domains. Geostatistics is the application of statistical methods to geological data. **Computer applications in geology** emphasizes the use of computers in specialized branches of geology: petrology, GIS,and others. The teaching and learning methodology involves class lectures, practical and laboratory demonstrations with equipment available in the Department. **Learning Outcomes:** The student gains a working knowledge of hydrogeology, geostatistics, and computer applications in geology for use in field geology, mineral prospecting, oil geology, and others.

HYDROGEOLOGY

UNIT I

Hydrological properties of rocks: porosity, permeability, specific yield and retention, base flow, transmissivity,and storage coefficient. Ground water flow equations: steady and transient flow. D'Arcy's law: hydraulic conductivity, steady, unsteady and radial flow. **Aquifers**: types and hydrostratigraphic units. Pumping tests:definition,methodology,data collected,and interpretation by Theis, Cooper-Jacob's, and Chow's method. Drilling methods for groundwater borewells.

UNIT II

Outline of water quality standards and guidelines: WHO, BIS and ICAR. Physical parameters of groundwater quality. Analysis of major and minor elements in groundwater using APHA standards. Water quality parameters for drinking, agriculture, and industrial uses. Graphical representation and interpretation of water quality data: Wilcox, USSL, Gibbs plot, Piper, Donean and Durov diagrams. **Coastal aquifers**: Ghyben-Herzberg relation and saline water intrusion.

UNIT III

Groundwater basins: drainage and basin morphometry. Methods of determining groundwater flow and preparation of water table contour maps. Problems due to over exploitation of groundwater. Groundwater recharge: natural and artificial methods. Rainwater harvesting: definition, methods, and design of harvesting structures. Outline of methods of groundwater exploration. Groundwater provinces of India and Tamil nadu.

STATISTICAL METHODS IN GEOLOGY

UNIT IV

Outline of basic principles.Concepts of Probability: addition and multiplication theorems; probability distribution. Random variables: expectations, movement, independence and dependence. Geological populations: definition and types. Numerical data in geology. Models of specific populations and their parameters.Sampling techniques: simple random,stratified, and clustered;Sampling estimates and standard errors. Random sampling from infinite populations. Distribution of simple statistics. Estimates of some

population parameters. Simple tests based on: normal, chi – square, and F distributions.Simple correlation and linear regression analysis. Multiple regression, discriminant function analysis, map analysis, time series analysis.

COMPUTER APPLICATIONS IN GEOLOGY

UNIT V

Flow charts in geology. Introduction to software with geological applications: Petrograph; Petroplot; Stereowin; Stereoplot; Rose plot; SPSS package; Rockware; AQUA; Surfer; GIS: Opensource GRASS & Quantum GIS; ArcGIS. Use of MS Excel for creating database,tables, and graphs for sediment sieve analysis data, estimation of assay values of ores, and hydrogeological parameters.

REFERENCE AND TEXTBOOKS

HYDROGEOLOGY

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.** (2001). 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.
9. **Hiscock,K.M.**(2005). Hydrogeology. Blackwell Science. Delhi.

GEOSTATISTICS

1. **Guptha,S.**(2004). Basic Statistics. S.Chand & Sons. Delhi.
2. **Davis,J.C.** (1985). Statistical and Data Analysis in Geology.Wiley. Delhi.
3. **Guptha,S.**(1990). Statistical Methods. S.Chand & Sons. Delhi.
4. **Le Maitre,R.W.** (1982). Numerical Petrology. Elsevier.Delhi.
5. **Krumbein,W.C. & F.A.Graybill.**(1965).An Introduction to Statistical Models in Geology.McGraw Hill.Delhi.
6. **Miller,R.L. & J.S.Kahn.** (1962). Statistical Analysis in the Geological Sciences. Wiley. New York.

COMPUTER APPLICATIONS IN GEOLOGY

1. **Ravichandran,D.**(2001). Introduction to Computers and Communication. Tata McGraw Hill.Delhi.
2. **Web resources** for Petrograph; Petroplot; Stereowin; Stereoplot; Rose plot; SPSS package; Rockware; AQQA ; Surfer; GIS: Opensource GRASS & Quantum GIS; ArcGIS, available in the Department.

