# PERIYAR UNIVERSITY

## PERIYAR PALKALAI NAGAR
## SALEM – 636 011

**DEGREE OF BACHELOR OF SCIENCE**

***CHOICE BASED CREDIT SYSTEM***

## Syllabus for

# B.Sc. APPLIED GEOLOGY

**(SEMESTER PATTERN)**

**(For Candidates admitted in the Colleges affiliated to Periyar University from 2021-2022 -onwards)**

**REGULATIONS**
**ELIGIBILITY**
**Refer this office circular No: PU/R/AD-1/UG/PG/Programs Eligibility/2019Dated: 16-04-2019.**

## 1.DURATION OF THE COURSE

The course for the degree of Bachelor of Science shall consist of three years divided into six semesters with internal assessment under choice based credit system.

## 2.COURSE OF STUDY

The course of study shall comprise instruction in the following subjectsaccording to the syllabus and books prescribed from time to time.

### SEMESTER - I

1. Language - I (Tamil etc.)
2. Communicative English-I
3. Core Geology Paper - I- Physical Geology and Geodynamics
4. Allied Chemistry Paper - I (or) Allied Mathematics Paper-I
5. Skill Based Elective Course-I (Select any one from list-1 SBEC)
6. Value education
7. Professional English – I

### SEMESTER - II

8. Language - II (Tamil etc.)
9. Communicative English - II
10. Core Geology Paper - II-Geomorphology and Structural Geology
11. Core Geology Practical Paper - I* Structural Geology and Surveying
12. Allied Chemistry Paper-II (or) Allied Mathematics Paper - II
13. Allied Chemistry Practical Paper-I* (or) Allied Mathematics Paper - III
14. Skill Based Elective Course – II (Select any one from list – 1 SBEC)
15. Environmental Studies
16. Professional English – II

### SEMESTER - III

17. Language - III (Tamil etc.)
18. Communicative English - III
19. Core Geology Paper – III Palaeontology
20. Allied Physics Paper - I
21. Skill Based Elective Course – III (Select any one from list-1 SBEC)
22. Non -Major Elective Course - I

## SEMESTER - IV

23. Language - IV (Tamil etc.)
24. Communicative English - IV
25. Core Geology Paper – IV Stratigraphy
26. Core Geology Practical Paper - II Paleontology and Stratigraphy
27. Allied Physics Paper - II
28. Allied Physics Practical Paper - I*
29. Skill Based Elective Course – IV (Select any one from list -1 SBEC)
30. Non -Major Elective Course - II
31. Add on course-Internship Training.

## SEMESTER - V

32. Core Geology Paper – V Crystallography
33. Core Geology Paper – VI Mineralogy
34. Core Geology Paper - VII Igneous Petrology
35. Core Geology Paper - VIII Sedimentary and Metamorphic Petrology
36. Skill Based Elective Course – V (Select any one from list - 1 SBEC)
37. Skill Based Elective Course – VI (Select any one from list - 1SBEC)

## SEMESTER - VI

38. Core Geology Paper - IX Economic Geology
39. Core Geology Paper - X Photogeology and Remote Sensing
40. Core Geology Paper - XI Mining and Engineering Geology
41. Core Geology Paper - XII Hydrogeology and Environmental Geology
42. Core Geology Practical Paper - III* Crystallography and Mineralogy
43. Core Geology Practical Paper - IV* Economic Geology and Petrology
44. Skill Based Elective Course – VII (Select any one from list-1 SBEC)

## LIST - 1: SKILL BASED ELECTIVE COURSES

1. Mapping Techniques in Geology
2. Gemology and Gemstone Evaluation
3. Field Hydrogeology and Techniques
4. Water Quality Analysis
5. Granite Exploration and Exploitation
6. Geostatistics and Computer Applications
7. Remote Sensing and GIS
8. Mines and Minerals Legislation of India
9. Introduction to Geoinstrumentation
10. Cartography
11. Geology for Competitive Examination
12. Principles of Surveying

## LIST - 2: NON-MAJOR ELECTIVE COURSES

1. Oceanography
2. Climatology
3. Basic Geochemistry
4. Basic Geophysics
5. Geohazards
6. Groundwater Management and Rainwater Harvesting

## LIST - 3: COMPULSORY COURSES

1. Value Education
2. Environmental Studies
3. Extension Activities (NSS, NCC, YRC, RRC, Green Club)

## 3. EXAMINATIONS

The Theory examination shall be three hours duration to each paper at the endof each semester. The candidates failing in any subject(s) will be permitted to appearfor each failed subject(s) in the subsequent examination.

## 4. SCHEME OF EXAMINATION

The scheme of examination of a different semester shall be as follows:

## B.Sc. GEOLOGY COURSE STRUCTURE UNDER CBCS
## (FOR CANDIDATES ADMITTED FROM THE ACADEMIC YEAR 2021ONWARDS)

| I – SEMESTER | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PART** | **SUBJECT** | **INSTRUCTION HRS/WEEK** | **EXAM HRS.** | **CREDITS** | **UNIVERSITY EXAMINATION** | | |
| | | | | | **NTERNAL** | **XTERNAL** | **TOTAL** |
| **I** | Tamil or any other Language Paper –I | 6 | 3 | 3 | 25 | 75 | 100 |
| **II** | English - I Communicative English | 6 | 3 | 3 | 25 | 75 | 100 |
| **III** | Core I - Geology Paper – I | 5 | 3 | 4 | 25 | 75 | 100 |
| | Core II Geology Practical Paper –I* | 3 | - | - | - | - | - |
| | Allied Chemistry Paper–I(or)Allied Maths Paper –I | 5 | 3 | 4 | 25 | 75 | 100 |
| | Allied Chemistry Practical Paper –I* | 2 | - | - | - | - | - |
| **IV** | Skill based Elective course-I (Select any one from the list-1) | 2 | 3 | 2 | 25 | 75 | 100 |
| | Value education | 1 | 3 | 2 | 25 | 75 | 100 |
| | Professional English-Physical Science-I | **6** | **3** | 4 | 25 | 75 | 100 |

***Examinations will be at the end of II semester**

| II SEMESTER | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PART** | **SUBJECT** | **INSTRUCTION HRS/WEEK** | **EXAM HRS.** | **CREDITS** | **UNIVERSITY EXAMINATION** | | |
| | | | | | **NTERNAL** | **XTERNAL** | **TOTAL** |
| **I** | Tamil or any other Language Paper –II | 6 | 3 | 3 | 25 | 75 | 100 |
| **II** | English –II Communicative English | 6 | 3 | 3 | 25 | 75 | 100 |
| **III** | Core III – Geology Paper – II | 5 | 3 | 4 | 25 | 75 | 100 |
| | Core IV - Geology Practical Paper –I* | 3 | 3 | 5 | 40 | 60 | 100 |
| | Allied Chemistry Paper–I(or)Allied Maths Paper –II | 5 | 3 | 4 | 25 | 75 | 100 |
| | Allied Chemistry Practical Paper –I* (or) Allied Maths Paper – III | 2 | 3 | 4 | 40 | 60 | 100 |
| **IV** | Skill based Elective course-I (Select any one from the list-1) | 2 | 3 | 2 | 25 | 75 | 100 |
| | Environmental Studies* | 1 | 3 | 2 | 25 | 75 | 100 |
| | Professional English-Physical Science-II | 6 | 3 | 4 | 25 | 75 | 100 |

**Continued from I semester and Examinations will be at the end of II semesterTotal**

**Credit for I and II Semester = 53 credits**

**Total Marks for I and II Semester = 1600Marks**

| III SEMESTER | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PART** | **SUBJECT** | **INSTRUCTION HRS/WEEK** | **EXAM HRS.** | **CREDITS** | **UNIVERSITY EXAMINATION** | | |
| | | | | | **NTERNAL** | **XTERNAL** | **TOTAL** |
| **I** | Tamil or any other Language Paper –III | 6 | 3 | 3 | 25 | 75 | 100 |
| **II** | English Paper –III | 6 | 3 | 3 | 25 | 75 | 100 |
| **III** | Core V - Geology Paper – III | 5 | 3 | 4 | 25 | 75 | 100 |
| | Core VI - Geology Practical Paper –II* | 3 | - | - | - | - | - |
| | Allied Physics Paper –I | 5 | 3 | 4 | 25 | 75 | 100 |
| | Allied Physics Practical Paper –I* | 2 | - | - | - | - | - |
| **IV** | Skill based Elective course-III (Select any one from the list-1) | 2 | 3 | 2 | 25 | 75 | 100 |
| | Non-Major Elective Course – I | 2 | 3 | 2 | 25 | 75 | 100 |

***Examinations will be at the end of IV semester**

| IV SEMESTER | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PART** | **SUBJECT** | **INSTRUCTION HRS/WEEK** | **EXAM HRS.** | **CREDITS** | **UNIVERSITY EXAMINATION** | | |
| | | | | | **NTERNAL** | **XTERNAL** | **TOTAL** |
| **I** | Tamil or any other Language Paper –IV | 6 | 3 | 3 | 25 | 75 | 100 |
| **II** | English Paper –IV | 6 | 3 | 3 | 25 | 75 | 100 |
| **III** | Core VII - Geology Paper – IV | 5 | 3 | 4 | 25 | 75 | 100 |
| | Core VIII - Geology Practical Paper –II* | 3 | 3 | 5 | 40 | 60 | 100 |
| | Allied Physics Paper –II | 5 | 3 | 4 | 25 | 75 | 100 |
| | Allied Physics Practical Paper –I* | 2 | 3 | 4 | 40 | 60 | 100 |
| **IV** | Skill based Elective course-IV (Select any one from the list-1) | 2 | 3 | 2 | 25 | 75 | 100 |
| | Non-Major Elective Course-II | 2 | 3 | 2 | 25 | 75 | 100 |
| | Add on course-Internship(Field visit and Report preparation) | - | - | - | - | - | - |

**Continued from III semester and Examinations will be at the end of IV semester**

**Total Credit for III and IV Semester = 45 credits**

**Total Marks for III and IV Semester = 1400 Marks**

| V SEMESTER | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PART** | **SUBJECT** | **INSTRUCTION HRS/WEEK** | **EXAM HRS.** | **CREDITS** | **UNIVERSITY EXAMINATION** | | |
| | | | | | **NTERNAL** | **XTERNAL** | **TOTAL** |
| **III** | Core IX - Geology Paper – V | 5 | 3 | 4 | 25 | 75 | 100 |
| | Core X - Geology Paper – VI | 5 | 3 | 4 | 25 | 75 | 100 |
| | Core XI - Geology Paper – VII | 5 | 3 | 4 | 25 | 75 | 100 |
| | Core XII - Geology Paper – VIII | 5 | 3 | 4 | 25 | 75 | 100 |
| | Core XIII - Geology Practical – III | 3 | 3 | - | - | - | - |
| | Core XIV - Geology Practical – IV | 3 | 3 | - | - | - | - |
| **IV** | Skill based Elective course-V (Select any one from the list-1) | 2 | 3 | 2 | 25 | 75 | 100 |
| | Skill based Elective course-VI (Select any one from the list-1) | 2 | 3 | 2 | 25 | 75 | 100 |

***Examinations will be at the end of VI semester**

| VI SEMESTER | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PART** | **SUBJECT** | **INSTRUCTION HRS/WEEK** | **EXAM HRS.** | **CREDITS** | **UNIVERSITY EXAMINATION** | | |
| | | | | | **NTERNAL** | **XTERNAL** | **TOTAL** |
| **III** | Core XV - Geology Paper – IX | 5 | 3 | 4 | 25 | 75 | 100 |
| | Core XVI - Geology Paper – X | 5 | 3 | 4 | 25 | 75 | 100 |
| | Core XVII - Geology Paper – XI | 5 | 3 | 4 | 25 | 75 | 100 |
| | Core XVIII - Geology Paper – XII | 5 | 3 | 4 | 25 | 75 | 100 |
| | Core XIX - Geology Practical - III* | 3 | 3 | 5 | 40 | 60 | 100 |
| | Core XX - Geology Practical - IV* | 3 | 3 | 5 | 40 | 60 | 100 |
| **IV** | Skill based Elective course-VII (Select any one from the list-1) | 2 | 3 | 2 | 25 | 75 | 100 |

***Continued from III semester and Examinations will be at the end of VI semester**

**Total credit for V and VI Semester = 48**
**Credits Total Marks for V and VI Semester = 1300 Marks**

**Total Credit for 3 years = 146 Credits**
**Total Marks for 3 years = 4300 Marks**

## 5. QUESTION PAPER PATTERN FOR EXAMINATION

Time:3 Hour Maximum Marks: 75

**Part-A (15 x 1=15 Marks)**
(Answer all Questions) (Three questions from each unit)
**Part - B (2 x 5=10 Marks)**
(Answer any two Questions) (One question from each unit)
**Part - C (5 x 10 = 50 Marks)**
(Answer all Questions) (One question from each unit with internal choice)

## 6. MINIMUM PASSING MARKS

**Theory**
**Internal Assessment :25marks** **University Examination: 75 Marks**

| EVALUTION OF IA | | PASSING MINIMUM | |
|---|---|---|---|
| Test | 15 Marks | IA (40%) | 10 Marks |
| Assignment | 05Marks | UE (40%) | 30 Marks |
| Attendance | 05 Marks | Total | 40 Marks |
| Total | 25 Marks | | |
| UE | 75 Marks | | |

**Practical-**
**Internal Assessment :40marks** **University Examination: 60 marks**

| EVALUTION OF IA | | PASSING MINIMUM | |
|---|---|---|---|
| Field visit, Collections and Report | 15 marks | IA (40%) | 16 marks |
| Model Exam | 05marks | UE (40%) | 24 marks |
| Record Submission | 15 marks | Total | 40 marks |
| Attendance | 05 marks | | |

| | | | |
|---|---|---|---|
| Total | 40 marks | | |
| UE | 60 marks | | |

## 7. CLASSIFICATION OF SUCCESSFUL CANDIDATES

Candidates who secure not less than 60% of the aggregate marks in the whole examination shall be declared to have passed in First Class. All other successful candidates shall be declared to have passed in Second Class. Candidates who obtain 75% of the marks in the aggregate shall be deemed to have passed in First Class with Distinction provide they pass all the examinations prescribed for the course at first appearance.

Candidates who pass all the examinations prescribed for the course in the first attempt and within a period of three academic years from the year of admission to the course alone are eligible for University Ranking.

