**A.D.M. COLLEGE FOR WOMEN (AUTONOMOUS),**

# NAGAPATTINAM - 611001

**(Nationally Re-accredited with "A" grade by NAAC – 3rd Cycle)**

# DEPARTMENT OF GEOLOGY

(For students admitted from the academic year 2019-2020 onwards)

# B.Sc. Geology
# SYLLABUS

**A,D.M. COLLEGE FORWOMEN (AUTONOMOUS), NAGAPATTINAM**
**B.Sc. Geology Programme**

(Applicable to the candidates admitted from the academic year 2019 -2020 onwards)

**PROGRAMME OBJECTIVES**

1. To study about surface geologic process and their impact on development of landforms, and ability to identify and interpret landform development.
2. Students will use maps (topographic and geologic) to estimate distances, visualise landforms, and locate/identify geographic and geologic features.
3. Students will identify common minerals in hand samples and in field exposures of rock using visual clues and simple tests.
4. Students will identify common minerals in hand samples and in field exposures using observations of mineral composition and textures.
5. To understand public issues in the geological sciences and be ready and able to contribute to their resolution.

**B.Sc. Geology 2019 – 2022**
**STRUCTURE OF THE PROGRAMME**

| Part | Title of the Part | No. of Papers | Hours | Credit |
|---|---|---|---|---|
| **I** | Language - Tamil | 4 | 24 | 12 |
| **II** | English | 4 | 24 | 12 |
| **III** | Core Course | 13 | 72 | 65 |
| | Allied | 6 | 28 | 18 |
| | Major Based Elective | 3 | 15 | 15 |
| **IV** | Skill Based Elective | 3 | 6 | 6 |
| | Non-Major Elective | 2 | 4 | 4 |
| **V** | Extension Activities | 0 | 0 | 1 |
| | Value Education | 1 | 2 | 2 |
| | Environmental Studies | 1 | 2 | 2 |
| | Soft-Skill Development | 1 | 2 | 2 |
| | Gender Studies | 1 | 1 | 1 |
| | **Total** | **39** | **180** | **140** |

**Passing Minimum**

A candidate shall be declared to have passed in each course if she secures not less than 40% marks out of 75 marks (i.e., 30 marks) in the End Semester Examination (SE) and 40% out of 25 marks (i.e., 10 marks) in the Continuous Internal Assessment.(CIA)

**A.D.M. COLLEGE FOR WOMEN (AUTONOMOUS), NAGAPATTINAM - 611001**

**DEPARTMENT OF GEOLOGY**

**B.Sc GEOLOGY**

**Course Structure under CBCS**

**(For students admitted from the year 2019-20 onwards)**

| SEM | PART | COURSE | TITLE | INST. HOURS/ WEEK | CREDIT | EXAM HOURS | MARKS | | TOTAL MARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | CIA | SE | |
| I | I | Language Course–I (LC) | Tamil-I | 6 | 3 | 3 | 25 | 75 | 100 |
| | II | English Language Course - I(ELC) | English-I | 6 | 3 | 3 | 25 | 75 | 100 |
| | III | Core Course–I(CC) | The Dynamic Earth | 6 | 6 | 3 | 25 | 75 | 100 |
| | | Core Practical – I(CP) | Structural geology and Surveying | 3 | - | - | - | - | - |
| | | First Allied Course–I(AC) | Mathematics–I (OR) Chemistry I | 4 | 3 | 3 | 25 | 75 | 100 |
| | | First Allied Course–II(AC) | Mathematics -II (OR) Chemistry II | 3 | - | - | - | - | - |
| | IV | Value Education | Value Education | 2 | 2 | 3 | 25 | 75 | 100 |
| | **Total** | | | **30** | **17** | | | | **500** |
| II | I | Language Course–II(LC)–Tamil | Tamil-II | 6 | 3 | 3 | 25 | 75 | 100 |
| | II | English Language Course–II(ELC) | English-II | 6 | 3 | 3 | 25 | 75 | 100 |
| | III | Core Course–II(CC) | Structural Geology | 6 | 6 | 3 | 25 | 75 | 100 |
| | | Core Practical – I(CP) | Structural geology and Surveying | 3 | 3 | 3 | 40 | 60 | 100 |
| | | First Allied Course–II(AC) | Mathematics-II (OR) Chemistry II | 2 | 3 | 3 | 25 | 75 | 100 |
| | | First Allied Course–III(AC) | Mathematics-III (OR) Chemistry III | 5 | 3 | 2 | 25 | 75 | 100 |
| | IV | Environmental Studies | Environmental Studies | 2 | 2 | 3 | 25 | 75 | 100 |
| | **Total** | | | **30** | **23** | | | | **700** |

| SEM | PART | COURSE | TITLE | INST. HOURS/ WEEK | CREDIT | EXAM HOURS | MARKS | | TOTAL MARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | CIA | SE | |
| III | I | Language Course–III (LC) | Tamil-III | 6 | 3 | 3 | 25 | 75 | 100 |
| | II | English Language Course-III(ELC) | English-III | 6 | 3 | 3 | 25 | 75 | 100 |
| | III | Core Course–III(CC) | Physical Geology | 5 | 5 | 3 | 25 | 75 | 100 |
| | | Core Practical – II(CP) | Paleontology and Crystallography | 4 | - | - | - | - | - |
| | | Second Allied Course–I(AC) | Physics–I | 5 | 3 | 3 | 25 | 75 | 100 |
| | | Second Allied Course–II(AC)-Lab | Physics–II | 2 | - | - | - | - | - |
| | IV | Non Major Elective | Fundamentals of Geology/Basic Geophysics | 2 | 2 | 3 | 25 | 75 | 100 |
| | **Total** | | | **30** | **16** | | | | **500** |
| IV | I | Language Course–IV (LC)–Tamil | Tamil-IV | 6 | 3 | 3 | 25 | 75 | 100 |
| | II | English Language Course–IV(ELC) | English-IV | 6 | 3 | 3 | 25 | 75 | 100 |
| | III | Core Course–IV(CC) | Paleontology and Crystallography | 5 | 5 | 3 | 25 | 75 | 100 |
| | | Core Practical – II(CP) | Paleontology and Crystallography | 2 | 4 | 3 | 40 | 60 | 100 |
| | | Second Allied Course–II(AC)-Lab | Physics–II | 3 | 3 | 3 | 25 | 75 | 100 |
| | | Second Allied Course–III(AC) | Physics–III | 4 | 3 | 3 | 25 | 75 | 100 |
| | IV | Non Major Elective | Introduction to Minerals, Rocks and Slides | 2 | 2 | 3 | 25 | 75 | 100 |
| | | Skill Based Elective | Climatology | 2 | 2 | 3 | 25 | 75 | 100 |
| | **Total** | | | **30** | **25** | | | | **800** |

| SEM | PART | COURSE | TITLE | INST. HOURS/ WEEK | CREDIT | EXAM HOURS | MARKS | | TOTAL MARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | CIA | SE | |
| V | III | Core course- V (CC) | Stratigraphy | 5 | 5 | 3 | 25 | 75 | 100 |
| | | Core course -VI (CC) | Mineralogy | 5 | 5 | 3 | 25 | 75 | 100 |
| | | Core Practical – III(CP) | Mineralogy & Applied geology | 4 | 3 | 3 | 40 | 60 | 100 |
| | | Major Based Elective-I | Hydrogeology & Environmental Geology | 5 | 5 | 3 | 25 | 75 | 100 |
| | | Major Based Elective-II | Remote sensing & Mining geology | 5 | 5 | 3 | 25 | 75 | 100 |
| | IV | Skill Based Elective-II | Water quality analysis. | 2 | 2 | 3 | 25 | 75 | 100 |
| | | Skill Based Elective-III | Geo statistics and computer application. | 2 | 2 | 3 | 25 | 75 | 100 |
| | | Soft Skill | Soft skill development | 2 | 2 | 3 | 25 | 75 | 100 |
| | **Total** | | | **30** | **29** | | | | **800** |
| VI | III | Core course-VII(CC) | Igneous petrology | 6 | 6 | 3 | 25 | 75 | 100 |
| | | Core course-VIII(CC) | Sedimentary and metamorphic petrology | 6 | 6 | 3 | 25 | 75 | 100 |
| | | Core Course-IX(CC) | Economic Geology | 6 | 6 | 3 | 25 | 75 | 100 |
| | | Core Practical – IV(CP) | Petrology and Economic Geology. | 6 | 5 | 3 | 40 | 60 | 100 |
| | | Major Based Elective-III | Mineral prospecting & Field Geology | 5 | 5 | 3 | 25 | 75 | 100 |
| | V | Extension Activities | Extension Activities | - | 1 | - | - | - | - |
| | | Gender studies | Gender studies | 1 | 1 | 3 | 25 | 75 | 100 |
| | **Total** | | | **30** | **30** | | | | **600** |
| **Grand Total** | | | | **180** | **140** | | | | **3900** |