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
Master of Science (M.Sc) APPLIED GEOLOGY
SECOND YEAR – IV SEMESTER
PAPER X – MINING GEOLOGY, ORE BENEFICIATION & ENVIRONMENTAL GEOLOGY
PAPER CODE – 17PGL10 CREDITS 4

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

MINING GEOLOGY

UNIT I

Prospecting and Sampling: Criteria for prospecting and assessing guides for locating ore bodies. Outline of controls of ore localization. Sampling of geological material: purpose; types of samples; selection and methodology of sample collection; sampling errors. Preparation of samples for analysis – coning and quartering method. Outline of sample analysis. **Open cast mining methods:** Parts of an open cast mine; over burden removal; Open cast mining equipment; Strip mining and surface augering; Alluvial mining methods; Quarrying methods; Hydraulicking methods; Offshore dredging of minerals; Outline of mechanised mining.

UNIT II

Mine Operations: Drilling: purpose; methods – rotary, percussive, diamond core drilling; augering; Removal of broken ores and rock. Groundwater problems of open cast mines. Mined Land reclamation. Outline of environmental parameters monitored in open cast mines. **Subsurface Mining Methods**: Open stopes: gophering; face level, underhand, overhand, mill hole; room and pillar and sublevel stoping; Supported stopes: overhand, pillar, domed, rill, and vertical face. Filled stopes: flat back, dry wall and cross cut. Shrinkage stopes: definition, method, limitations. Caving methods: top slicing, sub level caving, block caving. Mine ventilation; Groundwater problems in subsurface mines. **Coal Mining Methods**: board and pillar; longwall advance and retreat; horizon. Estimation of ore reserves and evaluation of ore bodies.

ORE BENEFICIATION

UNIT III

Ore beneficiation: definition and scope. General operating steps in ore dressing. Size reduction of ores:- jaw crushers: definition; types – gyratory, cone, rolls, gravity stamps, and special types. Laboratory sizing: definition, role of particle shape, sizing scale and graphical representation. Screening technique: hand, automatic, wet and dry. Classification technique: sedimentation, flocculation and centrifuging methods. Average size.

UNIT IV

Liberation of ore from gangue: size reduction, detachment, locked particles and degree of liberation. Grinding: definition and methods – ball mills, rod mills, and tube mills. **Froth floatation**: reagents, collectors, frothers, modifiers. Magnetic and electrostatic methods. Separation of solids suspended in fluids: classifiers- spiral classifiers, centrifugal. Gravity concentration: jigging, spiralling, tabling, sink – flotation process. Flow sheets for ore beneficiation.

UNIT V

Environmental impact of mineral extraction and processing. Marine oil pollution. Health hazards associated with mining. Coal mining hazards. Acid mine drainage. Hydrologic effects of urbanization. **Environmental issues**: Climate change and its causes. Health impacts of climate change. Global warming and its impact upon the Ecosystem. Acid rain. Ozone layer depletion.

REFERENCE AND TEXTBOOKS

1. **Arogyaswamy, R.N.P.** (1988). Courses in Mining Geology, Oxford & IBH, New Delhi.
2. **Singh,R.D.** (1998). Coal Mining. New Age Publishers,Delhi.
3. **Thomas,R.T.** (1986). Introduction to Mining Methods. McGraw Hill, New York.
4. **Peters,W.C.** (1978). Exploration and Mining Geology, Wiley,New York.
5. **Hartman,H.L.**(1992).SME Mining Engineering Handbook, SME Colorado,USA.
6. **McKinstry, H.E.**(1948).Mining Geology, Asia Publishing House,Delhi.
7. **Keller,E.A.**(1985). Environmental Geology. Merill. New York.
8. **Miller,T.G.**(2004). Environmental Science. Wadsworth Publishing. USA.
9. **Flawn,P.T.** (1970). Environmental Geology. Harper.New York.
10. **Coates,D.R.** (1984). Environmental Geology. McGraw Hill. New York.
11. **Gaudin,A.M.** (1939). Principles of Mineral Dressing. TMH. Delhi.
12. **Banerjee,P.K.& S.Ghosh.** (1997).Elements of Prospecting for non fuel mineral deposits. Allied .Madras.
13. **Pryor,E.J.** (1965). Mineral Processing. Elsevier.Delhi.
14. **Taggart,A.F.** (1945). Handbook of Mineral Dressing. Chapman & Hall.Delhi.
15. **Wills,B.A.** (1988). Mineral Processing Tecnology.Elsevier. 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 mines with proper permission.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
Master of Science (M.Sc) APPLIED GEOLOGY
FIRST YEAR – I SEMESTER
MAJOR BASED ELECTIVE - 1
MBE 1 – REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM

PAPER CODE – 17PGLM1 CREDITS 4

Broad Objectives & Methodology: Remote Sensing and GIS are subjects that utilize laboratory and computer based manipulation of digital imagery for practical geological applications such as tectonics, mineral exploration, and others. The student is introduced to the different methods of Remote Sensing and GIS and their field applications with appropriate Indian examples where necessary. 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 into Remote Sensing and GIS which may be useful for both competitive exams and job prospects related to mineral and oil exploration industries.

UNIT – I

Basics of remote sensing: Energy sources -Interaction with atmosphere and earth- Characteristics of remote sensing systems - An introduction to the types of satellites and orbits: Resolution of satellites- Multispectral scanning-types- multispectral detectors and sensors- sensors in LANDSAT-SPOT- IRS. **Thermal Remote Sensing:** Planck's blackbody law – displacement law and emissivity effects - heat capacity, thermal conductivity - thermal inertia – diurnal heat effects – thermal property of objects – thermal sensors – thermography – thermal image interpretation.

UNIT- II

Microwave Remote sensing: Active and Passive remote sensing- History of active remote sensing- components – Image characteristics – radiometric aspects and Geometric aspects of characteristics –SAR – SLAR – SRTM- Advantages of radar Interferometry. -An outline of passive microwave remote sensing. An introduction to **Hyperspectral remote sensing** and its applications. An outline of **LIDAR**.

UNIT- III

Visual interpretation and identification of drainages, landforms and rock types using satellite images. Application of remote sensing in mineral targeting-petroleum exploration- structural geology and tectonics. Applications of remote sensing natural hazard management and mitigation. Basic idea on maps and map projections.

UNIT – IV

Basics of GIS: Definition - Usefulness of GIS - Components of GIS – Computer Hardware, Software Modules and Organizational Context of GIS. Data Structure: Data Structure in GIS - Types of Data (Points, Lines and Polygons)- Data Base Structures (Raster Data Structures and Vector data Structures) - Data Conversion, (Vector to Raster and Raster to Vector). **Data Input, Verification, Storage and Output**: Spatial Data Input Processes and Devices (Sources of data, - Different Types of Data Entry methods, viz., Manual input, Run length code, Digitization,

Automated Scanning, etc. – Vector to Raster conversion – Raster to Vector conversion - Input devices) - Entry of non-spatial data – Linking of Spatial & Non-spatial data Data Verification (Errors of different types) – Correction– GIS capabilities for Data correction – Data output (Types of Output, GIS Capabilities for output, Output devices).

UNIT – V

Data Analysis and Spatial Modeling: Simple data retrieval – Data retrieval through Boolean Logic – Map Overlaying and Cartographic Modeling (Two layers, Multiple layers, Binary, Index, Regression, and Process Models) – Overlay analysis– Buffering –– Network analysis. Digital Elevation Modeling: Need For Three Dimensional Models - Methods of DEM - Products of DTM (Contour Maps, Shaded Relief Map, Maps Related To Slopes, Line of Sight Maps, Drainage Analysis, Volume Estimation, etc.) - Usefulness of DEM/DTM.