## EVALUATION OF CREDITS:

| LETTER GRADE | CUMULATIVEGRADE POINTS AVERAGE | GRADE DESCRIPTION | RANGEOF MARKS |
|---|---|---|---|
| S | 10 | Outstanding | 90-100 |
| A | 9 | Excellent | 80-89 |
| B | 8 | Very Good | 70-89 |
| C | 7 | Good | 60-69 |
| D | 6 | Average | 50-59 |
| E | 5 | Satisfactory | 40-49 |
| RA | 0 | Re-Appear | 0-39 |

$$(Marks\ obtained\ in\ course \times credit)100$$

$$GP = \frac{\text{Total grade points earned in a semester}}{Total\ credits\ registered\ in\ a\ semester}$$

$$GPA = \frac{\text{Sum of grade points earned}}{Sum\ of\ credits\ registered}$$

## CLASSIFICATION:

| | | |
|---|---|---|
| CGPA | 9 and above | I Class with Distinction |
| CGPA | Between 7 and 8.9 | I Class |
| CGPA | Between 5 and 6.9 | II Class |

The above classification shall be given for overall performance including Non- Major Electives and Skill based Courses. i.e., For Performance in the Part III only.

## 8. MAXIMUM DURATION FOR THE COMPLETION OF UG PROGRAM

The maximum duration for the completion of UG Program shall not exceed twelve semesters**.**

## 9. COMMENCEMENT OF THIS REGULATION

These regulations shall take effect from the academic year 2021 - 2022 and thereafter.

## 10. TRANSITORY PROVISION

Candidates who were admitted to the UG course of study before 2017 – 2018 shall be permitted to appear for the examinations under those regulations for a periodfor three years i.e. up to and inclusive of the examination of April/May 2021. Thereafter they will be permitted to appear only under regulations then in force.

## 11. SUBJECT AND PAPER CODES

| PAPER | SUBJECT | PAPERCODE |
|---|---|---|
| Core Paper-I | Physical Geology and Geodynamics | 21UGY01 |
| Core Paper-II | Geomorphology and Structural Geology | 21UGY02 |
| Core Paper-III | Palaeontology | 21UGY03 |
| Core Paper-IV | Stratigraphy | 21UGY04 |
| Core Paper-V | Crystallography | 21UGY05 |
| Core Paper-VI | Mineralogy | 21UGY06 |
| Core Paper-VII | Igneous Petrology | 21UGY07 |
| Core Paper-VIII | Sedimentary and Metamorphic Petrology | 21UGY08 |
| Core Paper-IX | Economic Geology | 21UGY09 |
| Core Paper-X | Photogeology and Remote Sensing | 21UGY10 |
| Core Paper-XI | Mining and Engineering Geology | 21UGY11 |
| Core Paper-XII | Hydrogeology and Environmental Geology | 21UGY12 |
| Core Practical-I | Structural Geology and Surveying | 21UGYP01 |
| Core Practical-II | Palaeontology and Stratigraphy | 21UGYP02 |
| Core Practical-III | Crystallography and Mineralogy | 21UGYP03 |
| Core Practical-IV | Economic Geology and Petrology | 21UGYP04 |
| Skilled Based Elective Courses | **List of Courses** | |
| | Mapping Techniques in Geology | 21UGYS01 |
| | Gemology and GemstoneEvaluation | 21UGYS02 |
| | Field Hydrogeology and Techniques | 21UGYS03 |
| | Water Quality Analysis | 21UGYS04 |

| | | |
|---|---|---|
| | Granite Exploration and Exploitation | 21UGYS05 |
| | Geostatistics and Computer Application | 21UGYS06 |
| | Remote sensing and GIS | 21UGYS07 |
| | Mines and Mineral Legislation of India | 21UGYS08 |
| | Introduction to Geoinstrumentation | 21UGYS09 |
| | Cartography | 21UGYS10 |
| | Geology for Competitive Examination | 21UGYS11 |
| | Principles of Surveying | 21UGYS12 |
| **List of Non majorElective Courses** | **List of Courses** | |
| | Oceanography | 21UGYN01 |
| | Climatology | 21UGYN02 |
| | Basic Geochemistry | 21UGYN03 |
| | Basic Geophysics | 21UGYN04 |
| | Geohazards | 21UGYN05 |
| | Groundwater Management and Rainwater Harvesting | 21UGYN06 |

# ALLIED GEOLOGY PAPERS FOR B.Sc., GEOGRAPHY (3rd and 4th Semester)

| SUBJECT PAPER | PAPER CODE |
|---|---|
| Allied Geology Paper - I | 21UGYA01 |
| Allied Geology Paper- I | 21UGYA02 |
| Allied Geology Practical-I | 21UGYAP01 |

# B.Sc. APPLIED GEOLOGY
## SEMESTER-I
## CORE I - PHYSICAL GEOLOGY AND GEODYNAMICS
## 21UGY01

**COURSE OBJECTIVES**:

1. Geology is the study of the Earth as a whole.
2. Physical Geology introduces different topics which define geology as a branch ofPhysical Geology.
3. The teaching and learning methodology involves class lectures, practicals and laboratory demonstrations. To impart knowledge of various tectonic features andtheir evolution.
4. Understand the formation of continent and ocean and distribution of volcanoes and earthquakes.

## PHYSICAL GEOLOGY

**UNIT-I**

Geology: Scope and Importance, Branches of Geology. Steller System- Solar System: Planets, Satellites, Asteroids, Meteorites and Comets. Origin of the Earth: Theories of Origin - Nebular, Planetesimal, and Tidal Hypotheses – Earth in the SolarSystem: Size, Shape, Mass, Density, Rotational and Revolution parameters. Parts of the Earth - Lithosphere, Hydrosphere, Atmosphere, Biosphere and their Composition.

**UNIT-II**

Age of the Earth: Age determination Methods:- Indirect method: Salinity method, Sedimentation Method, Tree-Ring or Growth rings, Lichenometric Method and Direct Method: Ur-Pb Method, K-Ar Method, Rb-Sr Method, C14 Method, Interior of the Earth: Structure and Composition of Crust, Mantle and Core.

**UNIT-III**

Earthquake: Definition, Focus, Epicenter. Measurement of Earthquake: Seismograph, Seismogram- Richter's scale, Magnitude, Intensity. Earthquake belts ofthe world with a special reference to India. Volcanoes: Definition, Types, Causes andEffects, Volcanic Products, Volcanic Landforms, Distribution of Volcanoes, Volcanoes in India

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## GEODYNAMICS

**UNIT-IV**

Dynamic Earth: Isostasy, Orogeny and Epeirogeny. Origin and Evolution of Oceans, Geosynclines, Profile of Continental Margins, Island Arcs. Sub-Marine, Topography features, Principles of Geodesy, Neotectonics.

**UNIT-V**

Continental Drift, Sea floor Spreading Theory and Evidences: Plate Tectonics – Convergent Boundaries, Divergent Boundaries, Transform Boundaries. Oceanic Trenches, Volcanic Arcs, Mid-Ocean Ridges, Paleomagnetism and its application.

**TEXT BOOKS:**

1. Porter and Skinner (1992), Principles of Physical Geology, John Wiley.
2. Arthur Holmes (1992), Principles of Physical Geology, Vol.1, Chapman and Hall,London
3. Mahabathra, G.B. (1994), Text book of Physical Geology, C.B.S publishers, Delhi.
4. V. Radhakrishnan (1996), General Geology, V.V.P. Publishers, Tuticorin.
5. Parbin Singh (2000), A text book of Engineering and General Geology, S.K. Katariaand sons, Delhi.
6. P.C. Sanjeeva Rao and D. Bhaskara Rao, Text book of Geology 2004, Discovery Publishing House, New Delhi.
7. P.K. Mukerjee (1997), Text book of Geology, World Press.

**REFERENCE BOOKS**

Porter and Skinner 1992 Principle of Physical Geology, IV John Wiley & sons.

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## B.Sc. APPLIED GEOLOGY
## SEMESTER II
## CORE II - GEOMORPHOLOGY AND STRUCTURAL GEOLOGY
## 21UGY02

**COURSE OBJECTIVE:**

1. The dynamic instability of the lithosphere, continuous and discontinuous deformation takes place within the rocks in solid or semi-solid state.
2. To decipher the fundamentals of structures and the underlying physical processesof rock deformation and geotectonics to understand landforms and their evolution.
3. To educate the students about the concept rock deformation.
4. To understand qualitative aspects of brittle and ductile deformation processes, and descriptive analysis.

### GEOMORPHOLOGY

**UNIT-I**

Meaning - Scope - Geomorphic Processes: Internal and External Processes - Diastrophism and Denudation, Internal Process - Faults, Folds and Cracks, Volcanism and Earthquakes: Types and Distribution. External Processes- Weathering: Physical, Chemical and Biological. Mass Wasting: Soil Creep, Landslide, Rock fall, Rock slip and Mudflow.

**UNIT-II**

**Geological Work of River:** Sources of Stream Water – River Profile – Geological work – Methods of river Erosion – Rate of River Erosion – Features of Stream Erosion – Sediment Transport by River, Deposition by River. Drainage Patterns and its types. Major Rivers in India.

**Lakes:** Description, classification, Origin, Geological function, Distribution and Indian lakes.

**Geological Work of Groundwater:** Description, Chemical Work of Groundwater,

Deposition by Groundwater, Mechanical work of Groundwater.

**Geological Work of Wind:** Wind Erosion and its Landforms, Sediment Transport by Wind and its Landforms, Deposition by Wind and its Landforms - Sand Dunes and their Types.

**UNIT-III**

**Geological Work of Glaciers:** Glacial Morphology – Types of Glaciers – Geological Work of Glaciers – Glacial Erosion – Rate of Glacial Erosion – Featuresof Glacial Erosion – Glacial Transport and Glacial Deposits – Morphological notes on Glacial Deposits.

**Geological Work of Sea:** Definition of Continental Shelf, Continental Slope, AbyssalPlain, Continental Rise and Sub-Marine Canyons. Marine Erosion and Features of Marine Erosion – Marine Deposition – Coral Reefs. Applied Geomorphology: Application in various fields of Earth Science Mineral Prospecting, Geohydrology, Civil Engineering and Environmental Studies, Geomorphology of India.

## STRUCTURAL GEOLOGY

**UNIT -IV**

Introduction and Scope of Structural Geology. Introduction of Topographical and Geological Map and Map Scale, Outcrop, Configuration of Rocks – Igneous Sedimentary Rocks - Principle of Geological Mapping, Map Reading, Projection Diagrams. Shear Zones: Brittle and Ductile Shear zones, Geometry and Products of Shear Zones; Stress-Strain Relationships for Elastic, Plastic and Viscous Materials.

Measurement of Strain in Deformed Rocks. Behaviour of Minerals and Rocks under Deformation Conditions.

**UNIT- V**

**Folds:** Definition- Parts of Folds -Types of Folds-Classification of Folds- Recognition of Folds.

**Faults:** Definition- Types of Faults-Classification of Faults-Recognition of Faults.

**Joints:** Definition- Types of Joints-Classification of Joints.

**Unconformity:** Definition-Types-Recognition of Unconformities-Distinguishing Faults from Unconformity. Superposed Deformation. Mechanism of Folding, Faulting and Progressive Deformation. Origin of Lineation and Foliation.

**TEXT BOOK:**

1. Richard Huggett, (2007), Fundamentals of Geomorphology. IIEdition. RoutledgeN.Y.
2. Ritter, D.F., Kochel, R.C., Miller, J.R., (2002), Process Geomorphology, Wavelandpress.
3. H.S. Sharma (1990). Indian Geomorphology. Concept Pub. Co., New Delhi.
4. Robert, S.A. and Suzanne, P.A. (2010), Geomorphology – The mechanics andchemistry of landscapes. Cambridge University Press.
5. Thornbury, W.D., (2004), Principles of Geomorphology, II Ed. Wiley Eastern Ltd.New Delhi.
6. Billings, M.P. Structural Geology: Prentice Hall, Englewood Clifts, U.S.A.

7. Novin, C. M. Principles of structural Geology John Willey, New York.
8. Gokhale, N. W. Theory of Structural Geology, CBS Publishers.

**REFERENCE BOOK:**

1. V.V. Belousov-Structural Geology, Moscow
2. P.C. Bedgley-Structural and Tectonic, Principles: Harper & Row, New York.
3. E.W. Spencer-An Introduction to structural Geology: Mc Graw Hill, New York.
4. Park, P.G.-Fundamentals of structural Geology, John Willey & Sons.

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## B.Sc. APPLIED GEOLOGY
## SEMESTER II
## CORE PRACTICAL I - STRUCTURAL GEOLOGY AND SURVEYING
## 21UGYP01

### STRUCTURAL GEOLOGY

Contour Maps and their Interpretation. Exercises to Predict Trends of theOutcrop of Horizontal, Vertical an Incline Beds with Respect to Topography – Reading of solid conformable maps – Deciphering Dip and Strike of Outcrops – Construction of map when three points over a bedding plane are given - Constructionof vertical sections order of superposition – Vertical thickness of formations.

Reading of solid fold and fault maps construction of vertical sections – Determination of throw of vertical faults. Reading of unconformable solid maps – Construction of sections. Reading of solid maps of areas when more than one structure is involved – Determination of comparative ages of structures and intrusions - Geological history.

Determination of true dip & apparent dip and thickness by calculation and graphical method.

Description of features in Survey of India's (SOI) Topo sheet: Extra marginal, marginal, intra marginal information, major conventional signs and symbols, physicaland socio-cultural features.

### SURVEYING

Chain surveying: Open traverse and closed traverse. Prismatic compass surveying: Determination of the distance between two inaccessible stations. Radiation method, method of Intersection– Plane table surveying: Determination of the distance between two inaccessible stations. Radiation method, method of Intersection – Leveling: Rise and fall method -Clinometer Compass and Brunton Compass: To find out dip and strike of the beds. GPS: Fundamentals and applications.

# B.SC. APPLIED GEOLOGY
## SEMESTER-III
## CORE III - PALAEONTOLOGY
## 21UGY03

**COURSE OBJECTIVES:**

1. To make the participant to acquire knowledge on ancient life, skills onidentification and documentation of paleontology.
2. The knowledge in palaeontology is to equip the students for understanding.
3. To educate various aspects biological events such as origin of life, evolution, mass extinctions, radiations, paleo-ecology, exceptional preservation, and functional morphology.
4. To prepare the students for professional job perspective in the field of basic palaeontological research, to benefit them in the preparation of various exam.

**UNIT-I**

Definition of Palaeontology –Scope of Paleontology- Geological Time Scale.Definition of fossils – Types of fossils -Nature and Modes of Preservation of fossils:Body fossils and Unaltered hard parts, Altered hard parts, Petrification, Permineralisation, Carbonization, Mould and Casts, Tracks, Trails, Borings. Uses offossils – Stratigraphic Indicators – Climatic Indicators- Indicators of Paleogeography
Indicators of Evolution and Migration of life forms –Indicators of New deposits ofCoal and Petroleum – Life through ages. Significance of Fossils-Introduction to Chronostratigraphy - Lithostratigraphy – Biostratigraphy.