## Department of Geology
## Mark Allocation for Theory Papers

| | | |
|---|---|---|
| CIA | - | 25 Marks |
| External | - | 75 Marks |
| | | 100 Marks |

**CIA Component**

| | | |
|---|---|---|
| Test | - | 10 Marks |
| Assignment | - | 2 Marks |
| Seminar | - | 3 Marks |
| Quiz/Group Discussion | - | 5 Marks |
| Attendance | - | 5 Marks |
| | | 25 Marks |

**Pattern of question Paper (Theory)**

| | |
|---|---|
| Section – A | 10 x 2 = 20 Marks (No Choice) |
| Section – B | 5 x 5 = 25 Marks (Either or) |
| Section – C | 3 x 10 = 30 Marks (Any three out of 5) |
| Total | 75 Marks |

## Mark Allocation for Practical Papers

| | | |
|---|---|---|
| CIA | - | 40 Marks |
| External | - | 60 Marks |
| | | 100 Marks |

**PROGRAMME SPECIFIC OUTCOME**

**PSO-1:** Demonstrate fundamental knowledge of : the physical and chemical properties of the lithosphere and hydrosphere (minerals, rocks, soils and water); geological time and Earth history; and crustal materials and dynamics in the context of plate tectonics theory

**PSO-2:** Demonstrate skills in: mineral and rock soil identification; interpretation of topographic and geologic maps; and interpreting and evaluating geological data, hypothesis and ideas.

**PSO-3:** Gain an understanding of the social relevance of earth systems.

**PSO-4:** Effectively communicate this knowledge and these skills using written and/or oral methods.

## CORE COURSE I
## THE DYNAMIC EARTH

| | | | |
|---|---|---|---|
| **Internal** | **: 25** | **Semester** | **: I** |
| **External** | **: 75** | **No. Of hours/week** | **: 6** |
| **Exam Hours** | **: 3** | **Credit** | **: 6** |

**Course Objective:**

- Introduction of the geological process that are dynamically involved in the formation of the planet Earth.
- To study the evolution of solar system and age of the Earth.
- Describe the Earth's interior, including the structure and composition.
- Clearly describe plate tectonics in general term.
- To learn about the endogenic process like earthquake, volcanoes and orogenic activity.

**Unit I**

Definition of Geology – Branches of Geology – Applied Geology – Geology in the service of man. The Solar system :– The Planets– Meteorites – Asteroids – Satellites – Comets;Evolution of the Solar system – Nebular hypothesis – Planetesimal hypothesis – Tidal hypothesis – Von Weiszacker's hypothesis and Dust Cloud hypothesis. The age of the earth – sedimentation method - salinity method – Kelvin's rate of cooling method – Radiometric methods: Uranium-lead, Thorium – Lead and Potassium – Argon methods – A note on C14 methods.

**(Content-15hrs, Assesment-3hrs)(18hrs)**

**Unit II**

Earthquakes: Definition – causes and effects – Focus and Epicenter – Magnitude and Intensity – Properties and propagation of seismic waves – Seismograph and Seismogram – Distribution of Earthquakes –Prediction of Earthquakes – Tsunami - Earthquakes in India.Detailed study of the structure and composition of Earths interior.

**(Content-15hrs, Assesment-3hrs)(18hrs)**

**Unit III**

Volcanoes: Definition – Types - Phases – Solid, Liquids and Gaseous Products, Distribution – topographic forms. Causes of volcanism – Effects of Volcanic activity - Prediction of volcanoes. Mass movements – Definition – Classification –Slow movements: Soil creep, Rock creep and solifluction. Rapid movements: Earth flows, rock falls and landslides. Causes and remedial measures.

**(Content-15hrs, Assesment-3hrs)(18hrs)**

**Unit IV**

Distribution of continents and oceans –Characters of continents and Oceans – Continental margin – Ocean basin - Continental drift: Wegner and Taylor hypothesis - Sea floor spreading - Concept of plate tectonics – Different kinds of plate margins – Evidences in favor and against the concepts of Continental Drift and Plate Tectonics - Mid Oceanic Ridges - Submarine trenches and Transform faults.

**(Content-15hrs, Assesment-3hrs)(18hrs)**

**Unit V**

Mountains: Classification – Life cycle of mountains – Origin of mountains - Geosynclines - Stille's, Kay's, Strahler's and Schuchert's Classification of geosyncines – Characters and distribution of Geosynclines - Types of plateaus and plains. Isostasy Prat's and Airy's Hypothesis - Causes, effects and evidences of Sea level changes.

**(Content-15hrs, Assesment-3hrs)(18hrs)**

**Text Books:**


1. Radhakrishanan V., General Geology., V.V.P. Press,1996.
2. Mahapatra, G.B., A text book of Geology, CBS, Delhi, 2015.
3. Arthur Holmes, Principles of Physical Geology, Thomas Nelson & sons, London. 1993.
4. Philip G. Worcester A textbook of geomorphology, D. Van Nostrand co., London 1948.


**Reference Books:**


1. W. D. Thornbury, A text book of geomorphology, D. Van Nostrand co., London,2004.
2. A.L. Bloom, General Geology, V.V.P.Press, 1978.
3. L.D. Leet & Judson Physical Geology, Prentice Hall, India, 1958.


**Web resources:**

1. www.uj.ac.za/library/bindery
2. https:llen.wikisource.org/wiki/portal:geology

**Course outcomes:**

On completion of the course, students should be able to

- Gain a better understanding of the Planets, Moons and other objects of our solar system in addition to their distribution and dynamical relationships.
- Understanding the geological origins of especially important natural hazards including Earthquakes, Tsunami, Volcanic eruptions and Landslides.
- Understand platetectonics and its central role as the unifying theory of geology.
- Articulate the relationship between Volcanoes, Earthquakes, Mountain belts and Tectonic plate boundaries.
- Understand the nature of the ocean floor.

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## CORE PRACTICAL - I
## STRUCTURAL GEOLOGY AND SURVEYING

| | | | |
|---|---|---|---|
| **Internal** | **: 40** | **Semester** | **: I&II** |
| **External** | **: 60** | **No. of hours/week** | **: 6** |
| **Exam Hours** | **: 3** | **Credit** | **: 3** |

**Course Objectives:**

- To know about the Exercises to predict the trends of the outcrop of horizontal, vertical and inclined beds with respect to topography.
- Reading of solid fold and fault, maps construction and problems relating to true dip and apparent dip.
- To read the marginal informations of toposheets.
- To become familiar with geological signs and symbols.
- To learn the practical aspects of survey instruments.