REFERENCES AND TEXTBOOKS

1. **Anon.** (1983). Manual of Remote Sensing, ASP, Falls Church, Virginia.USA.
2. **Bhatt,A.B.**(1994). Aerial Photography & Remote Sensing,BS & MPS Pub.Delhi.
3. **Burrough,P.A.** (1986). Principles of GIS for Land Resources Assessment.Clarendon Press.Oxford.
4. **Rampal,S.** (1999). Handbook of Aerial Photography and Interpretation, Concept publishing.
5. **Lillesand T.M., and Kiefer,R.W.**(2000). Remote Sensing and Image interpretation, 6th ed. Wiley.Delhi
6. **Jensen,J.R.**(1995).Introductory Digital Image Processing: A Remote Sensing Perspective. Wiley. Delhi.
7. **Richards,J.A.** (1999). Remote Sensing Digital Image Analysis. Springer. Delhi.
8. **Curran,P.J.** (1995). Principles of Remote Sensing. ELBS. London.
9. **Sabins, F.F.**(1978). Remote Sensing Principles and Image interpretation, W.H.Freeman & Co. USA.
10. **Chang, K.T.** (2006). Introduction to Geographic Information Systems, Pearson.Delhi.

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 (within the five units) may be suggested by the Teacher. **Suggested Group Work/Tasks:** A laboratory based project is suggested under proper supervision and with the submission of a report.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7
CHOICE BASED CREDIT SYSTEM
Master of Science (M.Sc) APPLIED GEOLOGY
SECOND YEAR – IV SEMESTER
MAJOR BASED ELECTIVE - 2
MBE 2 – PETROLEUM GEOLOGY, COAL GEOLOGY AND NUCLEAR GEOLOGY

PAPER CODE – 17PGLM2 CREDITS 4

Broad Objectives & Methodology: The student is introduced to the advanced and applied aspects of petroleum, coal, and nuclear geology. The methodology of teaching involves class lectures with problem solving exercises and simple laboratory demonstrations. **Learning Outcomes:** The student gains insight into the advanced and applied aspects petroleum, coal, and nuclear geology.

PETROLEUM GEOLOGY

UNIT I

Petroleum: physical and chemical properties. Origin of petroleum: organic and inorganic processes. Mode of occurrence of petroleum: surface and subsurface occurrence. Environment of petroleum formation: sedimentary basins; continental; and offshore. Types of sediments in the basins: fragmental, biochemical, chemical precipitates. Migration of petroleum and natural gas: Geological framework; short and long distance, migration, primary and secondary migration.

UNIT II

Geological factors and forces controlling migration; migration routes and barriers. Properties of reservoir rocks: porosity, permeability, and reservoir fluids. Types of reservoir rocks: fragmental biochemical, chemical, marine and non marine. Characteristics of traps and their classification: structural and stratigraphic and combination, and fluid traps. Outline of Petroliferous basins of India. Outline of methods of Mud Logging.

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. Petrographic and lithologic characters of coal: bed structure, coal texture – maceral concept: vitrain, clarain, durain and fusain.

UNIT IV

Coal for liquefaction; Coal gasification; Beneficiation of low grade coal. 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; An outline of estimation of coal reserves.

NUCLEAR GEOLOGY

UNIT V

Radioactive Mineral Exploration: Radioactive elements and minerals. Distribution of U and Th in igneous, metamorphic and sedimentary rocks. Geochemical guides for U and Th deposits. Host rocks for U and Th deposits: granite, pegmatite, carbonatite, and vein deposits; sedimentary host rocks; placer deposits; Field

Instrumentation: Geiger Muller counter – Scintillation detector – Gamma ray spectrometer – Radon emanometers. Units of measurement. Phases of prospecting; Radioactive elemental surveys. Bore hole logging in U and Th exploration. 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
Master of Science (M.Sc) APPLIED GEOLOGY
FIRST YEAR – II SEMESTER
PRACTICAL I - STRUCTURAL GEOLOGY, STRATIGRAPHY AND REMOTE SENSING

PAPER CODE – 17PGLP1 CREDITS 4

Broad Objectives & Methodology: This practical introduces the student to the field oriented aspects of structural geology, stratigraphy and remote sensing.The teaching and learning methodology involves practical and laboratory demonstrations with geological maps, fossil specimens, and remote sensing imageries available in the Department. **Learning Outcomes:** The student gains an understanding into the methods of working out and solving problems in structural geology, stratigraphy and remote sensing which may be useful for job prospects related to mineral deposit mapping, geological mapping and oil exploration industries.