**UNIT-II**

**Invertebrate Palaeontology: Phylum Mollusca:** Class **Pelecypoda** - Generalmorphology – Dentition type - Shell form - Ornamentation, Classification, Geological history. Class **Gastropoda:** General morphology -Types of coiling – Dextral and Sinistral – Shell form- Ornamentation, Classification, Geological history. Class**Cephalopoda**: Sub Class: Nautiloidea, Ammonoidea - General morphology - Patterns: Nautilitic, Goniotitic, Ceratitic and Ammonitic – Shell forms – Ornamentation – Classification, Geological history and Coleoidea – Morphology andGeological history of a Belemnite shell.

**UNIT -III**

**Phylum Arthropoda:** Class – **Trilobita-** General Morphology: Classification Geological history and. Phylum Porifera – A short account of sponges.
Phylum **Coelentrata** – Class **Anthozoa** –General Morphology- Shapes ofCorals - Classification– Geological distribution.
Phylum **Hemichordata** – Class **Graptozoa**–General Morphology,Classification, Geological distribution.

**UNIT- IV**

**Phylum Brachiopoda:** General morphology – Shell forms - Ornamentation, Classification, Geological history Distinguish between Lamellibranches and Brachiopods. **Phylum Echinodermata:** Class **Echinoidea**: General morphology: Periproct,Corona, Peristome. Classification – Regular and Irregular Echinoids and Geological history. Class **Crinoidea-** Morphology- Geological history. Class **Blastoidea**-Morphology- Geological history.

**UNIT-V**

**Phylum Protozoa** –Class **Sarcodina:** Order **Foraminifera**: General morphology – Dimorphism-Forms of Foraminiferal tests - Ornamentation- Geological history. **Phylum Arthropoda -** Class **Crustacea:** Sub-Class: **Ostracoda** – Morphology – Classification and Geological history.

**Vertebrate Palaeontology**: Classification of Animal kingdom - Habitats and Habits of animals-A brief outline of the Classification of Vertebrates – Evolution of Fishes, Horses, Elephants and Man. Dinosaurs – Evolution and Extinction of Dinosaurs.

**Paleobotany**: General classification of Plant kingdom – Gondwana Indian Plant fossils – A brief account of the following Plant fossils: Glossopteris, Gangamopteris, Ptilophyllum, Calamites, Lepidodendron and Sigillaria. Introductionto Spores and Pollens. Significance and Paleoclimatic conditions of Gondwana flora.Applications of Micropalaeontology.

**TEXT BOOKS**

1. Henry Woods Invertebrate palaeontolgy – Cambridge.
2. Romer, A.S. Vertebrate palaeontology, Chicagopress.
3. Arnold, C.A. An introduction to Palaeobotany., MC-Graw Hill.
4. B.U. Hag and A. Boersma (1978), Introduction to marine Micropalaeontology,Elsevier, Netherlands
5. Jain, P.C. and Anatharaman, M.S. An introduction to Paleontology, VishalPublications.

**REFERENCE BOOKS**

1. Raup, D.M. and Stanely, M.S. Principles of Palaeontology, CBS Publishers.
2. Moore, R.C., Laliker, C.G.& Fishcher, A.G. Invertebrate Fossils, Harperbrothers
3. Shrock, R.R. and Twenhofel, W.H. (1953), Principles of invertebrate Palaeontology, Amold publication Easton.

# B.Sc. APPLIED GEOLOGY
## SEMESTER-IV
## CORE IV – STRATIGRAPHY
## 21UGY04

**COURSE OBJECTIVE:**

1. To understand basic knowledge about Indian Stratigraphy.
2. To train the students to understand the processes of formations of timescalestratigraphy and significance of fossils.

**UNIT-I**

Stratigraphy-Definition-Principles of Stratigraphy: Law of Superposition, Uniformitarianism, Faunal succession, Correlation and Contemporaneous. Geological Timescale and their Divisions. Stratigraphic Unit. Homotaxis, Homotaxial and Synchronous Beds. Physiographic divisions of India,

**UNIT- II**

Precambrian Stratigraphy: Archean of Dharwar Province, Archean of Singbhum - Orissa, Archean of Eastern Ghats, Archean of Aravalli, Archean of TamilNadu – Sathyamangalam Group, Bhavani Gneissic Complex, Anorthosite Complex.Mineral Wealth of Archean India, The Ep-archean unconformity, Stratigraphy of Cuddapah -Economic minerals of Cuddapah System and Vindhyan System – KurnoolGroup– Economic minerals of Vindhyan System.

**UNIT- III**

Palaeozoic Stratigraphy: Distribution of Palaeozoic rocks in India, Cambrian, Carboniferous and Permian of Salt Range, Palaeozoic of Kashmir Valley. Palaeozoicof Spiti Valley and Paleozoic rocks of Peninsular India.

**UNIT- IV**

Mesozoic Stratigraphy: Importance of Gondwana Super Group and Gondwana Plant beds in Tamilnadu. Triassic of Spiti, Kashmir- Salt range-Jurassic of Cutch, Cretaceous of Tiruchirappalli and Narmada Valley–Thiruvakkarai Wood Fossil, Pondicherry. Age of Deccan traps – Bagh Beds – Lameta Beds.

**UNIT- V**

Cenozoic Stratigraphy: Geological Event during Cenozoic Era, Rise ofHimalaya, Neogene of Siwalik System. Tertiary of Assam-Karewa formation, Tertiary rocks of Tamil Nadu - Cuddalore Sandstone, Importance of Sivapithecus, Ramapithecus Apes. Pleistocene Glaciations - Mineral Wealth of Tertiary rocks of India.

**TEXT BOOKS**

1. Krishnan, M.S. (2003), Geology of India and Burma, 6th Edition, CBS.
2. Wadia, D.N. (1953), Geology of India, TATA McGraw –Hill.

3. Ravindrakumar, K.R. Stratigraphy of India.
4. Lemon, R.Y. (1990), Principles of Stratigraphy, Merrill Publishing Co.

**REFERENCE BOOKS**

1. Pascoe, E.H. (1968) - A manual of the Geology India and Burma, Govt. of India Publications.
2. Gregory, J.W. and Barret B.H- General Stratigraphy.

## B.Sc. APPLIED GEOLOGY
## SEMESTER-IV
## CORE PRACTICAL PAPER-II
## PALAEONTOLOGY AND STRATIGRAPHY-
## 21UGYP02

### PALAEONTOLOGY

Megascopic identification and description of the following fossils:

**Pelecypoda:** Arca, Meretrix, Pecten, Cardita, Alectryonia, Spondylus, Inoceramas, Gryphaea, Exogyra, Radiolites, Ostrea, Unio, Venus, Cardium.

**Gasteropoda**: Natica, Turbo, Trochus, Turritella, Cerethium, Conus, Voluta, Murex,Fusus, Physa, Bellerophon.

**Cephalopoda**: Nautilus, Goniatites, Ceratites, Acanthoceras, Scholenbachia, Perispinctus, Hamites, Scaphites, Baculites, Turrilites and Belemnites. **Echinodermata**: Pentrimites, Cidaris, Hemicidaris, Micraster, Holaster, Hemiaster, Stygmatophygus.

**Arthropoda**: Trilobita: Paradoxides, Calymene, Phacops. Trinucleus. **Brachiopoda**: Spirifer, Productus, Terebratula, Rhynconella, Atrypa, Athyris, Orthis.

**Graptolites**:Phyllograptus, Tetragraptus, Didymograptus, Diplograptus, Monograptus.

**Corals**: Calceola, Zaphrenitis, Favosites, Halysites**.**

**Plant fossils:** Glossopteris, Gangamopteris, Ptillophyllum, Lepidodendron, Sigillariaand Calamites.

**Micro Fossils:** Lagena, Nodosaria, Textularia, Operculina, Elphidium, Ammonia.

**Diagrams :** Paradoxides, Pentremites, Trigonia, Arca, Meretrix, Murex, Turritella, Nautilus, Spirifer.

### STRATIGRAPHY

**Stratigraphy -** Arranging the different Indian Stratigraphic horizons in accordancewith age, Stratigraphic position, Fossil content and Order of Superposition.

# B.Sc. APPLIED GEOLOGY
## SEMESTER-V
## CORE V – CRYSTALLOGRAPHY
## 21UGY05

**COURSE OBJECTIVE:**

1. The course's specific aim is to acquaint students about Crystal structures andtheir classification into unit systems and symmetry classes.
2. To acquaint students about various laws of crystallography governing the consistency of Crystal structures with respect to specific chemical composition. 3.To introduce how do minerals form. To explain chemical composition, bondingand internal structure of minerals.

**UNIT-I**

Definition of Crystal – Morphological Characters of Crystal – Faces –Forms – Edges,Solid angles – Interfacial angle. Contact Goniometer and its uses. Symmetry Elements– Crystallographic axes –Crystal notation – Parameter system of Weiss andMiller indices – axial ratio – laws of crystallography – The law of constancy of symmetry, the law of constancy of interfacial angles and the law of rational indices. Symmetry in General - Planes of Symmetry - Axes of Symmetry - Centre of Symmetry – Relation of Geometrical to Crystallographic symmetry - Pseudo symmetry - Crystallographic axes - Systems of crystallization.

**UNIT- II**

Crystals Forms-Introduction of Holohedral, Hemihedral, Hemimorphic and Enantiomorphic.

**Isometric System:** Normal, Pyritohedral, Tetrahedral, Plagiohedral classes with references to well-developed crystals of Galena, Spinel, Garnet, Fluorite, Diamond, Pyrite, Tetrahedrite, Boracite,and Cuprite.

**Tetragonal System:** Normal, Hemimorphic,Tripyramidal,Pyramidal - Hemimorphic Sphenoidal, Trapezohedral ,Tetratohedral classes with references to well-developed crystals of Zircon, Rutile, Casseterite, Vesuviante, Apophyllite, Shellie, Melonite, Wulfenite and Chalcopyrite.

**UNIT- III**

**Hexagonal System:** Hexagonal Division: Normal, Hemimorphic, Tripyramidal, Pyramidal, Hemimorphic ,Trapezohedral classes with references to well-developed crystals: Beryl, Zincite, Apatite Calcite, Corundum, Tourmaline, Phenacite and Quartz.Rhombohedral Division: Rhombohedra, Rhombohedral-hemimorphic Trirhombohedral ,Trapezohedral classes.

**UNIT-IV**

**Orthorhombic System:** Study of the Symmetry elements, Forms and typical minerals of Normal, Hemimorphic and Sphenoidal classes with special reference to well-developed crystals of Barite, Olivine Topaz, Staurolite, Sulphur, Calamine, Struvite and Epsomite.

**Monoclinic System:** Study of the Symmetry elements and Forms of the Normal class.
**Triclinic System:** Study of the Symmetry elements and Forms of the Normal class.

**UNIT- V**

Twinning : Definition – Evidence of Twinning- Laws of Twinning- Composition plane- Twinning plane - Twinning axis –Types of twinning - Simple Repeated (Polysynthetic) Contact and Penetration twinning – Secondary Twinning .

**TEXT BOOKS**

1. Dana, F.S. (1955), A text book of mineralogy - Asia Publishing House -Willey.
2. Wade, F.A. & Mattox, R.B. Elements of crystallography and mineralogy, HarperBros (1960).
3. Phillips, P.C. (1956), An introduction to crystallography Longmans green &co.,
4. Kerr. P.F. Optical Mineralogy.

**REFERENCE BOOKS**

1. Phillips, W.R. Optical Minerlogy, Griffen D.T. (1986).
2. Walhstrom, E.F. (1960), Optical crystallography – John Wiley.
3. Winchel, A.N. (1968), Elements of optical mineralogy, part 1 & 2 Wiley Eastern.
4. Smith H.G. Minerals under microscopy – Murby.

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## B.Sc. APPLIED GEOLOGY
## SEMESTER-V
## CORE VI –MINERALOGY
## 21UGY06

**COURSE OBJECTIVES:**

1. To study the physical chemical and optical properties of rock forming minerals. Thecourse will lay the foundation for the broader understanding of the geology by imparting the basic knowledge about the rock forming minerals.
2. To learn about minerals their formation, complexity, association, identification of the basic idea of mineral interaction.

**UNIT- I**

Definition of Mineral and Mineraloid, Scope of Mineralogy, Properties of minerals: Physical, Chemical, Optical.
Physical Properties of minerals: Based on cohesion: Form, structure, Cleavage, Hardness, Fracture, Tenacity, Specific gravity. Jolly balance and beam balance.
Based on Light: Colour, Streak, Lustre, Transparency, Fluorescence, Phosphorescence.
Based on Heat: Electricity, and Magnetism.
Based on Senses: Taste, Odour, feel.
Chemical Properties of minerals: Isomorphism, Polymorphism and Pseudomorphism.
Outline of blow pipe tests.

**UNIT- II**

Mineralogy, Structure, Chemical Composition, Optical and Physical Properties, Modes of Occurrence and Industrial uses of the following group of minerals: **Quartz Group:** Description, General Characteristics, Crystalline Varieties, Cryptocrystalline Varieties, Amorphous Varieties.

**Feldspar Group:** Introduction, Crystal System.

Alkali Feldspar:Orthoclase, Microcline, Perthite.

Plagioclase Feldspar: Plagioclase Series.

**UNIT- III**

Mineralogy, Structure, Chemical composition, Optical and Physical properties,Modes of Occurrence and Industrial uses of the following group of minerals: **Feldspathoid Group:** Leucite, Nepheline, Cancrinite, Sodalite, Hauynite, Noselite,Lazurite.

**Pyroxene Group:** Orthopyroxene, Clinopyroxene, Clinoenstatites, Pigeonite, Diopside-Hedenbergite, Augite, Wollastonite, Agerite, Jadeite, Spodumene, Rhodonite.

**UNIT-IV**

Mineralogy, Structure, Chemical composition, Optical and Physical Properties,Modes of occurrence and Industrial uses of the following group of minerals: **Amphibole Group:** Anthophyllite, Cummingtonite, Tremolite, Actinolite,Hornblende, Barkevekite, Glaucophane, Ribeckite, Arfvedsonite.

Mineralogy, Structure, Chemical composition, Optical and Physical Properties,Modes of occurrence and Industrial uses of the following group of minerals: OlivineGroup , Mica group, Garnet Group and Zeolite Group.

**UNIT- V**

**Optical Mineralogy:** Optical system-light –ordinary light, polarised light. The parts of Polarizing Microscope. Refraction: Snell's law. Optical properties of minerals: Refractive index (RI)Dispersion-total reflection-birefringence, Isotropic and Anisotropic, Double Refraction, Uniaxial and Biaxial Minerals, Optical Indicators- Optic axis –Optical sign.