**Structural Geology:** Contour maps and their interpretation. Exercises to predict trends of the outcrop of Horizontal, vertical anticline beds with respect to topography – reading of solid conformable maps – deciphering dip and strike of outcrops – construction of map with three points over a bedding plane are given construction of vertical sections-order of super position – 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 ages of structures and intrusions – narrate geological history – problems relating to true dip and apparent dip. Determination of vertical and true thickness by calculations.

Cartographic appreciation of Survey of India (SOI) Topographic sheets: Description of features in SOI's toposheet: Extramarginal, marginal, intramarginal information, major conventional signs and symbols, physical and socio-cultural features.

**SURVEYING:** Chain survey – prismatic compass survey – plane table survey – leveling. Clinometer Compass and Brunton Compass:-To find out dip and strike of the beds. GPS:- Fundamentals and applications.

**Course outcomes**:

On completion of the course students should be able to

- Read geologic maps and solve simple map problems using strike lines and cross sections for areas showing dipping strata, unconformities, faults and folds.
- Establish the basic structure, and the geological history, of a region from its geological maps.
- Survey of topographic features.
- Interpret the geologic structure from a geologic maps.
- Measure the attitude of beds in the field.

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## CORE COURSE – II
## STRUCTURAL GEOLOGY

| | | | |
|---|---|---|---|
| **Internal** | **: 25** | **Semester** | **: II** |
| **External** | **: 75** | **No. of hours/week** | **: 6** |
| **Exam Hours** | **: 3** | **Credit** | **: 6** |

**Course Objectives:**

- Understanding of the structure accommodate contractional and extensional deformation of the Earth's lithosphere.
- Describe the types of geological structures, how its form, how we can identify and describe them.
- To study the structure of igneous and sedimentary rocks.
- To recognise various geological structures in field.
- To know the preparation of geologic reports.

**Unit I**

Scope and aim of Structural Geology – Methods of representing physiographic features - Contours – Topographic and Geological maps, their preparation and uses. Physical properties of rocks: Deformation – brittleness, plastic and elastic properties. Beds and their attitudes – Dip and strike – Trends of outcrop – Rule of V of outcrops – Relation between true and apparent dips. Width of outcrops, True thickness, vertical thickness and their mutual relations.

**(Content-15hrs, Assesment-3hrs)(18hrs)**

**Unit II**

Primary and secondary structures – primary structures of extrusive and intrusive igneous rocks– primary structures of sedimentary rocks. Plutons – concordant and discordant plutons – dyke, sill, phacolith, lopolith, batholiths, ring dykes and cone sheets – brief study of salt domes.

**(Content-15hrs, Assesment-3hrs)(18hrs)**

**Unit III**

Folds – geometry and elements of folded surface – classification – descriptive study of different types of folds – recognition of folds in the field and on map. Unconformities – definition – types – significance – recognition in the field and on map – over lap and off lap; Inlier and Outlier.

**(Content-15hrs, Assesment-3hrs)(18hrs)**

**Unit IV**

Faults – definition – terminology – genetic and geometric classification and description – recognition of faults in the field and on the map – distinction between faults and unconformities – a short account of rift valleys. Joints – definition – geometric and genetic – classification – descriptive study – applications of joints.

**(Content-15hrs, Assesment-3hrs)(18hrs)**

**Unit V**

Foliation – Primary and secondary foliations; Cleavage and Schistosity – Types and Origin of Rock Cleavages. Lineation – Kinds and Origin of lineation; Mechanism and Uses of Clinometer and Brunton compass.Preparation of geological reports.

**(Content-15hrs, Assesment-3hrs)(18hrs)**

**Text Books:**


1. M.P. Billings, Structural Geology: Prentice Hall, Englewood Clifts, U.S.A,2017.
2. C.M. Novin, Principles of structural Geology John Willey, New York,1953.
3. De Sitter, Structural Geology, McGraw Hill, New York, 1956.
4. Gokhale, N.W., Theory of Structural Geology. CBS Publishers, 2013.


**Reference books:**


1. E.W. Spencer, An Introduction to structural Geology: Mc Graw, Hill, New York,1977.
2. Park, P.G.,Fundamentals of structural Geology, John Willey & sons, Canada, 1994.


**Web resources:**

1. http://www.uh.edul/jbutler/physical/physical .html.
2. www.geologyin.com.
3. www.geology.com.

**Course Outcomes:**

On completion of the course students should be able to

- Understand the concepts of stress and force, normal and shear stresses and hydrostatic stresses.
- Understand elastic and viscous strain in role behaviour, the effects of temperature, pressure and strain rate on rock strength and the mechanism of rock deformation.
- Know the classification of fold, joints and fault systems, the terminology used to describe them.
- Know the types of foliation and lineation, their origin, and their relationship to folding.
- Determining the same of fault movement from structures associated with faults.

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## CORE COURSE-III
## PHYSICAL GEOLOGY

| | | | |
|---|---|---|---|
| **Internal** | **: 25** | **Semester** | **: III** |
| **External** | **: 75** | **No. of hours/week** | **: 5** |
| **Exam Hours** | **: 3** | **Credit** | **: 6** |

**Course Objectives:**

- Understanding the physical and chemical properties of the lithosphere and atmosphere.
- To compare and contrast weathering among different rock types and different environments.
- To explain the various parts of hydrologic cycle including the interaction of surface and groundwater with the solid Earth.
- To describe and interpret surficial deposits and landforms.
- To understand the basic fundamentals of tsunami.

**Unit I**

Weathering of Rocks – Environment of weathering – weathering processes, chemical and mechanical weathering – Rates of weathering – kinds and products of weathering, soils – weather & climate – Role of weathering in Geologic cycle, Economic importance of weathering. Atmosphere – Its composition and zones. Movements of atmosphere – wind – Geological actions of wind- sand dunes and their types – loses – arid cycle of erosion – characteristics of deserts.

**(Content-12hrs, Assesment-3hrs)(15hrs)**

**Unit II**

Running water – source and surface flow – erosion, transportation and deposition – land reforms resulting from erosion and deposition – valley development – drainage patterns – fluvial cycle (youth maturity and old age) – interruptions to the normal cycle – stream rejuvenation – river capture.

**(Content-12hrs, Assesment-3hrs)(15hrs)**

**Unit III**

Underground water – sources – water table – zone of saturation – springs and wells – artesian wells – geysers – spring deposits – aquifer – geological work of ground water – solution – Karst topography – development of karst features – characteristics of Karst regions – origin of L.St. caverns – artesian belts of Tamilnadu.

**(Content-12hrs, Assesment-3hrs)(15hrs)**

**Unit IV**

Glaciers – origin and types of glaciers – movement of glaciers – transportation and deposition – glacio fluvial deposits – landforms produced by glaciers – short account of Ice ages. Lakes – classification – types of lakes – lake deposits.

**(Content-12hrs, Assesment-3hrs)(15hrs)**

**Unit V**

Seas and Oceans – waves, tides and currents– sea as a geological agent – classification of shore lines – shore line types – description of continental margin – continental – shelf –

continental slope – ocean basins – submarine canyons – sea mount , guyots, mid – oceanic ridges – ocean deposits – coral reef: their types and origin ; tsunamis – distribution and origin.

**(Content-12hrs, Assesment-3hrs)(15hrs)**

**Text Books:**


1. Philip G.Worcester : A text book of Geomorphology – D. Nostrandcomp Inc. New York.
2. Thornbury, W.D., (2004) Principles of Geomorphology. II edition. Wiley Eastern Ltd. New Delhi.


**Reference Books**


1. D.Leet & Shelton Judson: Physical Geology – prentice Hall, Internation Inc. Englewood, Cliff, U.S.A.
2. Arthur Holms : Principles physical Geology Thomos Nelson & sons, London
3. William J, Miller : An introduction to physical Geology, D. Van Nostrand Company, Inc New York
4. Radhakrishnan.V, 1996 : General Geology, VVP, Tuticorin.