Structural Geology Practical:

Preparation of geological maps from topographical maps and its interpretation. Determination of Dip, apparent dip by trignometrical, geometrical and graphical methods. Determination of true thickness. Calculation of the depth to a bed from a level or sloping surface. Trignometrical solutions to fault problems. Stereographic projection: Representing inclined planes, horizontal and vertical planes in a stereogram. Determination of dip, apparent dip of a bed,representing the intersecting planes in a stereogram. Solving the fold, fault and unconformity problems by stereographic projection method.

Stratigraphy Practical

Correlation of strata using lithographic columns. Correlation of fence diagrams using more than two lithographic columns. Interpretation of age relations using cross section diagrams. Graphical identification of missing beds or unconformities using lithographic logs or columns. Chronological study of important fossiliferous rocks. Determination of order of superposition using primary and secondary structures using lithologs or columns. Stratigraphic interpretation based on the evolutionary changes of Trilobites, Graptolites, and Cephalopods. Stratigraphical significance of important Gondwana and Tertiary flora.

Remote Sensing Practical

Study of Aerial Photographs using pocket stereoscopes and mirror stereoscopes. Geometry of vertical and oblique photographs: Determination of scale, height, slope, vertical exaggeration and image distortion. Photo geological study of drainage pattern and elementary geomorphic features.Interpretation of geologic structures and rock types.

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 fossil bearing area is suggested under proper supervision and with the submission of a field report.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7

CHOICE BASED CREDIT SYSTEM

Master of Science (M.Sc) APPLIED GEOLOGY

FIRST YEAR – II SEMESTER

PRACTICAL II - ADVANCED CRYSTALLOGRAPHY AND MINERALOGY

PAPER CODE – 17PGLP2 CREDITS 4

Broad Objectives & Methodology: This practical introduces the student to the methods of advanced crystallography and mineralogy. The teaching and learning methodology involves practical and laboratory demonstrations with mineral specimens and thin sections, crystallographic models, and working out methods of calculating mineral compositions and others. **Learning Outcomes:** The student gains an understanding into the methods of advanced crystallography,mineralogy and mineral calculation is useful for routine laboratory work.The megascopic and petrographic aspects ofthe practical finds use in field geology and mineral exploration done in most mining,mineral and oil exploration industries.

ADVANCED CRYSTALLOGRAPHY

Calculation of Crystal elements: Zone symbol, Anharmonic Ratio, Tangent Relations, Equation to a normal drawn to a crystal face. X-Ray Crystallography: Simple problems based on Bragg's Law and Powder Camera Data. **Stereographic Projection**: Plotting of stereogram of Normal classes of the crystal Systems. Application of Napier's Theorem.

MEGASCOPIC MINERALOGY

Identification of rock forming minerals in hand specimen based on their megascopic properties.

MICROSCOPIC MINERALOGY

A. Identification of common rock forming minerals in thin section using their optical and diagnostic properties.

B. Exercises in Optical Mineralogy:

1. Measurement of mineral dimensions in thin section using Stage Micrometer.
2. Michel - Levi Interference Chart and the utility of Mica and Gypsum plates and the Quartz wedge in optical mineralogy.
3. Sign of Elongation of minerals.
4. Optic sign determination of Uniaxial minerals.
5. Optic sign determination of Biaxial minerals.
6. Pleochroic scheme of Anisotropic minerals.

MINERAL CALCULATION EXERCISES

Calculation of molecular and structural formula using analytical data of the following mineral groups: Olivine, Pyroxene, Garnet, Feldspar, Amphibole and Mica.