**TEXT AND REFERENCE BOOKS:**

1. Berry, L.G., Mason, B.H. and R.V. Dietrich (1983), Mineralogy: Concepts, Descriptions, Determinations. W.H. Freeman & Co.,612p.
2. Dana, E.S. (2011), A Text-Book of Mineralogy, Read Books Design Publishers, London.
3. Dana, J.D. (2012), Manual of Mineralogy, Merchant Books Publishers, New York.
4. Erni, H. (2010), Mineralogy Simplified, Forgotten Books Publishers, London,436
5. Mason, B. and Berry, L.G (1978), Elements of Mineralogy, W.H. Freeman &Co.
6. Nesse, W.D. (2014), Introduction to Mineralogy, Oxford University Press, USA.
7. Paul F. Kerr (1984), Optical Mineralogy, Mc Graw-hill book company New York.

# B.Sc. APPLIED GEOLOGY
## SEMESTER-V
## CORE VII - IGNEOUS PETROLOGY
## 21UGY07

**COURSE OBJECTIVE:**

1. To understand characteristics and genesis of Igneous rocks.
2. To understand igneous processes, physical and chemical characteristics of magma and various rock types its geological setting, petrogenesis, classification, and natural characteristics, textures and structures.
3. To identify mineral assemblages, textural and chemical composition of mineral.

**UNIT-I**

Introduction to Petrology – Igneous Rocks-Magma- Definition, Types and Origin: Basaltic, Andesitic, Rhyolitic magma –Rock Cycle - Plutonic, Hypabyssal andVolcanic rocks formation - Composition and Constitution of magma- Primary and Parental magma. Forms of Intrusive igneous rocks: Concordant and Discordant forms-Forms of Extrusive igneous rocks.

**UNIT -II**

Textures: Definition -Types: Crystallinity, Crystallites, Microlites, Devitrification, Granularity.
Shape of Crystals – Equigranular Texture: Allotriomorphic, Hypidiomorphic, Panidiomorphic, Microgranular, Orthophyric, Felsitic texture. Inequigranular Texture: Porphyritic, Poikilitic, Ophitic, Intergrowth, Directive overgrowth, Reaction texture. Structures: Definition- Types: Vesicular and Amygdaloidal, Blocky lava, Ropy lava,Pillow structure, Flow structure, Sheet joints, Mural joints, Columnar joints, Rift andGrain, Reaction Rims, Xenolithic structure.

**UNIT- III**

Physical properties of magma: Crystallization of Unicomponent magma- Binary magma: (Di-An) Eutectic system, (Al-An) Solid solution system – Ternary system (Ab-An-Di). Bowen reaction series, Diversity of Igneous rocks – Magmatic differentiation: Fractional crystallisation, Liquid immiscibility, Assimilation.

**UNIT- IV**

Classification of Igneous Rocks: CIPW classification, Mineralogical classification, Megascopic (or) field classification, Tyrrell tabular classification, - Classification based on the Alkali to Plagioclase feldspar.

**UNIT- V**

Petrography and Petrogenesis of the following Acid and Intermediate rocks: Granite, Granodiorite, Syenite, Diorite, Rhyolite, Dacite, Trachyte, Andesite, Pegmatite and Aplite. Basic, Ultrabasic and Ultramafic rocks: Gabbro, Dolerite, Basalt – Monomineralic rocks: Dunite, Pyroxenite, Anorthosite.

**TEXT AND REFERENCE BOOKS**

1. Tyrrell, G.W. (1978), The principles of petrology – Chapman and Hall Ltd.,London.
2. Bowen, N.L. The Evolution of the Igneous Rocks – Dover publication, Inc, NewYork.
3. Barth, FW. (1962), Theoritical petrology -Wiley.
4. Walstrom, E.E. (1961), Theoritical Igneous petrology, Wiley.
5. Turner, F.J. and Verhoogen. J (1960), - Igneous and Metamorphic petrology –McGraw Hill.
6. Hatch, F.H. Wells, A.K. (1949), Petrology of Igneous Rocks, Thomas Murby &Wells,
7. Johannesen, A (1962) Descriptive petrography of Igneous Rock.

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## B.Sc. APPLIED GEOLOGY
## SEMESTER-V
## CORE-VIII SEDIMENTARY AND METAMORPHIC PETROLOGY
## 21UGY08

**COURSE OBJECTIVE:**

1. To impart knowledge of formation of sedimentary rocks.
2. To train the students to understand the mode of formations, transportation and deposition of the sediments and also about the processes modifying the sediments after their burial.
3. To infer the metamorphic agents, kinds and formation of metamorphic rocks.
4. To understand implications of various physic-chemical parameters in formulating metamorphic history of rocks

### SEDIMENTARY PETROLOGY

**UNIT-I**

**Sedimentary Formation:** Description and formation of Sedimentary Rocks- Mechanical deposits, Chemical deposits, Organic deposits and Pelitic deposits **Environmental Formation**:Facies-Continental-Transitional-Marine. Sedimentary Process: Weathering-Disintegration and Decomposition, Erosion, Transportation,Deposition, Lithification and Diagenesis.

**UNIT- II**

**Sedimentary Classifications:** Brief study of F.J. Pettijhon and Tyrrell classification of sedimentary rocks into Residual, Mechanical, Chemical and Organicdeposits. **Textures of Sedimentary Rocks:** Origin of grains, Size, Shape, Packing, Fabric and Crystallization of grains. **Structures of Sedimentary Rocks:** Mechanical,Chemical, Organical.

**UNIT- III**

Petrographic details of important Silicic and Carbonate rocks such as- Conglomerate, Breccia, Shale, Sandstone, Clay, Limestone, Dolomite, Coal-Iron oresof Sedimentary Origin-Gypsum-Rocksalt-Flint-Chert and Phyllite. Sedimentary Basins of India and Tamilnadu.

## METAMORPHIC PETROLOGY

**UNIT- IV**

Definition, Agents and Kinds of Metamorphism –Metamorphic Grade, Zone, Facies. Textures and Structures of Metamorphism. Classsification of Metamorphic Rocks. Cataclastic Metamorphism and its Products. Retrograde Metamorphism.Thermal Metamorphism of Pelitic Sediments, Pure and Impure Calcareous rocks. Abrief study of Flaser, Mylonite, Hornfels, Marble, Ophicalcite.

**UNIT- V**

Dynamo Thermal Metamorphism of Pelitic Sediments. Plutonic Metamorphism. Petrography and Origin of Charnockites – Metamorphic Differentiation –Pneumatolytic Injection Metamorphism – Anataxis and Palingenesis. Brief study of Slate, Phyllite, Quartzite, Schist. Gneiss, Granulite, Leptynite, Charnockite, Eclogite, Amphibolite, Schorl, Adinole, Lit- Par- Lit – gneissand Migmatite.

**TEXT AND REFERENCE BOOKS**

1. Tyrrel, G.W- Principles of petrology, Asia Publishing House.
2. Huang, W.T.-Petrology, MC Graw Hill
3. Pettijhon, F.J.-Sedimentary Rocks, Harper &Bros.
4. Harker, A. -Petrology for Students, Cambridge,
5. Turner. F.J. & Verhogen. J. -Igneous and Metamorphic Petrology, McGraw Hill.
6. Williams, H, Turner, F.j. & Gillibert, C.M. - Petrography, Freeman.
7. Winkler, A. G.F.- Petrogenesis of Metamorphic Rocks, McGraw Hill.

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## B.SC. APPLIED GEOLOGY
## SEMESTER-VI
## CORE IX - ECONOMIC GEOLOGY
## 21UGY09

**COURSE OBJECTIVES:**

1. To study mineral deposits and processes of formation of deposits and the nature of different mineral deposits, its genesis and distribution of major ore minerals.
2. To understand the genetic controls of physical and chemical processes of oreformation in various geological settings.
3. To provide the knowledge on geological processes responsible for mineral and ore formation, weathering and other secondary mineralization processes.
4. To familiarize mode of occurrence of economic minerals, metallic and non-metallic minerals.

**UNIT-I**

**Economic Geology -**Definition and Scope. Concept of Ore minerals, Gangue minerals. Tenor, Grade and Ores. Classification of Mineral Deposits. Outline of Lindgren's and Bateman's Classifications. Controls of Ore Localization – Structural Controls- Stratigraphic, Physical and Chemical – Brief study of Metallogenetic Epochs and Provinces – Geologic Thermometers.

**UNIT- II**

Magmatic processes. – Mode of formation – Early magmatic processes and Deposits, Disseminations. Segregations and Injections – Late magmatic processes and deposits – Residual liquid segregation and Injection – Immissible liquid segregation and Injection – Sublimation. Contact Metasomatic processes– Effects – Resulting mineral deposits. Hydrothermal processes – Principles – Factors affecting deposition – Wall rock alteration – Minerals Sequence-Cavity filling deposits, Fissure veins, Shear zone, Stock-work, Saddle reef, Ladder vein, Fold cracks, Breccia filling, Solution cavities, Ore space and Vesicular filling – Replacement deposits, The process and Deposits – Criteria of replacement.

**UNIT- III**

Sedimentary processes and Cycles – Principles involved in Sedimentation – Cycles of Iron and Manganese, Weathering Processes-Principles-Concentration Process and Deposits – Mechanical Concentration Principles – Eluvial, Alluvial, Beachand Aeolian placers. Oxidation and Supergene Sulphide Enrichment –Solution and deposition in the Zone of Oxidation – Secondary Sulphide Enrichments– Gossans and Capping. Metamorphic processes – Formation of Graphite, Asbestos,Talc, Soapstone and Sillimanite group of minerals.

**UNIT- IV**

**Mineral Resources of India**– Ore mineralogy, Association, Genesis, Modes of occurrence, origin and Indian Distribution of the following Metallic Ore Deposits-Copper, Gold, Silver, Uranium, Thorium, Beryllium, Zirconium, Tin, Lead and Zinc.

**UNIT- V**

Mineralogy, mode of occurrences, uses and distribution in India of the following Metalliferous deposits –Iron, Manganese, Molybdenum, Titanium, Aluminum, Chromium. Refectory minerals, Industrial minerals, Abrassive minerals, Ceramic mineral and Fertilize, Pigments minerals. Fossil fuels – Coal – Uses, Classification, Constitution, Origin and Distribution in India. Petroleum- Composition, Uses, Theories of Origin, Oil Traps and Important Oil fields of India.

**Mineral Economics:** Concepts-Strategic-Critical and Essential Minerals- Demand and supply – Mineral Conservation and substitution. Outline of National Mineral Policy (NMP) and Mineral Concession Rules. (MCR).

**TEXT AND REFERENCE BOOKS**

1. Bateman Allan (1962), M. Economic Mineral Deposits, Asian Publishing House, 2nd Edition
2. Lindgren, W. (1993), Mineral Deposits, McGraw Hill.
3. Coggin, B. and Dey, A.K. (1955), India's Mineral Wealth.
4. Park, C.F. and Mac diarmid, R.A (1970), Ore deposits, Freeman.
5. Krishnaswamy, S. India's Mineral Resources, Oxford and IBH.
6. Deb, S. (1980), Industrial Minerals and Rocks of India, Allied.
7. Gokhale, K.V.G.K. & Rao, T.C. (1978), Ore deposits of India, their distribution and processing, Thosmson.

# B.Sc APPLIED GEOLOGY
## SEMESTER-VI
## CORE X - PHOTOGEOLOGY AND REMOTE SENSING
## 21UGY10

COURSE OBJECTIVE:

1. To understand the aerial photography and Preparation of Photo-geologic Maps. Mosaic controlling factors of aerial photograph.
2. To know about Electro-Magnetic Spectrum, Space platforms and Elementary idea about active and passive sensors.
3. Application of photo-geology and remote sensing in geological studies.
4. To impart knowledge of environmental geology, natural hazards and basic concepts of remote sensing and GIS.

## PHOTOGEOLOGY

**UNIT- I**

Definition and Scope of Remote Sensing in Geology. Electromagnetic Spectrum – Definition and Components. Energy sources and radiation – Outline of Interaction of Electromagnetic Spectrum with Atmosphere and Earth surface features – Spectral Signatures – Atmospheric Windows.

**UNIT- II**

Types of Remote Sensing: Based on 1) Energy sources: Active and Passive. 2)Platforms: Aerial and Satellite and 3) Sensors: Optical, Thermal, and Microwaves. 4)RADAR. Aerial Remote Sensing-Types of Aerial Photographs: Vertical and Oblique.Scale of Aerial Photographs – Flight Procedures. Stereoscopes: Pocket and Mirror Stereoscopes.

**UNIT- III**

Photo Interpretation Elements. Mosaics: Controlled and Uncontrolled Mosaics – Advantage and Disadvantages – Application of Mosaics in Geology Studies. Satellite Remote Sensing: Principles of Optical Remote Sensing: Satellite Orbiting Mechanisms – Brief account of Multi Spectral Scanning – Along track and Across track scannings. Types of Resolution – Data Acquisition and Interpretation.

## REMOTE SENSING

**UNIT -IV**

Aerial Photography: Types of Aerial Photographs, Geometry of AerialPhotographs: Oblique, Vertical and Stereopair. Scale of Photograph: Determination of Scale-relief displacement –Stereoscopes-Parallax bar.

**UNIT-V**

Thermal Remote Sensing: Thermal Radiation Principles – Atmospheric Windows – Advantages and Disadvantages. SLAR – Principle and Applications. A short account of LANDSAT, SPOT, India Remote Sensing Satellites and Indian SpaceMissions.

**TEXT AND REFERENCE BOOKS**


1. Curran, P.B. (1985), Principles of Remote Sensing, ELBS, London.
2. Drury, S.D. (1993), Image Interpretation in Geology, Allen &Unwin, London.
3. Miller, V.C. (1961), Photogeology McGraw Hill, New York.
4. Pandey, S.N. (1989), Principles and Applications of Photogeology, Wiley Eastern,Delhi.
5. Sabins, F.F. (1974), Remote Sensing Principles and Interpretation, Freeman, New York.
6. Reddy, A. (2010), Principles of Remote Sensing and GIS, CBS, Delhi.
7. Gupta, R.P. (2003), Remote Sensing Geology, Springer, New Delhi.
8. Lillisand, T.M. & R.W. Kiefer (2000), Remote Sensing and Image Interpretation, Wiley.