**Web resources:**

1. http://www.uh.edul/jbutler/physical/physical .html.
2. www.geologyin.com.
3. www.geology.com.

**Course Outcomes:**

On completion of the course students should be able to

- Understand the concepts of weathering.
- Understand the process and features formed due to running water.
- Know the sources of groundwater and its features.
- Know the weathering process of glaciers and ice age.
- Determining the ocean features and tsunami.

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## CORE PRACTICAL-II
## PALAEONTOLOGY AND CRYSTALLOGRAPHY

**Internal : 40** | **Semester : III**
**External : 60** | **No. Of hours/week : 4**
**Exam Hours : 3**

**Course Objectives:**

- To identify the different types of fossils.
- To know the evolutionary period of fossils.
- To identify some of the morphological characteristics of fossils.
- To understand the crystal structure.
- To learn the twinning of crystals.

**Palaeontology**

Megascopic identification and description of the following fossils:- Corals: Calceola, Zaphrentis, Favosites, Halysites,; Brachiopoda: Spirifer, Productus, Terebratula, Rhynconella, Atrypa, Athyris, Orthis, Echinodermata: Pentrimites, Cidaris, Hemicidaris, Micraster, Holaster, Hemiaster, Stygmatophygus, Mollusca: Pelecypoda: - Arca, Cardium, Meretrix, Cardita, Pecten, Trigonia, Megaladon, Pholodomya, Gryphea, Exogyra, Ostrea, Inoceramus, Alectryonia. Gasteropoda:- Natica,Turbo, Trochus, Turritella, Cerethium, Conus, Voluta, Murex, Fusus, Physa, Bellerophon. Cephalopoda:- Nautilus, Goniatites, Ceratites, Acanthoceras, Scholenbachia, Perisphinctes, Hamites, Scaphites, Baculites, Turrilites and Belemnites, Arthropoda: Trilobita:- Paradoxides, Calymene, Phacops. Trinucleus, Graptolites: - Phyllograptus, Tetragraptus, Didymograptus, Diplograptus, Monograptus, Plant fossils:- Glossopteris, Gangamopteris, Ptillophyllum, Lepidodendron, Sigillaria and Calamites.

**Micro Fossils:**

Lagena, Nodosaria, Textularia, Operculina, Elphidium, Ammonia.

**Diagrams:**

Paradoxides, Pentremites, Trigonia, Arca, Meretrix, Murex, Turritella, Nautilus, Spirifer.

**Crystal Models:**

Identification and description of the following crystal models:

Galena, Garnet, Fluorite, Pyrite, Tetrahedrite, Boracite, Sphalerite, Cuprite, Zircon, Cassiterite, Rutile, Octahedrite, Apophyllite, Vesuvianite, Scheelite, Meonite, Wulfenite, Chalcopyrite, Beryl, Zincite, Apatite, Calcite, Haematite, Dolomite, Corundum, Tourmaline, Phenacite, Dioptase, Quartz, Olivine, Topaz, Barite, Andalusite, Cordierite, Sulphur, Staurolite, Hypersthene, Calamine, Struvite, Epsomite, Gypsum, Orthoclase, Augite, Hornblende, Epidote, Sphene, Axinite, Albite, Kyanite and Rhodonite.

**Simple Twin Models:**
Galena, Fluorite, Pyrite, Rutile, Calcite, Quartz, Staurolite, Gypsum, Augite, Orthoclase, Albite.

**Course Outcome:**

On completion of the course students should be able to

- Find, collect, prepare, study and exhibit fossils.
- Collect and analyze geologic materials in field.
- Determine the environment of the earth during the geologic past.
- Interpret the miller indices of crystals.
- Recognize crystallographic panes and directions.

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**NON MAJOR ELECTIVE –I**
**FUNDAMENTALS OF GEOLOGY**

| | | | |
|---|---|---|---|
| **Internal** | **: 25** | **Semester** | **: III** |
| **External** | **: 75** | **No. of Hours/Week** | **: 2** |
| **Exam Hours** | **: 3** | **Credit** | **: 2** |

**Course Objective:**

- To study the evolution of solar system and age of the Earth.
- To learn about the endogenic process like earthquake, volcanoes and orogenic activity.
- Clearly describe plate tectonics in general term.
- To compare and contrast weathering among different rock types and different environments.
- To explain the various parts of hydrologic cycle including the interaction of surface and groundwater with the solid Earth.

**Unit I**

Definition of Geology — Branches of Geology – Geology in the service of Man. The Solar system: – The Planets – Meteorites – Asteroids – Satellites – Comets; Evolution of the Solar system –Nebular hypothesis – Planetesimal hypothesis – Structure and composition of Earth's interior.

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**Unit II**

Earthquakes: Definition – causes and effects – Focus and Epicenter – Magnitude and Intensity –Prediction of Earthquakes – Tsunami - Earthquakes in India. Volcanoes: Definition - Types –Causes of volcanism – Effects of Volcanic activity - Prediction of volcanoes.

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**Unit III**

Mass movements – Definition – Classification –Causes and remedial measures. Concept of plate tectonics – Different kinds of plate margins – Evidences in favor and against the concepts of Continental Drift and Plate Tectonics.

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**Unit IV**

Weathering of Rocks –weathering processes chemical and mechanical weathering- Economic importance of weathering. Atmosphere – Its composition and zones. Wind – Geological actions of wind- sand dunes and their types.

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**Unit V**

Running water –erosion, transportation and deposition – brief study of land forms resulting from erosion and deposition. Underground water – sources – water table – zones of groundwater – springs and wells – artesian wells – geysers– aquifer. Glaciers – origin and types of glaciers. Seas and Oceans – waves, tides and currents– sea as a geological agent.

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**Text Books:**

1. Arthur Holmes Principles of physical Geology: Thomas Nelson & sons London.
2. Radhakrishanan. V . General Geology - V.V.P. Press.

**Reference Books:**

1. William J. Miller Principles of physical Geology : Thomas Nelson & sons , London.
2. W. D. Thornbury A text book of geomorphology : D. Van Nostrand co., London.
3. A.L. Bloom General Geology V.V.P. Press.
4. L.D. Leet & Judson Physical Geology : Prentice Hall, India.

**Web resources:**

1. www.uj.ac.za/library/bindery
2. https:llen.wikisource.org/wiki/portal:geology
3. http://www.uh.edul/jbutler/physical/physical .html.

**Course outcomes:**

On completion of the course, students should be able to

- Gain a better understanding of the Planets, Moons and other objects of our solar system in addition to their distribution and dynamical relationships.
- Understanding the geological origins of especially important natural hazards including Earthquakes, Tsunami, Volcanic eruptions and Landslides.
- Understand plate tectonics and its central role as the unifying theory of geology.
- Understand the concepts of weathering.
- Know the sources of groundwater and its features.

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## CORE COURSE-IV
## PALAEONTOLOGY AND CRYSTALLOGRAPHY

| | | | |
|---|---|---|---|
| **Internal** | **: 25** | **Semester** | **: IV** |
| **External** | **: 75** | **No. of Hours/Week** | **: 5** |
| **Exam Hours** | **: 3** | **Credit** | **: 5** |

**Course Objectives:**

- Understanding the age of the earth through the study of fossils.
- To compare the evolution of life through geologic times.
- To understand the paleoclimate and paleoenvironment conditions.
- To describe the morphology of crystals.
- To understand the basic fundamentals of different types of crystal system.