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.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7

CHOICE BASED CREDIT SYSTEM

Master of Science (M.Sc) APPLIED GEOLOGY

FIRST YEAR – II SEMESTER

PRACTICAL III – PETROLOGY

PAPER CODE – 17PGLP3 CREDITS 4

Broad Objectives & Methodology: This practical introduces the student to the different aspects of practical petrology and their applications. The teaching and learning methodology involves practical and laboratory demonstrations with rock specimens and thin sections, and working out methods of calculating rock compositions and others. **Learning Outcomes:** The student gains an understanding into the methods of practical petrology useful for routine laboratory work. The megascopic and petrographic aspects of the practical finds use in field geology and mineral exploration done in most mining,mineral and oil exploration industries.

IGNEOUS PETROLOGY

Megascopy & Microscopy: Megascopic and microscopic study of important igneous rocks with reference to texture, mineralogy, mode of occurrence, structure and petrographically interesting features.

Igneous Rock Geochemistry: Calculation of Niggli values. Preparation of Harker's and Niggli's variation diagram and their interpretation. Preparation of Addition and Subtraction diagrams and their interpretation. CIPW Norm calculation and calculation of normative mineral and relevant oxide based petrological parameters.Preparation of mantle and chondrite normalized spider plots using REE and ICE data of igneous rocks and their interpretation.

METAMORPHIC PETROLOGY

Megascopy & Microscopy: Megascopic and microscopic study of important metamorphic rocks with reference to texture, mineralogy, mode of occurrence, structure and petrographically interesting features.

Metamorphic Rock Geochemistry: Calculation of parameters and graphical representation of data on ACF, AKF and AFM diagrams of rocks coming under selected contact metamorphic and regional metamorphic facies.

SEDIMENTARY PETROLOGY

Megascopy & Microscopy: Megascopic and microscopic study of important sedimentary rocks with reference to texture, mineralogy, mode of occurrence, structure and petrographically interesting features.

Sedimentology: Mechanical analyses of sediments, calculation of sedimentological parameters,their graphical representation and interpretation. Exercises related to analyses and interpretation of depositional environments.

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.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), SALEM-7

CHOICE BASED CREDIT SYSTEM

Master of Science (M.Sc) APPLIED GEOLOGY

SECOND YEAR – IV SEMESTER

PRACTICAL IV – HYDROGEOLOGY AND MINING GEOLOGY

PAPER CODE – 17PGLP4 CREDITS 4

HYDROGEOLOGY

Hydrogeochemistry: Determination of pH, specific conductivity (EC), total dissolved solids (TDS), hardness of water - titration method. Estimation of Na, K, Ca, Mg, CO_3, HCO_3, Cl, SO_4. Methods of representation of water quality data: vertical bar graphs, vector diagram, pattern diagram, circular diagram, and USSL classification.

Hydrology: Calculation of average depth of rainfall by Theissen Method. Preparation of Isohyetal Maps. Estimation of potential evapo-transpiration by using Thornwaite equation. Construction of Hydrographs and separation of different components. **Morphometric analysis** :Drainage density, Stream frequency, Bifurcation ratio, Ruggedness number, Water budget calculation.

MINING GEOLOGY

Diagrammatic Representation of Open cast and Underground mines. Estimation of ore reserves. Evaluation of ore bodies.

FIELD TRAINING PROGRAMME:

In partial fulfillment of the M.Sc. Applied Geology degree course, the students should be trained in geological mapping of structurally complex area, for a period of 1 to 2 weeks. Similarly, they should be taken on field trips for 1 – 2 weeks to various parts of India to familiarize them with economic mineral deposits and different geological formations. Field training should be followed by laboratory processing of rocks samples and ores collected during the field work. The marks for full attendance in the Field Training Programme, submission of field report, and proper display of field specimen collections is 25. There is no passing minimum for internal assessment for the practical. Full attendance in the Field Training Programme is mandatory.

Candidates who are **absent for all days** in the Field Training Programme schedule will be awarded zero marks (0) irrespective of reasons cited or submitted by the student. The candidate has to redo the Field Training Programme in the next or eligible subsequent even semester. 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. Submission of the candidate's field programme report and display of specimens collected in the field is compulsory and is mandatory prior to the main practical examination. Internal marks will be reduced when the student fails to submit the field report or fails to display the field collections/specimens or both within the timeframe specified prior to the Main Practical Examination.