## B.SC. APPLIED GEOLOGY
## SEMESTER-VI
## CORE XI - MINING AND ENGINEERING GEOLOGY
## 21UGY11

**COURSE OBJECTIVES:**

1. To understand the basic fundamental concepts of various mining methods, their terminologies, and the type of sampling adopted, explosives used in the mine, and tohave a basic knowledge about mine machineries.
2. To provide the knowledge of geological investigation for site selection of engineering projects.
3. To understand the rock type and their engineering properties, suitability of site conditions for Dam, tunnel, roads and highways.
4. To develop concept and applied aspect of geology in various civil or geo engineering projects.

### MINING GEOLOGY

**UNIT- I**

Sampling-Principles - Types- Collection of sample-Core Sample and their Preservation. Mining Terminology: Exploitation-Development-Shaft, Level, Adit, Hanging Wall, Foot wall, Drive, Cross-Cut, Tunnel, Raise, Winze and Chute**. Drilling:** Percussion-Rotary-Miscellaneous drilling methods-Geological Logging of Borehole samples. **Methods of breaking rocks – Explosives:** Low, High, Sheathed,Permitted, Liquid Oxygen and Miscellaneous.

**UNIT- II**

**Mining Methods:Opencast Mining-**Loading by Manual, Machines, Glory Holeand Kaoline Mining. **Underground Mining:** Stoping-Open stopes, Overhand: Timbered, Filled, Shrinkage, Mitchell Slicing System and Caving Methods.

**UNIT-III**

**Alluvial Mining –** Pan and Batea-Rocker-Longtom-Sluicing-Derrick and Cableway - Hydraulicking-Drift and Dredging. **Coal Mining:** Pillar methods- Longwall advancing-Longwall retreating-Horizon mining and Miscellaneous: Underground hydraulic mining - Strip mining.

## ENGINEERING GEOLOGY

**UNIT-IV**

**Introduction to Engineering Geology:** Scope, Engineering properties ofrocks, Rock Discontinuity. Physical characters of Building, Decorative stones and Concrete aggregates and Road materials.

**Soils**-Physical and Engineering Properties. Soil Formation, Profile and Classification. Soil erosion and Its control. An account on Soil Group of India..

**Dams**: Definition, Types, Geological conditions, Site investigations and Damfoundations. Ashort note on important Indian Dams.

**Reservoirs** - Definition, Selection of Reservoir sites and Groundwater conditions. Problems in Reservoirs: Sedimentations, Slope control, Leakage andSeismicity. Short account of Indian and Tamilnadu reservoirs.

**UNIT- V**

**Tunnels** - Definition, Parts of a Tunnel, Tunneling in hard and soft rocks,Geological investigation and Ground water conditions.

**Roads**- Complicated regions for Roads, Geological problems after roadconstruction. Improvement of Sites- Soil stabilization.

**Foundations**-Definition, Geological investigations and groundwater problems.

**Landslides**-Definition, Slope stability, Slope failure and Safety. Slope Control,Geological factors, Groundwater conditions and Remedial measures.

**Mass Movements-**Causes,Types, Monitoring and Controls of mass movements.

**TEXT BOOKS**

1. R.N.P. Arogyasamy, Courses in mining Geology, Oxford & IBH Publishing Co.
2. Mckinstry- Mining Geology.
3. K.K. Chatterjee -An Introduction to Mineral Economics.
4. R.K. Sinha & N.L. Sharma- Mineral Economics.
5. Thomas R.T. (1979) – An Introduction to Mining –Methun.
6. REFERENCE BOOKS
7. Bell, F.G. (2005), Fundamentals of Engineering Geology, B.S. Publications Hyderabad.
8. Krynine, P.D.& W.R. Judd (1956), Principles of Engineering Geology& Geotechnics, CBS, Delhi.
9. Legget, R.F.& A.W. Hatheway (1988), Geology and Engineering. 3rd Ed. McGraw Hill, New York.

# B.SC. APPLIED GEOLOGY
## SEMESTER-VI
## CORE XII - HYDROGEOLOGY AND ENVIRONMENTAL GEOLOGY
## 21UGY12

**COURSE OBJECTIVE:**

1. To impart knowledge of basic hydrogeology including groundwater origin, occurrence and distribution.
2. To train students on basics of well hydraulics, method of exploration, water budget and management.
3. To impart theoretical, practical and field knowledge pertaining to Hydrogeological domain.
4. To understand the relationship in between water and rock interaction and salt water intrusion and its remedial measures in the coastal aquifers.

## HYDROGEOLOGY

**UNIT-I**

Definition of Hydrology and Hydrogeology – Hydrological cycle -Origin of Groundwater- Water bearing formations: Aquifers, Aquiclude, Aquifuge and Aquitards. Types of Aquifers: Unconfined, Semi-confined, Confined and Perched – Vertical distribution of groundwater – **Springs**: Types, Geological conditions favoring development of springs. Artesian wells and Piezometric surface. Rock properties affecting groundwater. Types of Openings, Porosity, Specific yield, Specific retention and Permeability. Determination of permeability in field and lab.
Groundwater movement – Darcy's law and its applications – Groundwater occurrencein Igneous, Sedimentary and Metamorphic rocks.

**UNIT-II**

Groundwater investigation-Electrical Resistivity Methods: Wenner's and Schlumberger's electrode arrangements. **Wells:** Outline of Dug wells, Tube wells, Jetted wells, Infiltration galleries and Collector wells – Well design and development– Fluctuations of groundwater – Groundwater recharge methods. Suitability for drinking and irrigation purposes – Seawater intrusion: Causes, Consequences and Preventive and Control measures.

**UNIT-III**

**Groundwater Quality:** Analysis of $p^H$-TDS-TSS-Specific Conductance- Hardness-Mineral characteristics-Expression of Analysis: Cations, Anions.Groundwater resources of Tamilnadu including its quality. The latest drinking and irrigation water standards of WHO and BIS – Waterborne diseases. Groundwater Recharge:- Recharge Methods - Basin method, Stream channel method, Ditch or Furrow method, Flooding method, Irrigation method, Pit method and Recharge well method. Rainwater Harvesting Systems.

## ENVIRONMENTAL GEOLOGY

**UNIT- IV**

Introduction to Environmental Sciences-A brief account of Energy System.

Classification of Natural Resources -Renewable and Non-Renewable resources.
**Water Resources:** Surface and Groundwater-Uses and Exploitation. Flood, Drought, Dams, Benefits and Problems.
**Mineral Resources:** Resource and Exploitation, Effects of Extraction on Environment.
**Land Resources:** Land as a resource, Land degradation, Man induced landslides, Soil erosion and Desertification. Role of Individual in Conservation Natural Resources, Equitable use of resources for sustainable lifestyle.

**UNIT- V**
**Ecosystem:** Concept of an ecosystem, Structure and function of an ecosystem.Forest, Grassland, Desert, Aquatic Ecosystem. Cause, effects and control measures of Water pollution, Air pollution and Mine pollution- Marine pollution- Noise pollution.Cause, Effects and Control measures of Thermal pollution- Nuclear hazards- Solid and Radioactive waste management. Role of individual in prevention of pollution. Disaster Management: Floods, Earthquakes, Landslides and Soil erosion.

**TEXTBOOKS**

1. Todd, D.K. and L.W. Mays (2004), Groundwater Hydrology, John Wiley &Sons.
2. Davis, S.N. & Deweist., R.J.M. (1966), Hydrogeology, John Wiley & Sons, New York
3. Ragunath, H.M. (2007), Groundwater, New Age International Publishers, Delhi
4. Karanath, K.R. (1987), Groundwater Assessment, Development & Management, Tata McGraw Hill.
5. Ramakrishnan, S. (1998), Groundwater, K.G. Graph Arts, Chennai.
6. REFERENCES BOOKS
7. Valdiya, K.S (1987), Environmental Geology – Indian Context. Tata McGraw-Hill.,Delhi.
8. Kellar, E.A. (1979), Environmental Geology, Charles. Merrill Publishing Co. ohio.
9. Lundgren, I. (1986), Environmental Geology, Prentice Hall.

## B.Sc. APPLIED GEOLOGY
## SEMESTER-VI
## CORE PRACTICAL - III CRYSTALLOGRAPHY ANDMINERALOGY
## 21UGYP03

**CRYSTALLOGRAPHY**
**Description of forms present and determination of Miller indices of thefollowing:**
CRYSTAL MODELS:
**Isometric System:** Normal Class – Galena, Fluorite, Magnetite, Garnet, and Leucite, Copper-Pyritohedral class – Pyrite, Tetrahedral Class – Tetrahedrite.
**Tetragonal System**: Normal Class – Zircon, Vesuvianite, Cassiterite, and Rutile. Tripyramidal – Scheelite, Meionite Sphenoidal Class – Chalcopyrite.
**Hexagonal System**: Normal Class – Beryl, Tripyramidal – Apatite, Hemimorphic – Zincite, Rhombohedral Normal – Calcite, Trapezohedral Class – Quartz.
**Orthorhombic System**: Normal – Barite, Sulphur, Stibnite, Topaz, Staurolite, and Aragonite. Hemimorphic – Calymene, Sphenoidal Class – Epsomite.

**Monoclinic System**: Normal – Gypsum, Pyroxenes and Amphiboles.
**Triclinic System**: Normal – Axinite, Albite, and Rhodonite.
**Twin Crystals**: Contact and Penetration twins of Fluorite, Iron Cross Twin of Pyrite,Knee type twin of Cassiterite, Polysynthetic twin of Aragonite, Cyclic twin of Cerussite, Swallow Tail of Gypsum, Twins of Carlsbad, Baveno, Manebach, Albite law of Albite.

**MINERALOGY**

Megascopic identification and description of the following:
**Quartz Group**: Quartz, Chalcedony, Opal, Agate, Flint, Jasper, Amethyst, Rosequartz, Chert.
**Feldspar Group**: Orthoclase, Microcline, Albite, Oligoclase, Labradorite.**Feldspathoid Group**: Adularia, Sanidine, Nepheline, Sodalite, llapislazul.**Pyroxene Group:** Enstatite, Bronzite, Hypersthene, Augite.
**Amphibole Group**: Hornblende, Actinolite, Tremolite.
**Olivine Group:** Olivine, Serpentine.
**Mica Group**: Muscovite, Biotite, Phlogopite, Lepidolite, Vermiculite.
**Other Minerals**: Chlorite, Epidote, Garnet, Apophyllite, Stilbite, Heulandite, Talc, Steatite, Beryl, Kaolin, Cordierite, Apatite, Andalusite, Staurolite, Sillimanite, kyanite, Tourmaline, Topaz, Calcite, Dolomite Fluorspar.

**Optical Mineralogy:**

Microscopic identification and description ofthe following: Quartz,Orthoclase, Albite, Oligoclase, Andesine, Labradorite, Anorthite, Nepheline, leucite, Sodalite,Hypersthene, Augite, Diopside, Aegirine, Hornblende, Tremolite, Actinolite, Glaucophane, Riebeckite, Muscovite, Biotite, Phlogopite, Olivine, Serpentine, Chlorite, Epidote, Garnet, Apatite, Zircon, Sphene, Magnetite,Tourmaline, Calcite, Dolomite, Andalusite, Staurolite, Sillimaniteand Cordierite

**Geochemistry:**

Identification of the following mineral powders by simple blow pipe tests:Apatite, Barite, Calcite, Celestite, Cerusite, Chalcopyrite, Galena, Gypsum, Chromite, Haematite, Magnesite, Magnetite, Psilomelane, Pyrolusite, Siderite, Sphalerite, Strontianite, Witherite, Stibnite, Ilmenite and Wolframite.

## B.Sc. APPLIED GEOLOGY
## SEMESTER-VI
## CORE PRACTICAL PAPER – IV ECONOMIC GEOLOGY AND PETROLOGY
## 21UGYP04

## ECONOMIC GEOLOGY

**Industrial Minerals:**

**Megascopic identification and description, Indian occurrences and uses ofthe following:**

Magnesite, Gypsum, Asbestos, Fluorite, Calcite, Graphite, Barite, Talc, Witherite, Strontianite, Anhydrite, Bauxite, Halite, Dolomite, Aragonite, Kaolin, Garnet, Corundum, Phosphate Nodule**,** Coal and its varieties.

**Fe Ores:** Magnetite, Hematite, Limonite, Pyrite, Marcasite and Siderite.
**Cu Ores:** Chalcopyrite, Cuprite, Bornite, Malachite, Azurite, Native Copper.
**Mn Ores:** Pyrolusite, Psilomelane,Rhodochrosite, and Rhodonite.
**Pb Ores:** Galena, Cerussite, Anglesite.
**Zn Ores:**Smithsonite, Sphalerite.
**Sn Ore:** Cassiterite.
**As and Sb Ores:** Realgar, Orpiment, Stibnite.
**Miscellaneous Ores:** Wolframite, Molybdenite, Bauxite, Chromite, Ilmenite, Rutile, Cinnabar.
**Radioactive Ores:** Monazite, Zircon, Pitchblende, and Pyrochlore.

## PETROLOGY

Megascopic identification of the following rocks:

**IGNEOUS ROCKS:**

Granite, Graphic granite, Pegmatite, Aplite, Schorl Rock, Granite Porphyry, Syenite, Syenite porphyry, Diorite, Gabbro, Anorthosite, Dunite, Pyroxenite,Dolerite, Dolerite Porphyry, Basalt, Trachyte, Rhyolite, Obsidian, Pumice, Scoria.

**SEDIMENTARY ROCKS:**

Conglomerate, Breccia, Sandstone, Arkose, Shale, Shelly Limestone, Laterite, Peat, Lignite.

**METAMORPHIC ROCKS:**

Slate, Phyllite, Schists,Gneisses, Quartzite, Marble, Amphibolite, Ecologite, Leptynite, Charnockite, Khondalite, and Basic Granulite.

Microscopic identification and description of the following rocks:

**IGNEOUS ROCKS:**

Mica Granite, Hornblende Granite, Tourmaline Granite, Schorl Rock, Aplite,Graphic Granite, Mica Syenite, Hornblende Syenite, Nepheline Syenite, Diorite, Gabbro, Norite, Dunite, Peridotite, Granite – porphyry. Syenite – Porphyry, Diorite – Porphyry, Dolerite, Minette, Vogasite, Anorthosite, Trachyte, Andesite, Basalt, Phonolite, Volcanic Breccia, Vitrophyre.

**SEDIMENTARY ROCKS:**

Conglomerate, Breccia, Sandstone, Arkose, Shale, Shelly Limestone.

**METAMORPHIC ROCKS:**

Slate, Chlorite Schist, Mica Schist, Kyanite Schist, Staurolite Schist, Garnetiferous Schist, Glaucophane Schist, Granulite, Charnockite, Ecologite Amphibolite, Leptynite, Khondalite, Cordierite, Gneiss, Garnet – Sillimanite Gneiss, Calc Granulite.