**Unit I**

Definition of Palaeontology - Definition of fossils – nature and modes of preservation of fossils: Body fossils and trace fossils; Body fossils - Petrifaction, permineralisation, carbonisation, recrystallisation, silicification; trace fossils- mould, casts, tracks , trails, borings. Uses of fossils in – stratigraphy – palaeoclimate - palaeogeography – palaeolife - evolution and migration of life forms – economic geology. Life through ages. Phylum Arthropoda:- Class – Trilobita- General morphology - classification – geological history and stratigraphic importance. Subphylum Hemichordata – class Graptozoa: order Graptoloidea – general morphology, classification, geological history and stratigraphic importance.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit II**

Phylum Coelentrata – class Anthozoa - classification –- tabulate corals – Rugose corals. General morphology geological distribution – stratigraphic importance. Phylum Mollusca: Class Pelecypoda - General characters - dentition, classification and geological history. Class Gasteropoda:- General morphology, shell forms – types of coiling – dextral and sinistral, perforate and imperforate-classification and geological history. Class Cephalopoda:- General morphology, suture line pattern, classification, geological history. Morphology of a Belemnite.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit III**

Phylum Brachiopoda:- General morphology – brachial skeleton, classification, geological history. Phylum Echinodermata: Class Echinoidea: General morphology– regular and irregular echinoids, classification – geologicial history. Class Crinoidea:- General morphology and geological history. Class Blastoidea: General morphology and geological history. Phylum protozoa – Order: Foraminifera: General morphology – dimorphism – classification and stratigraphic importance. A brief account of the following plant fossils: - Glossopteris, Gangamopteris , Ptilophyllum , Calamites , Lepididendron and Sigillaria.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit IV**

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 and Miller 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. Study of the symmetry elements, and forms of the Normal, pyritohedral , tetrahedral and plagiohedral classes of cubic system. Study of symmetry elements and forms of Normal, Hemimorphic, Sphenoidal and Trapezphedral classes of Tetragonal system.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit V**

Study of the symmetry elements and forms of Normal, Hemimorphic Trapezohedral, Rhombohedral , Rhombohedral Hemimorphic classes of Hexagonal system. Study of the symmetry elements and forms of the Normal , Hemimorphic and Sphenoidal classes of Orthorhombic system. Study of the symmetry elements and forms of the Normal classes of the Monoclinic and Triclinic systems. Twin crystals – Definitions – simple and repeated (polysynthetic twins), contact and penetration twins: secondary twins.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Text Books:**

1. Jain, P.C., and Anatharaman, M.S., An introduction to Paleontology, Vishal Publications.
2. Dana, F.S.(1955) : A text book of mineralogy - Asia Publishing House - Willey.

**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 , Harper brothers
3. Shrock. R.R. and Twenhofel , W.H – 1953 : Principles of invertebrate Palaeontology, Amold publication
4. Phillips, W.R. Optical Minerlogy,Griffen, D.T.1986.
5. Walhstrom, E.F.1960 - Optical crystallography – John wiley.

**Course outcomes:**

On completion of the course, students should be able to

- Demonstrate their understanding of how life has evolved through geologic time.
- Identify and explain the morphological characters of fossils.
- Explain the evolutionary trends of fossils.
- Understand the concepts origin of crystal.
- Know the forms and faces of crystals.

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## SKILL BASED ELECTIVE –I
## CLIMATOLOGY

| | | | |
|---|---|---|---|
| **Internal** | **: 25** | **Semester** | **: IV** |
| **External** | **: 75** | **No. of Hours/Week** | **: 2** |
| **Exam Hours** | **: 3** | **Credit** | **: 2** |

**Course Objectives:**

- Understanding the way in which the climate affects our everyday lives.
- To know what the monsoons are and what causes them.
- To understand the properties of air masses and fronts.
- To describe how tornadoes arise.
- To designate any climate station under Koppen's and Thornthwaite climatic scheme.

**Unit I**

Nature and scope of climatology: elements of weather and climate -composition and structure of the atmosphere – Insolation – heat budget – horizontal – vertical and seasonal distribution of temperature.

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**Unit II**

Atmospheric pressure: vertical and horizontal distribution of pressure - Wind: planetary, seasonal – monsoon – local winds - Atmospheric circulation – general and tri cellular model.

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**Unit III**

Humidity, - cloud – fog – precipitation: forms and types - evaporation – condensation hydrological cycle – air masses: types - fronts: classification and properties.

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**Unit IV**

Atmospheric disturbances: tropical and temperate cyclones – Anti cyclone - thunderstorms – tornadoes.

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**UNIT V**

Climatic classification: Koppen's and Thornthwaite - Atmospheric pollution - global warming –sea level rise – ozone depletion.

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**Text Books:**

1.McIlveen, J.R., 1986. Basic meteorology: a physical outline. Wokingham: Van Nostrand Reinhold.

2. Bonan, G., 2015. *Ecological climatology: concepts and applications*. Cambridge University Press.

**Reference Books**


1. D.S. Lal (1998) -Climatology, Chaitanya Publishing House, Allahabad.
2. Critchfield.H (1969) General –Climatology, Prentice Hall of India Pvt, Ltd, New Delhi.
3. Keith Smith (1988). Applied Climatology, McGraw Hill, New York.
4. Das Gupta, A &Kapoor, A.N. (2001) Principles of Physical Geography,
5. S.C.Chand & Company Ltd. New Delhi.Strahler, A. H. &Strahler, A N. (2001) Modern Physical Geography (4/E), John Wiley and Sons, Inc., New York.


**Course outcomes:**

On completion of the course, students should be able to

- Demonstrate their understanding about Earth's present atmosphere evolved over time.
- Explain the causes of season.
- Explain the different clouds and how cloudiness varies from pole to pole.
- Understand the concepts of major cyclones.
- Recognize how mankind is enhancing Global warming.

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**NON MAJOR ELECTIVE –II**

**INTRODUCTION TO MINERALS, ROCKS AND FOSSILS**

| | | | |
|---|---|---|---|
| **Internal** | **: 25** | **Semester** | **: IV** |
| **External** | **: 75** | **No. of Hours/Week** | **: 2** |
| **Exam Hours** | **: 3** | **Credit** | **: 2** |

**Course Objectives:**

- Understanding the physical properties of minerals.
- To describe the origin and uses of minerals .
- To study the igneous structures and rocks.
- To describe the properties of sedimentary and metamorphic rocks.
- To understand the paleoclimate through fossils.

**Unit I**

Definitions of Mineral, Mineraloid, Ore and Gangue. Brief study of Physical Properties of Minerals; Nature, Streak, Cleavage, Hardness, Luster and fracture Description of physical properties and chemical composition (a) Quartz group (Rock crystal, Amethyst,) (b) Feldspars (Orthoclase, Labradorite) (c) Pyroxenes (Hypersthene, Augite) and (d) Amphiboles (Anthophyllite, Hornblende).

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**Unit II**

Physical properties, Chemical composition, origin and uses of; Iron ores (Magnetite, Hematite), Placers (Garnet), Copper ores (Chalcopyrite). Calcite, Graphite, Asbestos, Talc, and Bauxite. Introductory knowledge about properties, origin and uses of Lignite of Neyveli.

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

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**Unit III**

Brief study of common characters of igneous rocks. Igneous structures - Dyke, Sill and Batholith. Descriptive study of structure, texture, mineralogy and origin of; 1. Granite 2. Gabbro 3. Basalt 4. Anorthosite .

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**Unit IV**

Common properties of sedimentary rocks. Simple classification of sedimentary rocks – Mechanical, Chemical, Organical and Residual. Description of texture, mineralogy and origin of (a) Conglomerate (b) sandstone (c) Shale. General characters of metamorphic rocks. Agents and kinds of metamorphism. Brief study of slate, schist and gneiss.

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**UNIT V**

Definition of Palaeontology —. Definition of fossils – Types of preservation of fossils. Uses of fossils. Megascopic identification and description of the following fossils:-

Brachiopoda: Productus, Terebratula; Pelecypoda: Arca, Pectan; Gasteropoda: Turbo, Physa; Cephalopoda: Goniatites, Ceratites.

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**Text Books:**

1. Dana, F.S. 1955 - A text book of mineralogy – Asia publishing House, Wiley.
2. Tyrrel, G.W. 1978 - The principles of petrology – Chapman and Hall Ltd., London.
3. Mahapatra, G.B. - A text book of Geology, CBS, Delhi

**Reference book**

1. Raup, D.M. and Stanely, M.S. Principles of Palaeontology, CBS Publishers.
2. Berry , Mason, Dietrich,2000 - Mineralogy, CBS Publication
3. Cornelis Klen and Cornelius S. Hurlbut , 1985 – Manual of Minerology, John wiley & Sons
4. Turner,F,J &Verhogen,J -Igneous and Metamorphic Petrology, MC Graw Hill

**Course outcomes:**

On completion of the course, students should be able to

- Demonstrate the difference between minerals and ore minerals.
- Explain the formation of placers and other minerals.
- Explain the origin of igneous rocks and structures.
- Understand the origin of sedimentary and metamorphic rocks.
- Identify few fossils and explain their morphological characteristics.

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## CORE COURSE-V
## STRATIGRAPHY

| | | | |
|---|---|---|---|
| **Internal** | **: 25** | **Semester** | **: V** |
| **External** | **: 75** | **No. of Hours/Week** | **: 5** |
| **Exam Hours** | **: 3** | **Credit** | **: 5** |

**Course Objectives**

- To learn about the geological time scale, principles of stratigraphy and the description of strata and their relationship to tectonics, climate, fossils along with their distribution in different parts of India from Precambrian to recent.
- To study the geological and applications of stratigraphy.
- To realize the different geological epoch formation.
- To collect stratigraphic data in the field.
- To synthesize geological and biological information to interpret local and regional geologic history.

**Unit I**

**Principles of Stratigraphy:** Law of order of superposition. law of uniformitarianism and law of faunal succession. Correlation: fossiliferous and unfossiliferous rocks. Standard stratigraphic scale and Indian Geologic Time scale. Imperfections in Geological record. Geological divisions. Stratigraphic classification and Nomenclature. Stratigraphic Units: Lithostratigraphic unit, Biostratigraphic unit , Geochronologic Unit. Homotaxis. Physiographic divisions of India: Peninsular India, Indogangetic alluvial plains, Extra Peninsular India.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit II**

**Precambrian Stratigraphy:** Archaeans of Dharwar Province, Archaeans of Eastern Ghat - The Sausar and Sakoli Group, Archaeans of Singhbhum – Iron Ore Group and Gangpur Group. Archaeans of Tamilnadu, Mineral Wealth of Archaeans of India, The Eparchaean Unconformity, Stratigraphy and Mineral Wealth of Cuddapahs, Stratigraphy and Mineral Wealth of Vindhyans, Kurnool group, Life during Precambrian.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit III**

**Paleozoic Stratigraphy:** Distribution of Paleozoic rocks in India, Cambrian of Salt Range, Age of Saline Series, Upper Carboniferous and Permian rocks of Salt Range, Paleozoic rocks of Kashmir Valley, Paleozoic rocks of Spiti Valley, Paleozoic rocks of Peninsular India.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit IV**

**Mesozoic Stratigraphy:** The Depositional Environment-distribution-life-classification and economic importance of Gondwana formations of India, Coastal Gondwana of India, Gondwana formations of Tamilnadu, Triassic of Spiti – The Lilang System, Jurassic of Kutch, Cretaceous of Tiruchirapalli – Pondicherry – Bagh Beds, Deccan traps :

distribution , structure , Lameta beds – infratrapean and intertrappean beds, age of the Deccan traps.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit V**

**Cenozoic Stratigraphy:** Comprehensive account of the geological events took place during Cenozoic era in India, rise of Himalayas, stratigraphy of Siwalik Super Group, fauna and flora of Siwaliks, Tertiary rocks of Assam, Karewa formation, Tertiary rocks of Tamilnadu, Tertiary rocks of Kerala, Pleistocene Glaciation - Mineral wealth of Tertiary rocks of India.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Textbooks:**

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. 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 mathuen.

**Course Outcome:**

- It focus specifically on settings and time periods that the students will encounter on our field trips, emphasizing the combined use of sedimentological characteristics and fossil content
- Student would understand the Indian Stratigraphy and its age related problems.
- Utilizes both forward reasoning and inverse reasoning to construct one or more hypotheses for the paleogeographic and environmental histories that produced a series of strata.
- The course then adds larger geological principles to the foundation stratigraphy, effects of sedimentary processes and sedimentation rates on interpretation of evolution in the fossil record.

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## CORE COURSE-VI
## MINEROLOGY

| | | | |
|---|---|---|---|
| **Internal** | **: 25** | **Semester** | **: V** |
| **External** | **: 75** | **No. of Hours/Week** | **: 5** |
| **Exam Hours** | **: 3** | **Credit** | **: 5** |

**Course objectives:**

- The first unit deals with the introduction to the rock forming minerals and other concepts related to mineralogy.
- The second unit deals with the physical, chemical, and optical properties of common rock-forming minerals.
- Recognize that minerals are chemical compounds made up of atoms linked together by a variety of chemical bond types
- Systematic mineralogy of common rock-forming minerals.

**Unit I**

**Descriptive mineralogy:** Definition of Mineral and Mineraloid – Scope and aim of Mineralogy. Chemical elements and periodic Table - Bonding of atoms – Metallic, Co-valent, Ionic and Van der Walls Bonding in Minerals, Structure and classification of silicates. Isomorphism, Polymorphism and Pseudomorphism in minerals. Physical properties of minerals depending upon cohesion and elasticity, specific gravity, light, heat, electricity, magnetism and the senses.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit II**

Mineralogy, Structure, Chemistry, Optical and Physical properties, Modes of occurrences and industrial uses of the following groups of minerals: Polymorph and varieties of Quartz –Alkali and Plagioclase group of Feldspars – Nepheline and Sodalite group of Feldspathoides - and Zeolites.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit III**

Mineralogy, Structure, Chemistry, Optical and Physical properties, Modes of occurrences and industrial uses of the following groups of minerals: Pyroxenes, Amphiboles, Micas, Olivine and Garnet.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit IV**

**Optical mineralogy:** Nature of light – Ordinary and polarized light – Refraction and reflection. Refractive index, Critical angle and Total internal reflection. Double refraction - Plane polarization by Reflection, Brewster's law - Plane polarization by Refraction, Nicol Prism - Plane polarization by absorption, Polaroid. Petrological microscope and its parts – Optical accessories, their construction and uses – Quartz wedge (Determination of order of Interference Colour), – Gypsum plate and Mica plate (Determination of Fast and Slow vibration directions), and Bereck Compensator (Determination of Birefringence)

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit V**

Optical classification of minerals. Optical properties of isotropic and anisotropic minerals observed under parallel and crossed Nicols. Differences between Isotropic and anisotropic minerals. Definition of extinction, Types of extinction, Extinction angles and their determination, and uses – Characters of Uniaxial and biaxial minerals – Optics axis and optic axial angle – Acute and Obtuse Bisectrix – Optic sign of Uniaxial and Biaxial minerals – Uniaxial and Biaxial Indicatrix - Sign of elongation - Optical anomalies.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Text Books:**


1. Dana, F.S. 1955 – A text book of mineralogy – Asia publishing House, Wiley.
2. Read, H.H- 1974, - Rutley's elements of mineralogy – Thomas murby & co.
3. Mason ., B and Berry, L.G - Elements of Mineralogy – W.H. Freeman & Co.
4. Kerr.P.F : Optical Mineralogy.