# B.SC. APPLIED GEOLOGY
# LIST OF SKILL BASED ELECTIVE COURSES PAPER I
# MAPPING TECHNIQUES IN GEOLOGY
# 21UGYS01

## COURSE OBJECTIVE:

1. To impart knowledge of geological field survey.
2. To train the students to understand functioning of necessary instruments required during geological field survey.

## UNIT- I

Definition and Scope of Mapping in Geology. Geologic Field Notes: Field Equipments: Clinometer and Brunton Compass - Geological Hammer - Pocket lens –Streak plate– Hand magnet – Measuring tape.

## UNIT- II

Field Observations – Measuring Attitudes of Structural features: Dip and Strikeof beds - Fold- Fault- Unconformity- Foliation – Lineation – Joints.

## UNIT- III

Topographic Maps: Definition of Topography- Parts of Topographic map – Features represented, Map Enlargement, Reduction and Preparation of Base map – Height / elevation datum in topographic maps.

## UNIT- IV

Introduction to Scale in Topographic Maps – Aerial Photographs. Global Positioning System (GPS) - Estimating location and Relative Height. Preparation of Geological Maps and its Interpretation.

## UNIT- V

Sampling and Collection – Minerals, rocks, fossils. Geological Report – CrossSection – order of superposition.

## REFERENCE BOOKS

1. Compton, R.R. (1962), Manual of Field Geology, Wiley, New York
2. Mathur, S.M. (2001), Guides to Field Geology, Prentice Hall of India, Delhi. 3.Freeman,
3. T. (1999), Procedures in Field geology, Blackwell science Oxford, U.K. 4.Dutro, T.J.(1989), AGI data sheet, American Geological institute, Alexandria VirginiaU.S.
4. Lahee, F.H. (1961), Field Geology, CBS, Delhi.
5. Davis, G.H. (1985), Structural Geology of rocks and regions, Wiley, New York.
6. McClay, (1995), Mapping of Geological Structures, Geological Soc. Publication HouseBarth, U.K.

# B.SC. APPLIED GEOLOGY
# LIST OF SKILL BASED ELECTIVE COURSE PAPER II
# GEMMOLOGY AND GEMSTONE EVALUATION 21UGYS02

## COURSE OBJECTIVES:

1. To learn and to examine the nature, quality, rarity of gemstones. To understand the physical and optical properties of gemstones.
2. To summarize the origin, classification of gems.
3. To give an idea about the gem testing instruments.
4. To gain knowledge and to provide skills to become a successful gemologist.

## UNIT- I

Definition and Scope of Gemmology – Minerals as Gemstones – Classificationof Gemstones – Characteristic and Desirable Features of Gemstones. Basic Physical and Optical properties of Gemstones– Optical Classification of Gemstones.

## UNIT- II

Gem Testing: Introduction to Gem Mineral Equipment and Instruments: Polarizer – Refractometer – Pycnometer – Use of Heavy liquids. Non-destructive methods in gem Identification. Gem Simulants and Proxies. Artificial Gemstones andSubstitutes.

## UNIT- III

Gemstone Cutting: Cutting Instruments: Diamond Saw – Blade. Preliminary Observations – Rough Cutting of Gemstones – Sizing and Shaping of Raw stones – Styles of Cutting: Rounding, Cabochon, Flat, Square, Rectangle, Crown, Brilliant, and Laser Sculpting.

## UNIT- IV

Weight Standard Schemes used in Gemology – 4Cs Scheme for Diamonds. Polishing of Gemstones – Polishing Angles and limits. Polishing Equipments. Feasibility and Economics of Gem Industries in India with special reference to TamilNadu. Grading, Valuation and Pricing of Gems.

## UNIT- V

Gemstone Prospecting: Host rocks – Gemstone Mineralization – Deposits. Exploration Techniques and Exploitation. Gemstone Occurrences in India and with special references to Tamil Nadu.

## REFERANCE AND TEXT BOOKS

1. Karanth, K.V. (2000), Gem and gem industry in India, Memoir 45, Geological Society of India, Bangalore.
2. Anderson, B.W. (1990), Gem testing (10th edition), Butterworth Scientific, London.Babu, T.M. (1998), Diamonds in India, Geological Society of India, Bangalore.
3. Hall, C. (1994), Gemstone, Dorling Kindesley, London, Deer, W.A., Houre, R.,

Aabdzussman, S. (1992), An introduction to rock forming minerals, ELBS, London.
4. Kerr, P.F. (1997), Optical mineralogy, 4th Ed. McGraw Hill Book & Co New York.

## B.Sc. APPLIED GEOLOGY
## LIST OF SKILL BASED ELECTIVE COURSES
## FIELD HYDROGEOLOGY AND TECHNIQUES
## 21UGYS03

**COURSE OBJECTIVE:**

1. To impart knowledge of basic field hydrogeology including groundwater origin, occurrence and distribution.
2. To train students on basics of Calculation of Porosity and Permeability, Pump Test data, Calculation of Groundwater Fluctuations.

**UNIT-I**

**Importance of Hydrology** – Difference between Hydrogeology and Hydrology, Water Bearing Geologic formations. Ground water Provinces of Tamil Nadu. Collection of Rain fall data. Short account on Thiessen Polygon Isohyetal maps.

**UNIT-II**

**Hydrogeologic Parameters:** Calculation of Porosity and Permeability, PumpTest data, Calculation of Groundwater Fluctuations.

**UNIT- III**

Wells – Well Inventory Survey: Water level, Water level Fluctuation, Subsurface Layers (Soil thickness, Weathered zone, Fractured zone, Bed rock) - Wellconstruction - Well logging - Sedimentary aquifers: Sandstone, limestone.

**UNIT- IV**

**Hardrock Aquifers:** Charnockites, Gneiss, Granite formation - Field observation and Measurement of Soil moisture zone, Zone of Aeration, Zone of saturation.

**UNIT- V**

**Pumping Test:** Yield, Drawdown, Recuperation, Transmissivity,Permeability. Case studies: Rainfall in Salem district, Groundwater condition in Salem district. Rain Water Harvesting.

**TEXT BOOKS**

A Text book of Groundwater – 2000 – P. Arul, Dhanam Agency, 99D, BazaarStreet, Virudachalam– 606 001.
Groundwater Hydrology – 1959 – David K. Todd – John Willey & Sons, New York.
Ragunath, H.M. 1987, Groundwater, Wiley Eastern Ltd., New Delhi.

## B.Sc. APPLIED GEOLOGY
## LIST OF SKILL BASED ELECTIVE COURSESPAPER IV
## WATER QUALITY ANALYSIS
## 21UGYS04

**COURSE OBJECTIVES:**

1. To impart knowledge of basic water quality analysis.
2. To train students on basics of laboratory methods using quality of water.
3. Study about Recycling of water, Water borne diseases, Reverse Osmosis (RO) System and Desalination of water.

**UNIT- I**

Physical Properties of Water: Color, Odor, Taste, Temperature, Turbidity and Viscosity. Methods of Analysis of Physical Properties. WorldHealth Organization (WHO) and Bureau of Indian Standards (BIS).

**UNIT- II**

Chemical Properties of Water: $p^H$-Alkalinity, Acidity and their Measurements,Ionization Potential, Gas solubility, Precipitation and Dissolution of Ions, EquivalentWeight and its measurement, Colloids and Coagulation, Insoluble Components and their Measurements.

**UNIT- III**

Laboratory Methods of Analysis: Standard Solutions – Determination of $p^H$– Hardness – Dissolved Oxygen – BOD – COD, TDS-TSS. Determination of F, Cl, N,P, K, Na Ca, Mg, Fe, CaCO3, HCO3& Trace metals.

**UNIT- IV**

Utility of Standards required for Potable, Agricultural and IndustrialPurposes. Tools used for assessing the quality of water.

**UNIT-V**

Water Pollution: Urban, Industrial pollution and Remedial measures. Arsenic and Fluoride Content in water. Recycling of water, Water borne diseases, Reverse Osmosis (RO) System and Desalination of water.

**REFERENCE BOOKS**

1. Davis, N.S., Dewiest, R.J.M. (1996), Hydrogeology, John Wiley, New York.
2. Todd, D.K., (2002), Ground water 3rdedition, John Wiley, Singapore.
3. Freeze, R.A., Cherry, J.A. (1979), Ground Water, Prentice Hall, New Jersey.
4. Sawyer, C.N., McCarty, P.L. (1878), Chemistry for Sanitary Engineers, 3rdedition, McGraw Hill, New York.
5. APHA, (1980), Standard Methods for the Examination of Water and Waste Water, 15thedition, American Water Works Association and Water Pollution Control Federation, New York.

**B.Sc. APPLIED GEOLOGY**
**LIST OF SKILL BASED ELECTIVE COURSES PAPER V**
**GRANITE EXPLORATION AND EXPLOITATION**
**21UGYS05**

**COURSE OBJECTIVES**:

1. The objective of this course is to give hands on experience for the students in identifying types, mining methods of granite, exploration and marketing.

**UNIT-I**

Definition of Granite. Magma types- Granitic magma, Building Stones. Basicproperties of Building and Dimensional stones. Engineering properties of Granite.

**UNIT-II**

Types of Granites and their Commercial Terminologies. Granite rock Exploration. Mining Methods of Granites - Marking methods. Methods of Cuttingand Polishing of Granites.

**UNIT- III**

Methods of Exploration: Geological and Geophysical methods. Importantrocks of Granite Industries– Granites and Marbles.

**UNIT- IV**

Machineries used in Granite Industries – Wire Saw Machine, Cutting andPolishing Machines.

**UNIT-V**

Marketing, Pricing and Export of Granites. Granites and Granite Industries ofIndia and Tamil Nadu. End uses of Granite wastes. Manufacture Sand.

**REFERENCE BOOKS**

2. Courses in Mining geology –RPN Arogyasamy- John Wiley Eastern Pub
3. Economic minerals–U. Prasad-CBS
4. An introduction to Mineral Economics-KK Chattejee -John Wiley Eastern Pub
5. Mineral Economics-RK Sinha & NL Sharma-Oxford &IBH
6. Field Geology-Mathur.

# B.Sc. APPLIED GEOLOGY
## LIST OF SKILL BASED ELECTIVE COURSES PAPER VI
## GEOSTATISTICS AND COMPUTER APPLICATIONS
## 21UGYS06

**COURSE OBJECTIVE:**

1. To understand the description of statistical parameters employed to analyse.2.To synthesize geological data for accurate and authentic interpretation.

## GEOSTATISTICS

**UNIT- I**

Geoscience Systems and Statistics: Numerical data in Geoscience. Frequency distribution: Mean Median, Mode, Dispersion and Measures of Central Tendency: Merits and Demerits. Measures of Dispersion: Skewness and Kurtosis, Addition, Multiplication and Division.

**UNIT- II**

Sampling and Sampling plan in Geoscience: Theoretical basis and sampling: Sample Random Sampling Systematic and Stratified and Cluster sampling: StandardErrors. Null Hypothesis. Correlation and Regression Analysis in Geoscience.

## COMPUTER APPLICATIONS

**UNIT- III**

Introduction to Computer – Elements of Computer: Hardware and Software. Hardware: Input devices: Keyboard, Mouse – Output devices: Monitor, Printer – Memory – Primary: - RA, RAM and Secondary Memory: Hard Disk, Floppy & CD.

**UNIT- IV**

A short account on: Algorithm – Flowcharts, Programming languages – Operating Systems – DOS – Windows – DBMS. Computer applications in Geology:Flowcharts for simple Programmes – Geological aspects in Windows.

**UNIT- V**

Introduction to GIS Software in GIS, Utility of computer Software in Geological studies – Bar diagram, Pie diagram, Role diagrams, Scatter diagram, X-Yplots.

**TEXT BOOKS**

1. Balagurusamy, Introduction to Computers.
2. Saroj K. Pal (1985) – Statistics for Geoscientists: Techniques and applications, concept publishing Co., New Delhi.
3. C. Davis (1975), Statistics and data analysis in Geology, John Wiley &Sons.
4. Gupta, G.V. (1995), Basic Statistics, Chand.
5. Ravichandran, D. (2001), Introduction to Computers and communication, Tata McGraw Hill Publication Ltd.,
6. REFERENCE BOOKS

7. D.F. Merriam (1989), Edited Statistical Analysis: A Computer Oriented Approach, Computer Application in the Earth Sciences, A.A. Affi. An International Symposium Pienum Press, New York.
8. Robert L. Miller (1982), Statistical analysis in the Geological Sciences, John Wiley andSons, New York.
9. Palk, S.K. (1998), Statistics for Geoscientist Techniques and Applications.
10. Gregory, S. (1963), Statistical Methods and the geographer Long man &London.

## B.Sc. APPLIED GEOLOGY
## LIST OF SKILL BASED ELECTIVE COURSESPAPER VII
## REMOTE SENSING AND GIS
## 21UGYS07

**COURSE OBJECTIVE:**

To impart knowledge and applications of remote sensing and GIS in Geology.2.To learn basic of aerial remote sensing and its applications.
To understand the physics of electromagnetic spectrum and learn satellite remotesensing.
To have training in GIS components, models and applications

### REMOTE SENSING

**UNIT- I**

Definition and Types: Aerial, Satellite and Radar, Development of Space Programmes - History and Organization Associated with Remote Sensing in India and in other Countries.

**UNIT- II**

Remote Sensing: Sources of Energy, Electromagnetic Radiations (EMR) Atmospheric Windows, Energy Interaction with Atmosphere and Earth. Types of Platforms: Active and Passive. Remote Sensing Methods, Ideal Remote Sensing Systems.

**UNIT- III**

Fundamentals of Aerial Remote Sensing: Components of Aerial Camera,Types of Aerial Photographs, Marginal Information of Aerial Photographs, Elements of Photo Interpretation.

### GIS

**UNIT -IV**

Fundamentals of Satellite Remote Sensing: Types of Satellites: Geo-Stationaryand Sun-Synchronous Satellites, Resolution: Spatial, Spectral, Radiometric and Temporal, Types of Data Products, Marginal Information of Satellite Images.

**UNIT- V**

Geographical Information Systems (GIS) Meaning- Developments-Raster andVector Data-Data Integration-Global Positioning System (GPS) Advantages and Limitations of GIS and GPS.

**REFERENCE BOOKS**

1. Barret, E.C. and Curtie, L.F. (1990), Introduction to Environmental Remote Sensing, Chapman and Hall, London.
2. Cambell, James B. (1987), Introduction to Remote Sensing, The Guilford Press, New York.
3. Lillesand, T. M. and Kieper (1987), Remote Sensing and Image Interpretation, John Willyand Sons, New York.
4. Lueder, D.R. (1959), Aerial Photographic Interpretation, McGraw Hill Book, ce., New York.
5. Wolf, P.R. (1974), Elements of Photog ram me try, McGraw Hill, New York.

## B.Sc. APPLIED GEOLOGY
## LIST OF SKILL BASED ELECTIVE COURSES PAPER VIII
## MINES AND MINERALS LEGISLATION OF INDIA
## 21UGYS08

**COURSE OBJECTIVES:**

1. The course aim to provide an overview of the legal and policy framework on the mining sector in India.
2. To understand the procedure for obtaining mineral concession of regulation and development.

**UNIT- I**

Introduction to Mineral Economics; Essential, Critical and Strategies minerals - Demand and Supply- National Mineral Policy – Problems and Prospects – Industrialpolicy Resolutions, 1956 – Schedule – A, Schedule – B, Energy policy, Forest policy.

**UNIT-II**

Essential - Strategic and Critical minerals – Minor minerals – Major minerals.Evolution of National Mineral policy – Ideal Scope of a Mineral Policy – Categoriesof Minerals for Grant of Concessions.

**UNIT- III**

Procedure for Obtaining Mineral Concession – Termination, Surrender and Determination of Mining Lease – The Oil fields (Regulation &Development) Act, 1948 – The Mines &Minerals (Regulation &Development) Act, 1957.

**UNIT- IV**

Mineral Concession Rules, 1960 – The Mining leases (Modification of terms)Rules, 1956 – Minerals Conservation and Development Rules, 1958. The Coal minesAct, 1974 - Coal mines Regulation, 1957.

**UNIT- V**

The Atomic Energy Act, 1957 – The Atomic Energy Act, 1962 – The Mines Act, 1952 – Mines Rules, 1955 — Metalliferous Mines Regulation, 1961 – Mineral Taxation and Incentive measures – Incidence of Taxes – Depletion Allowance – Simplification of Taxation laws.

**REFERENCE BOOKS**

1. An Introduction to Mineral Economics – K.K. Chatterjee.
2. Mineral Economics - R.K. Sinha &N.L. Sharma.
3. Industrial Minerals and Rocks of India (1980) – S. Deb, Allied Publishers.

## B.Sc. APPLIED GEOLOGY
## LIST OF SKILL BASED ELECTIVE COURSES PAPER IX
## INTRODUCTION TO GEOINSTRUMENTATION
## 21UGYS09

**COURSE OBJECTIVE:**

1. To train the students to understand functioning of necessary instruments required during geological field survey.
2. To impart knowledge and applications of field photographic techniques and GIS in Geology.
3. To train the students description handling and application of the following equipments.

**UNIT- I**

Basic Equipments: Description, Handling and Applications of the following equipments: Hammers, Chisels, Hand lenses, Clinometer, Brunton Compass, Jacob'sstaff, Pedometer.

**UNIT- II**

Survey Equipments: Chain survey, Plane Table, Prismatic Compass, Theodolite, GPS. Field Photographic Techniques, Spot Analysis Kit for water and Soil test.

**UNIT- III**

Geophysical Survey Equipment: Gravimeters, Magnetometers, Resistivity Survey Equipments, Seismic Survey Equipments, Scintillation counter, Well loggingInstruments.

**UNIT- IV**

Pocket Stereoscope, Mirror Stereoscope, Stereometer, Pantograph, Rotometer,Plotting Equipments. Petrological Microscope, Ore Microscope, Photomicrograph Equipment, Stereomicroscope.

**UNIT-V**

Geochemical Equipment: $p^H$& Eh meters, Potentiometers, TDS determination, Chromatographic Techniques, AA Spectrometer, ICP – MS, XRF – XRD.

**REFERENCE BOOKS**

1. Field Geology - S.M. Mathur
2. Field Geology -Gokhale
3. Field Geology - F. Lahee 4
4. Field Geology - R. Compton
5. Surveying -Punmia
6. Geophysics -Telford
7. Geophysics – Ramachandra Rao
8. Mineralogy -Dennan
9. Text Book of Surveying - S.K. Husain and M.S. Nagaraj.

## B.Sc. APPLIED GEOLOGY
## LIST OF SKILL BASED ELECTIVE COURSES PAPER X
## CARTOGRAPHY
## 21UGYS10

**COURSE OBJECTIVE:**

1. To understand the various purposes, roles and representation of cartography. To gain and practice language in the creative design process.
2. To gain and practice skills in cartographic design, representation and produced in a GIS environment.
3. To be able to create digital maps in formats reflecting the purpose, content and function of input data.

**UNIT- I**

Cartography - Nature, Scope and Content of Cartography - Arts and Science of Cartography - Cartography as a system of communication - Maps - Classification andtheir uses - Growth, Development and Modem trends in cartography.

**UNIT- II**

Map Drawing and Measuring Techniques - Map Setting – The Earth and System of Co-ordinates - Base Map - Compilation and Generalization of Maps.

**UNIT- III**

Symbolization: Types of Cartographic Symbols - Point, Line, and Area symbols - Qualitative and Quantitative Data Generalization.

**UNIT- IV**

Map Design and Layout: General Design Problems - Principles of Cartographicdesign and Design of Map Symbols - Lettering – Lettering Methods, Positioning of letters - Geographical names.

**UNIT- V**

Map Reproduction - Process of Map Production –Photographic Systems - Multiple

Reproduction Processes - Computer Application in Cartography - ComputerMapping - Remote Sensing and Cartography - Uses of Air photographs and Satelliteimages in Cartography.

**REFERENCE BOOKS**

1. Misra, R.P. and A.P. Ramesh - Fundamentals of Cartography
2. Robinson - Elements of Cartography
3. Keats, J.S - Cartographic Design and Production.
4. Raiz - Principles of Cartography.

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## B.Sc. APPLIED GEOLOGY
## LIST OF SKILL BASED ELECTIVE COURSES PAPER XI
## GEOLOGY FOR COMPETITIVE EXAMINATIONS
## 21UGYS11

**COURSE OBJECTIVE:**

1. To impart knowledge of objective geology for various competitive examination, know about various question paper pattern information.

**UNIT-I**

Types of Competitive examinations: State and Central Competitive examinations – TNPSC, UPSC (Civil Services, GSI, IFS), UGC-CSIR, ONGC, AMD, Coal India Ltd etc.

**UNIT-II**

Awareness of syllabus prescribed for various competitive examinations. Objective and descriptive type of questions. Preparation strategies - Collection of previous question papers - Internet and library search for information.

**UNIT- III**

Scope and limits of Objective type examinations - Pattern and Style of Objective type Questions - Level of difficulty and Standard Expected - Long Term study and Planning. Preparation strategies for short answer and short essay type examination.

**UNIT- IV**

Study methods - Objective type - Short essay type. Examination techniques: - Pre- Exam preparation - Writing / Choosing Questions from Simple to Complex (or)vem known to partly known before Answering/ writing Answers –Time Concept andExamination Ethics.

**UNIT- V**

Interview - Basic English, Mathematical Ability, Logical Reasoning and Mental Aptitude - Group Discussion, Technical Interview and Management Round. Dress Code and Physical Fitness.

**REFERENCES BOOKS**

1. Julka and Ravi Misra (2003), Geo informa – for the cause of promoting Geoscience,Technology Publications, Dehradun.
2. Maddox, H. (1985), How to study, Rupa publications, Delhi
3. Barrass, R.C. 2001, Study, Routledge study quides, chapman &Hall,4. Srivastava
4. A.P. (1994), Scoring high in examinations, hearting laboratory publications, Delhi.
5. Barles Rob, (1992), Successful study for degrees, Routledge, London.
6. Sayeed, A. (2002), Trends in objective Geology, CBS, Delhi
7. Jhulka, A. (1992), Objective Geology, CBCS, Delhi,
8. Bopche, A. (1999), Objective Geology, Dhanpat Rai, Delhi.

## B.Sc. APPLIED GEOLOGY
## LIST OF SKILL BASED ELECTIVE COURSES PAPER XII
## PRINCIPLES OF SURVEYING
## 21UGYS12

**COURSE OBJECTIVES:**

1. The systematic investigation of geology the purpose of creating a geological map. And contour and cross section.
2. To know about survey types and methods for field and ground.**3.**To train the students to understanding the survey equipments.
3.

**UNIT- I**

Surveying - Definition - Scope and Content - Types of Surveying - Area measurement - Height determination - Advantages of Survey.

**UNIT-II**

Chain Survey - Accessibility -FMB -Methods of Chain Survey - Triangulation - Open and Closed traverse - Plotting of chain Survey and Results.

**UNIT- III**

Prismatic Compass - Parts of Prismatic Compass - Accessories - Traverse - Plotting of Prismatic Compass - Errors and its Corrections – Bow ditich's method ofcorrection - Calculation of bearings from included Angles.

**UNIT- IV**

Plane Table - Equipments - Methods of Plane Table Survey - Preparation workfor the Plane Table Survey - Leveling and Orienting the Table - Resection Points - Trial and Error Method - Tracing Paper Method - Advantages and Disadvantages ofPlane Table Survey.

**UNIT- V**

Height measurement - Determination of Height - By Dumpy level- Parts of Dumpy level- Methods of dumpy level survey - Height measurement by Indian Clinometer and Abney level.

**REFERENCE BOOKS**

1. Lekh Raj & Raghunandan Singh - Map work and practical geography.
2. Jayachandran – Practical Geography.
3. ZamirAlvi - A Text book of Practical Geography.
4. PijushkantiSaha and ParthaBasu - Advanced Practical Geography.

## B.Sc. APPLIED GEOLOGY
## LIST OF NON-MAJOR ELECTIVE COURSESPAPER-I
## OCEANOGRAPHY
## 21UGYN01

**COURSE OBJECTIVE:**

1. To impart basic knowledge of morphological and structural features, and operating processes in sea and ocean basins.
2. To train the students to in understanding the marine economic resources.

**UNIT-I**

Oceanography: Scope, Content, Significance, Distribution of Land and Sea - Hypsometric Curve, Surface Configuration of the Ocean Floor: Continental Shelf, Continental Slope, Deep Sea Plain, Oceanic Deeps and Submarine Canyons.

**UNIT- II**

Relief Features of the Major Oceans: Atlantic, Pacific and Indian Ocean – Horizontal and Vertical Distribution of Seawater Temperature. Salinity: Factors Affecting Salinity and Distribution.

**UNIT- III**

Ocean Water Circulation: Factors Influencing Ocean Circulation - General Circulation of Ocean Currents, Currents of the Atlantic, Pacific and Indian Ocean, Waves and Tides: Definition and Types, Tsunamis: Origin and Effects.

**UNIT- IV**

Marine Deposits: Classification and Distribution - Coral Reefs types -Conditions for the Growth.

**UNIT- V**

Marine Resources: Types - Distribution and Uses - Tidal Energy - Role ofNational Institute of Oceanography in India.

**REFERENCE BOOKS**

1. Anikouchine, W. A. and Sternberg, R.W. (1973), The World Oceans - An Introduction to Oceanography, Englewood Cliffs.
2. Garrison, T. (1998), Oceanography, Wadsworth Co, USA.
3. Gerald, S. (1980), General Oceanography: An Introduction, John Wiley & Sons, New York.

4. King, C. A. M. (1972), Beaches and Coasts, E. Arnold, London: King, C. A. M.(1975), Oceanography for Geographers, E. Arnold, London.
5. Ramasamy, G. (1970), Oceanography (Tamil Edition), Tamil Nadu Text Book Society, Chennai.
6. Sharma, R. C. and Vatel, M. (1970), Oceanography for Geographers, Cheytanya Publishing House, Allahabad.

## B.Sc. APPLIED GEOLOGY
## LIST OF NON-MAJOR ELECTIVE COURSESPAPER II
## CLIMATOLOGY
## 21UGYN02

**COURSE OBJECTIVES:**

1. To understand the meteorology and earth radiation balance.
2. To know the behaviour of meteorological parameters.
3. To learn the concept of EL Nino impact and weather forecasting. **4.**To study the climate changes over geological period and its impact.

**UNIT-I**

Definition and Significances of Climatology - Rotation and Revolution of theEarth, Solstice, Equinox and Seasons, Elements of Weather and Climate, Composition and Structure of the Atmosphere, Isolation: factors affecting Isolation,Global energy budget, Horizontal and Vertical Distribution Inversion of Temperature and factors affecting them.

**UNIT- II**

Atmospheric Pressure: Diurnal and Seasonal Variations – Vertical and Horizontal distribution and factors affecting - Pressure Gradient - Corialies force and Deflection. Winds: Causes and Types - Jet stream, planetary winds, Monsoonand Local winds

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**UNIT- III**

Atmospheric moisture and Precipitation: Humidity types - Condensation -Cloud types - Precipitation and Rainfall: Types and measurements.

**UNIT- IV**

Air Masses and Fronts: types, Classification and Properties - Atmospheric Disturbances: Tropical, Temperate Cyclones, Thunderstorms and Tornadoes - Origin,Development and associated weather conditions.

**UNIT- V**

Climatic Classification: Need and Basis of Climatic Classification- Koppen'sClimatic Classification -Weather forecasting: Observation, Types and Uses.

**REFERENCE BOOKS**

Critchfield, H. (1975), General Climatology, Prentice-Hall, New York.
Das,R. K. (1968), The Monsoons, National Book Trust, New Delhi.
Mather, J. R. (1974), Climatology, McGraw Hill, New York.

Patterson, S. (1969), Introduction of Meteorology, McGraw Hill Book Co., London.
Stringer, E. T. (1982), Foundation of Climatology, Surjeet Publications, New Delhi.
Trewartha, G. T. (198), An Introduction to Climate, International Students Edition, McGraw Hill, New York.
Kumaraswamy, K., et al. (2003), Climatology (Tamil Edition), Grace Publishers, Kumbakonam.

## B.Sc. APPLIED GEOLOGY
## LIST OF NON-MAJOR ELECTIVE COURSES PAPER-III
## BASIC GEOCHEMISTRY
## 21UGYN03

**COURSE OBJECTIVE:**

1. To impart basic knowledge of elemental and isotopic concentrations, classification and behaviour of elements in the crust, continental lithospheric mantle and mantle.
2. To train the students to understand the behaviour of geochemical elements in different igneous rock types.

**UNIT-I**

Origin, Abundance and Distribution of elements in the Universe Solar Systemand Earth – composition of Crust, Mantle, Core, Hydrosphere and Atmosphere: Geochemical classification of Elements.

**UNIT- II**

Basic Crystal Chemistry: Minerals as chemical compounds-bonding – Ionization Potential-Electro negativity-Periodic Table of elements: Periodic lawand its utility.

**UNIT-III**

Geochemical processes and their geochemical signatures - Processes controlling chemical composition of Igneous, Metamorphic, and Sedimentary rocks.

**UNIT- IV**

Geochemistry of REE, Trace elements, stable and radiogenic isotope andtheir applications.