**Reference Books:**


1. Deer. W.A.,Howoe. R.A and Zuessman, J. -1966 .An introduction of the Rock forming minerals . Longmans.
2. Berry , Mason, Dietrich,2000 - Mineralogy, CBS Publication
3. Cornelis Klen and Cornelius S. Hurlbut , 1985 – Manual of Minerology, John wiley & Sons
4. Phillips, W.R. Optical Minerlogy,Griffen, D.T.1986.
5. Winchel, A.n. 1968 Elements of optical mineralogy, part 1 & 2 wiley Eastern


**Course Outcome:**

- Student thoroughly understands the various crystal structures and megascopic and optical characters of various minerals.
- Understand the basic crystal-chemical properties of minerals and how variability in these properties relates to physical and optical characteristics as well as the formation and stability of minerals in igneous, metamorphic, and sedimentary environments.
- Recognize and quantify the physical and optical properties of minerals.
- Microscopic thin section study and identity characterize common rock-forming minerals.
- Extract information about the conditions of formation and subsequent history of a mineral from its properties and its presence in a rock.

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## CORE PRACTICAL-III
## MINEROLOGY AND APPLIED GEOLOGY

| | | | |
|---|---|---|---|
| **Internal** | **: 40** | **Semester** | **: V** |
| **External** | **: 60** | **No. of Hours/Week** | **: 4** |
| **Exam Hours** | **: 3** | **Credit** | **: 3** |

**Course Objectives:**

- To learn the Megascopic and Microscopic identification of Quartz, Feldspar, Feldspathoid, Pyroxene, Amphibole groups.
- Describe the characteristic physical properties that we use to identify minerals, including crystal shape, color, luster, and hardness.
- To discuss the cite examples of the important properties and characteristics of the silicate nonsilicate rock-forming minerals.
- To interpret the hydrogeological data
- To solve the calculation of ore reserves.

**MEGASCOPIC MINERALOGY:**

Megascopic identification and description of the following: Quartz, Rosy quartz, Amethyst, Chalcedony, Agate, Flint, Jasper, Chert, Opal, Orthoclase, Microcline, Albite, Oligoclase, Labradorite, Nepheline, Leucite, Sodalite, Enstatite, Bronzite, Hypersthene, Diopside, Augite, Spodumene, Acmite, Rhodonite, Wolastonite, Anthopillite, Tremolite, Actinolite, Hornblende, Glaucophane, Olivine, Serpentine, Muscovite, Biotite, Vermiculite, Chlorite, Epidote, Garnet, Olivine, Natrolite, Stilbite, Apophyllite, Talc, Steatite, Andalusite, Kyanite, Sillimanite, Staurolite, Cordierite, Apatite, Beryl, Topaz, Calcite, Dolomite, Tourmaline, Zircon, Fluorite.

**MICROSCOPIC MINERALOGY:-**

Microscopic identification and Description of the following:- Quartz, Orthoclase, Microcline, Albite, Oligoclase, Labradorite, Nepheline, Leucite, Enstatite, Hypersthene, Glaucophane, Biotite, Muscovite, Olivine, Epidote, Garnet, Apatite, Zircon, Sphene, Tourmaline, Calcite, Andalusite, Kyanite, Sillimanite, Staurolite, and Cordierite

**APPLIED GEOLOGY:-**

Interpretation of maps – Calculation of ore reserves – Included area method. Simple problems relating to interpretation of hydrogeological data.

**BLOW PIPE:-**

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 Worlframite.

**Course outcome:**

- Students can able to describe several common mineral crystal habits
- Students will be trained in how to investigate the nature of things through observation and using their senses.
- Compare samples of various kinds of rock, and identify similarities and differences
- Describe some common uses of rocks and minerals
- Student thoroughly understands the various crystal structures and megascopic and optical characters of various minerals.

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## MAJOR BASED ELECTIVE-III
## ENVIRONMENTAL GEOLOGY AND HYDROGEOLOGY

| | | | |
|---|---|---|---|
| **Internal** | **: 25** | **Semester** | **: V** |
| **External** | **: 75** | **No. of Hours/Week** | **: 5** |
| **Exam Hours** | **: 3** | **Credit** | **: 5** |

**Course Objectives:**

- To study the environmental problems and hazards.
- Understanding the Components of the hydrologic cycle
- To estimate aquifer properties and well design
- To study on ground water exploration
- Derivation ground water chemistry and quality
- Application of ground water problem

**Unit I**

**Environmental geology**: Definition of ecology and environmental Geology. Different ecosystems. Classification of Natural resources. A short account of renewable and nonrenewable resources. Environmental problems due to surface geological processes. Causes, hazards and remedial measures relating to landslides, floods, and soil erosion, Impact of wind on environment. Degradation of coastal environment and measures for coastal protection.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit II**

Influence of deep seated geological processes – Earthquake hazards, Earthquake prediction control and warning; Reservoir – induces seismicity – hazards of volcanism; Techniques of volcanic prediction and human adjustments to volcanic environments. Benefits of volcanism. Man as an agent of environmental modifications. Environmental degradation due to mining and mineral processing. – Effects of urbanization on surface water, causes for ground water pollution. Population explosion and their pressure on geological environments.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit III**

**Hydrogeology :** Ground water in Hydrologic cycle – origin of ground water meteoric water, connate water and Juvenile water – vertical distribution of ground water – zone of aeration, zone of saturation and water table. Springs – geological conditions favouring development of springs. Definition of aquifers, aquitards and aquicludes. Geologic formations as Aquifers. Types of Aquifers – unconfined, confined, and perched Aquifers – Artesian wells, peizometric surface.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit IV**

Rock properties affecting Ground Water, openings in rocks. types of openings – primary openings – secondary openings. Porosity, specific yield, specific retention and permeability. Ground water movement - forces causing ground water movement:

seepage, capillary movement, laminar flow, turbulent flow, Darcy's law co-efficient of permeability and field measurement of permeability. Fluctuations in Ground water levels – causes of fluctuations.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit V**

Ground water quality – physical, Bacterial, and chemical qualities – drinking water standards – major ions affecting chemical quality of ground water. Ground water recharge – natural and artificial recharge. Ground water exploration – surface methods – electrical resistivity method. Water wells – types of wells – well construction and development – collector wells and infiltration galleries. Ground water in Tamilnadu.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Text Books:**


1. Tolman., G.F. 1937 Ground water McGraw Hill. New York.
2. Todd, D.K. 1959 Ground water Hydrology. John wiley & Sons.
3. Davis, S.N. & Deweist. 1966 Hydrogeology , John Wiley & Sons.
4. Regunath, H.M. 1983 Ground water, Wiley Eastern.
5. Valdiya, K.S (1987). Environmental Geology – Indian Context. Tata McGraw-Hill., New Delhi
6. Kellar, E.A. 1979 Environmental Geology, Charless. Merrill publishing Co. ohio.
7. Lundgren, l. 1986 Environmental Geology , Prentice Hall.