**UNIT- V**

Geochemistry to mineral exploration: Elements, dispersion and halos aroundan ore body-sampling methodology-analytical techniques: AAS-ICP-MS- Gravimeter – Chromotography flame photometry-DTA.

**REFERENCE BOOKS**

1. Krouskoph, K.C. and D.K. Bird (1995) Introduction to Geochemistry, 3rd Ed Wiley, New York.
2. Mason, B. and C.B Moore, (1992), Principles of Geochemistry,4rdEdWiley, New York.3.Rollinson, H. (1993), Using Geochemical Data evaluation, preparation and interpretation, Longman, Singapore.

3. Gill, R.C. (1997), Chemical fundamentals of Geology, Chapman & Hall, U.K.

## B.Sc. APPLIED GEOLOGY
## LIST OF NON-MAJOR ELECTIVE COURSES PAPER IV
## BASIC GEOPHYSICS
## 21UGYN04

**COURSE OBJECTIVE:**

1. To impart knowledge of Geophysics and applications of physics in geology
2. To enhance knowledge and applications of geophysics in exploration of earth resources**.**

**UNIT-I**

Definition and scope of Geophysics. Resistivity, Electrical conduction throughrocks, Range of Resistivity for Rock Sand Minerals. Measurement of Earth Resistivity: Measurement of Earth Resistance, Potential Distribution, Electrode Configuration, Configuration factor, Wenner Array, Lee Partitioning Array,Schlumberger Array, Dipole Arrays, Gradient Array.

**UNIT- II**

Seismic properties of rocks, Densities of various layers of earth (Lithosphere).Distribution of density and pressure within Earth. Survey Procedure: ElectricalProfiling, Resistivity Sounding (VES), Precautions.

**UNIT- III**

Heat flow: Definition – Units – Origin – Causes. Geotherms: Continental andOceanic. Heat flow measurements. Earth's magnetism: Definition – Parts of earth's magnetic field – Variation of Earth's field – Magnetic properties of rocks and minerals – Basic outline of Palaeomagnetism.

**UNIT- IV**

Geochronology: Definition – Methods – Limitations – Radioactivity schemes – Concordia and Discordia ages.

**UNIT -V**

Isostasy: Definition – Scope – Different Theories and limitations of Isostasy. Introduction to Geophysical tools.

**REFERENCE BOOKS**

Lowrie, W.F. (2008) Fundamentals of Geophysics, 2nd edition, Cambridge UniversityPress, Cambridge U.K.

Anderson, D.L. (2007) Theory of Earth, 2nd edition, Cambridge University Press, Cambridge U.K., Holmes A.L. (revised by Duff & Others), (1995) Physical Geology, 5th edition ELBS, London.

**B.Sc. APPLIED GEOLOGY**
**LIST OF NON-MAJOR ELECTIVE COURSESPAPER V**
**GEOHAZARDS**
**21UGYN05**

## COURSE OBJECTIVES:

1. To explain students about the physical and geological processes causing geohazards. To discuss the methods for quantifying geohazards.
2. To understand the possible consequences as well as risk and disaster management.
3. To make them aware about landslides, floods, tsunamis and earthquakes, for which the geological and physical process were to be discussed.
4. To discuss potential inter linkages between different types of geohazards, disaster prevention and management and quantification and communication of uncertainties.

## UNIT-I

Geological Hazards: Introduction to Natural Hazards. Earthquakes: Causes and Measurements – Earthquake Hazards and Risks – Earthquake Prediction and Control – Earthquake Case Histories – Tsunami.

## UNIT- II

Volcanoes, Magma, and Volcanic Eruptions- Volcanic Landforms, Volcanoesand Plate Tectonics – Volcanic Hazards, Beneficial Aspects, and Predicting Eruptions- Volcanic Case Histories.

## UNIT- III

Landslides – Mass Wasting and Mass – Wasting Processes – Slope Stability, Triggering Events, Mass Wasting Hazards – Subsidence: Dissolution & Human Related Causes.

## UNIT- IV

The Ocean-Atmosphere System – Thunderstorms & Tornadoes – Tropical Cyclones – Hurricane – Tornadoes – Windstorms – Lightening – Drought – Frost andFreezes – Wild Fire.

## UNIT- V

Coastal Zones – Costal Erosion – River Systems & Causes of Flooding – RiverFlooding – Flooding Hazards, Prediction and Human Intervention. Extra-terrestrial Hazards. Meteorites & Impacting Events.

## REFERENCE BOOKS

1. Montgomery, C.W. (2008), Environmental Geology, McGraw Hill 8$^{th}$Edition.
2. Abbott Patrick, L. (2006), Natural Disasters, McGraw Hill, Boston, MA.
3. Bryant, E. (2005), Natural Hazards, Cambridge University Press, Cambridge, U.K.

## B.Sc. APPLIED GEOLOGY
## LIST OF NON-MAJOR ELECTIVE COURSES PAPER V
## GROUNDWATER MANAGEMENT AND RAINWATER HARVESTING
## 21UGYN06

COURSE OBJECTIVE**:**

1. To impart knowledge of global and national scenario of water resources and associated challenges.
2. To familiarize about occurrence and movement of sub-surface water. Al so to train students about various groundwater management techniques.
3. To understand the importance of rainwater harvesting for water supply and will learn about different types of rainwater harvesting systems.
4. To get familiar with different potential uses of rainwater and understand the advantages and limitations.
5.

**UNIT- I**

Groundwater development – Dynamic Equilibrium in Natural Aquifers –Groundwater budget – management Potential of Aquifers – Safe yield – Water law –Legal concepts.

**UNIT- II**

Parameters of groundwater balance – Conjunctive and Consumptive use.Modeling Techniques in groundwater management. Groundwater resources evaluation in India. Estimation of recharge components.

**UNIT- III**

Sampling of Geological material: Types of geological samples – Precaution – Collection and marking of samples and their location – Storage of samples – Outlineof Methodology - followed in Mineral, Core, Rocks and Fossil sampling. Report writing: (purpose and scope) – Style – Clarity – Drawings and Diagram – Section.

**UNIT- IV**

Groundwater Mining and Cyclic storage. Rainwater, Surface water and groundwater interactions. Problems and remedial methods. Watershed management.

**UNIT-V**

Rain water harvesting: Definition and types – storm water harvesting – rooftopharvesting – ground water recharge - storage tanks – check dams - quality developments. Consumptive and Conjunctive use of water.

**REFERENCE BOOKS**

1. Todd, D.K., (2002), Ground Water, 3rd edition, John Wiley, Singapore.
2. Fetter, C.W. (1990), Applied Hydrogeology, 2nd edition, CBS, New Delhi.
3. Karanth, K.R. (1980), Ground Water Assessment Development and Management, Tata McGraw Hill, New Delhi.

4. Chaturvedi, M.C. (1987), Water Resources Systems Planning and Management, Tata McGraw Hill, New Delhi.
5. Davis, N.S., De Wiest, R.J.M. (1979), Hydrogeology, John Wiley, New York.
6. Freeze, R.A., Cherry, J.A. (1979), Ground Water, Prentice Hall, New Jersey.

## B.Sc. APPLIED GEOLOGY
## GEOLOGICAL FIELD WORK

It is an integral part of the course students should be taken to a field training during the academic year.

**FIRST YEAR**

Students should be taken to the local area for studying Geomorphological, Structural aspects of geology. The duration of the trip may be a week and submit a report to the department.

**SECOND YEAR**

Students should be taken to nearby area and familiarize Paleontological and Stratigraphical aspect, collect geological samples from the field and display at the time of their practical examination for internal evaluation. The duration may be a week.

**THIRD YEAR**

A visit to geologically interested and mineralized zones within Tamil Nadu it includes mine visit, geological mapping, minerals, rocks collection and display at thetime of their practical examination for internal evaluation. The duration may be for two weeks.

## B.Sc. GEOGRAPHY
## ALLIED GEOLOGY PAPERS

| | |
|---|---|
| Allied Geology paper – 1 (21UGYA01) | Third Semester |
| Allied Geology paper – 2 (21UGYA02) | Fourth Semester |
| Allied Geology Practical (21UGYAP01) | Fourth Semester |

## ALLIED GEOLOGY–I (21UGYA01)

**UNIT - I**

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

**UNIT-II**

**Structural Geology:** Definition and scope of Structural Geology. Concept of rock Outcrop -Definition of Dip and Strike of Rock formations. Folds: definition andparts of a fold. Brief description of the following fold types: Anticline, Syncline, Symmetrical, Asymmetrical, Isoclinal and Recumbent folds. Brief description of thefollowing fold systems: Anticlinorium and Synclinorium. Faults: definition and partsof a fault. Brief description of the following types faults: Normal, Reverse, Strike, Dip, Oblique, Parallel and Step Faults, Brief outline of Joints and Unconformities.

**UNIT- III**

**Crystallography:** Definition of crystallography and crystals. Morphological characters of crystals: Faces – Forms – Edges. Symmetry elements of crystals: Axis,Plane and Centre of symmetry. Miller's Indices. Study of the following Crystal Systems: Normal Classes of the Cubic, Tetragonal, Hexagonal, Orthorhombic, Monoclinic and Triclinic systems.

**UNIT- IV**

**Mineralogy I:** Definition of Mineralogy and Mineral. Outline of physical properties of minerals: Color, form, luster, Hardness, Cleavage, fracture andSpecificgravity. Description of the following minerals: Quartz. Orthoclase – Microcline – Albite – Labradorite - Anorthite. Nepheline – Leucite-Sodalite. Enstatite - Hypersthene – Augite – Diopside.

**UNIT-V**

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

**REFERENCE AND TEXTBOOKS**

1. Parbin Singh, B. (2005), A Textbook of Engineering and General Geology S.K.Kataria & Sons, Delhi.
2. Mukherjee, P.K. (1984), A Textbook of Geology, World Press, Kolkata.
3. Mahapatra, G.B. (1994), Textbook of Physical Geology, CBS Publishers, Delhi.
4. Mahapatra, G.B. (2000), General Geology, CBS Publishers, Delhi.

## B. Sc. GEOGRAPHY
## ALLIED GEOLOGY PAPERS
## ALLIED GEOLOGY–II
## (21UGYA02)

**UNIT-I**

**Palaeontology**: Definition of Palaeontology and fossils. Outlines of modes ofpreservation in sedimentary rocks. Brief account of the uses of fossils. Study of the morphological characters and geological age of the following fossil groups: Pelecypods, Gastropods, Cephalopods, Brachiopods, Corals, and Trilobites.

**UNIT-II**

**Stratigraphy:** Definition and scope of Stratigraphy. Outline of the GeologicalTime Scale. Brief account of the following geological formations in India: Dharwar Group, Cuddapah Group, Vindhyan Group, Gondwana Group, Cretaceous formationsof Tiruchirappalli and Karewa Formation.

**UNIT- III**

**Igneous Petrology:** Definition of Igneous Petrology and Igneous rocks. Formsof Igneous rocks: Sill, Lopolith, laccolith, Phacolith, Dyke, and Batholith. Brief description of the following igneous rocks: Dunite, Pyroxenite, Gabbro, Dolerite, Syenite, Granite, Pegmatite, Aplite, Andesite, and Basalt.

**UNIT- IV**

**Sedimentary Petrology:** Definition of sedimentary rocks and sedimentarypetrology. Primary structures of sedimentary rocks: Common bedding, cross- bedding, current-Bedding, graded-bedding. Surface structures: Ripple marks, Mud- cracks, and Rain prints. Brief description of the following sedimentary rocks: Sandstone, Arkose, Grit, Shale, and Limestone.

**Metamorphic Petrology:** Definition of metamorphic rocks. Metamorphism and metamorphic process. Agents of metamorphism. Brief description of the following sedimentary rocks: Sandstone, Arkose, Grit, Shale, and Limestone. Brief descriptionof the following metamorphic rocks: Slate, Phyllite, Schist, Gneiss, Marble, Quartzite, Granulite, and Amphibolite.

**UNIT- V**

**Economic Geology:** An outline of the following processes of ore formation: Magmatic – Hydrothermal – Placer – Marine Evaporites. Brief description of the physical properties and Indian occurrences of the following ore and industrial minerals: Graphite, Bauxite, Magnesite, Hematite, Magnetite, Chromite, Gold, pyrolusite, pyrite, Galena, Asbestos, Gypsum, Chalk, Calcite, Dolomite, Barite, and Kaolin. Brief description of the following coal types: Peat, Lignite, Bituminous, andAnthracite. Brief introduction to petroleum, its origin and occurrence in India.

**REFERENCE AND TEXTBOOKS**

1. Parbin Singh, B. (2005), A Textbook of Engineering and General Geology, S.K. Kataria &Sons, Delhi.
2. Mukherjee, P.K. (1984), A Textbook of Geology, World Press, Kolkata.
3. Mahapatra, G.B. (1994), Textbook of Physical Geology, CBS Publishers, Delhi.
4. Mahapatra, G.B. (2000), General Geology CBS Publishers, Delhi.

## B. SC. GEOGRAPHY ALLIED GEOLOGY PAPERS
## ALLIED GEOLOGY PRACTICAL

**Crystallography:** Simple forms of the Normal classes of the different crystal systems and models representing the following minerals: Cubic system: Galena,Fluorite, and Garnet. Tetragonal system: Zircon, Casseterite. Hexagonal system:Beryl. Orthorhombic system: Barite, Sulfur, Staurolite. Monoclinic system: Gypsum. Triclinic system: Axinite.

**Mineralogy:** Identification and physical description of the following minerals: Quartz Group: Rock crystal, Chalcedony, Agate, Jasper, Flint. Feldspar Group: Orthoclase, Microcline, Albite, Perthite. Pyroxene Group: Augite, Hypersthene. Amphibole Group: Hornblende, Tremolite, Actinolite. Mica Group: Muscovite, Biotite, Chlorite. Other silicate minerals: Olivine, Garnet, Beryl, Tourmaline, Staurolite. Non silicates: Corundum, Apatite. Ore minerals: Magnetite, Chromite,Bauxite, Pyrolusite, Pyrite, Galena, Hematite. Industrial Minerals: Talc, Asbestos, Magnesite, Barite, Gypsum. Coal varieties: Peat, Lignite, Bituminous, andAnthracite.

**Petrology:** Identification and physical description of the following rocks: Igneous rocks: Granite, Pegmatite, Syenite, Diorite, Gabbro, Dolerite, Dunite, Pyroxenite. Metamorphic rocks: Slate, Mica schist, Chlorite schist, Hornblende gneiss, Garnet-mica gneiss, Granulite, Marble. Sedimentary rocks: Sandstone, Conglomerate, Arkose, Grit, Shale, Limestone.

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

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