**Reference Books**


1. Walton, W.C. 1970 Ground water Resources evaluation, McGraw Hill.
2. Karanath, K.R. 1987 Ground water Assessment Development & management Tata McGraw Hill.
3. Howard, A.D. & Ramson. I.1978, Geology in environmental planning. McGraw Hill, New Delhi


**Course outcome:**

- Student would understand the hydrodynamics, quality of groundwater, groundwater exploration and groundwater conservation
- Understand the components of hydrologic cycle.
- Understand measurement of ground water exploration techniques
- Understand the various artificial recharge techniques
- Understand the quality of groundwater

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## MAJOR BASED ELACTIVE-II
## REMOTE SENSING AND MINING GEOLOGY

| | | | |
|---|---|---|---|
| **Internal** | **: 25** | **Semester** | **: V** |
| **External** | **: 75** | **No. of Hours/Week** | **: 5** |
| **Exam Hours** | **: 3** | **Credit** | **: 5** |

**Course objectives:**

- The paper deals about the basics of remote sensing and image processing.
- Attain a foundational knowledge and comprehension of the physical, computational, and perceptual basis for remote sensing.
- Gain familiarity with a variety of earth science applications of remote sensing.
- To study the sensor characteristics, satellite orbits and various current and future missions involving a range of sensors across the visible, radar and microwave components of the spectrum
- To study the surface and underground mining methods

**Unit I**

Introduction to Remote Sensing: Definition of Remote sensing - processes and elements involved in electromagnetic remote sensing of earth resources – Electromagnetic spectrum and its components – Atmospheric windows – Energy interaction in the atmosphere – Energy interactions with earth surface features – Spectral reflectance curves of water, vegetation and soil – Data acquisition and interpretation. An outline of remote sensing applications.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit II**

Photogeology: Types of aerial photographs – Scale in aerial photographs and causes for its variation – Flight planning procedures – Mosaic and its types – Stereoscopy and stereoscopes – Outline of vertical exaggeration and parallax – Principles of photo interpretation – Annotation of aerial photographs.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit III**

Satellite Remote Sensing: Types of satellites – Scanning systems and detectors – Sensor resolutions: spatial, spectral, radiometric and temporal; Sensor characteristics of Landsat, Spot and IRS and high resolution satellites; Satellite image interpretation: visual and digital interpretation techniques and an outline of digital image processing techniques.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit IV**

Role of geology in mining industries – definition of mining terms, shaft, Hanging wall, Adit, roof, Drive crosscut, Tunnel, Raise, Winze, Stope – Types; Surface methods of mining, Alluvial mining – pan & betea, sluicing, Hydraulicking, Dredging. opencast mining. Benches, Explosives, working slope , mining equipments – Dragline, power showels.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit V**

Subsurface mining :- (underground mining )- advantages and limitations. Stoping – open stopes, supported stopes, pillar supported stopes – square supported stoping – timber supported stopes- filled stopes – shrinkage stopes – shaft sinking. Caving; Top slicing. Sublevel caving and Block caving. Coal mining (surface mining) Strip mining and Augering. Underground mining. Room and pillar method – Longwall method-hydraulicking. Mineral Economics and its concept. Role of Minerals in National Economy. Problems peculiar to Mineral Industruy, strategic, critical and Essential Minerals. Mineral conservation and substitution.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Text Books:**


1. Lillesand, T.M and R.W. Kiefer (2000). Remote sensing and image interpretation. John Wiley & Sons, New York
2. Sabins, F.F (1987). Remote sensing principles and interpretation. Freeman Publishers, New York
3. Miller, V.C (1961). Photogeology. McGraw-Hill Publishers, New York
4. Allum, J.A.E (1978). Photogeology and regional mapping, Pergamon Press Ltd., Oxford
5. Siegal, B.S and R. Gillespie (1980). Remote sensing in Geology, John Wiley & Sons, New York
6. Pandey, S.N (1987). Principles and applications of photogeology. Wiley Eastern Ltd., New Delhi
7. Burrough, P.A.(1986)- Principles of Geographical information system for land resource assessment.
8. Arogyaswamy, R.N.P. Courses in Mining Geology – Oxford &IBH, New Delhi.
9. Thamus, P.J. 1979 An introduction to mining, Methun.
10. Mc Kinstry, H.E 1960 Mining Geology, New york.


**Reference Books:**


1. Anji Reddy, M (2001). Textbook of remote sensing and GIS, BSP PS Publications, New Delhi
2. Rampal, K.K (1999). Handbook of aerial photography and interpretation. Concept Publishers Company, New Delhi
3. Narayan, L.R.A (1999). Remote sensing and its application. Universities Press Ltd., Hyderabad.

**Course Outcome:**

- Students will be able to recognize and explain at basic level fundamental physical principles of remote sensing, including the electromagnetic spectrum; the emission, scattering, reflection, and absorption of electromagnetic (EMR) radiation
- Student would understand the remote sensing , image processing and application of Geographic Information system.
- Students will be able to recognize and explain basic computational properties of remote sensing data acquisition, storage, and image processing.
- Students will be able to discuss the surface and subsurface mining methods.

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**SKILL BASED ELECTIVE –II**
**WATER QUALITY ANALYSIS**

| | | | |
|---|---|---|---|
| **Internal** | **: 25** | **Semester** | **: V** |
| **External** | **: 75** | **No. of Hours/Week** | **: 2** |
| **Exam Hours** | **: 3** | **Credit** | **: 2** |

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**Course Objectives:**

- To study the physical properties of minerals
- To study the pH and their measurements
- To make the students understand the water pollution
- To understand the Reverse Osmasis system
- To gain knowledge on water borne diseases

**Unit I**

Physical properties of water: Colour,odour,taste,temperature,turbidity and viscosity.Methods of analysis of physical properties. World Health Organisation (WHO) and Bureau of Indian Standards (BSI).

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**Unit II**

Chemical properties of water:pH-alkalinity,acidity and their measurements,ionization potential,gas soloubility,precipitation and dissolution of ions,equivalent weight and its measurements,colloids and cogulation,insoluble components and their measurements.

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**Unit III**

Laboratory methods of Analysis: standard solutions-determination of Ph-Hardness-Dissolved oxygen-BOD-COD,TDS-TSS. Determination of F,Cl,N,P,K,Na,Ca,Mg, Fe,$CaCo_3$,$HCO_3$ & Trace Metals.

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**Unit IV**

Utility of standards required for potable, Agricultural and Industrial purposes.Tools used for assessing the quality of water.

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**UNIT V**

Water pollution: Urban, Industrial pollution and remedial measures. Arsenic and Fluoride content in water. Recycling of water, water borne diseases, Reverse Osmasis (RO) system and Desalination of water.

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**Reference Books**


1. Davis,N.S.,DeWeist,R.J.M.(1996)Hydrogeology,John Wiley,New York.
2. Todd,D.K.,(2002) Grond Water 3rd edition,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,3rd edition,McGraw Hill,New York.
5. APHA(1980) Standard Methods for the Examination of Water and Waste Water,15 th edition, American Water Association and Pollution Control Federation,New York.


**Course outcome:**

- Students able to discuss the water quality parameters
- Understand the laboratory techniques
- To discuss the water related diseases and remedial measures.
- Describe the Fluoride and Arsenic in groundwater
- Students able to discuss the various drinking water standards

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## SKILL BASED ELECTIVE -III
## GEOSTATISTICS AND COMPUTER APPLICATION

| | | | |
|---|---|---|---|
| **Internal** | **: 25** | **Semester** | **: VI** |
| **External** | **: 75** | **No. of Hours/Week** | **: 2** |
| **Exam Hours** | **: 3** | **Credit** | **: 2** |

**Course Objectives:**

- Understanding the mathematical and statistical principles of numerical data.
- To determine whether the correlation and regression is significant .
- To learn and practice basic keyboarding and mouse use and search engines, and locate www addresses.
- To demonstrate an understanding of computer programming language concepts.
- To gain a basic, practical understanding of GIS and GPS concepts, techniques and real world applications.

**Unit I**

Numerical data in geoscience. Frequency distribution: Mean median, mode, dispersion. Measures of Dispersion Skewness and Kurtosis,addition,multiplation and division.

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**Unit II**

Sampling and sampling plan in Geoscience: Sample Random Sampling Systamatic and stratified and Cluster sampling: Standard errors.Correlation and Regression Analysis in Geoscience.

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**Unit III**

Introduction to Computer-Elements of computer: Hardware and Software. Input devices-keyboard,mouse.Output devices-Monitor,Printer.Memory:primary-RA,RAM. Secondary Memory-Hard Disk,Floppy & CD.

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**Unit IV**

A short accont on: Algorithm-Flow charts, Programming languages.Computer applications in geology: Flow chart for simple programmes-Geological aspects in window.

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**Unit V**

Basic principles of GIS. Elements, concepts and Usefulness of GIS, components of GIS. Data source, spatial data, Raster and vector data- Data analysis and application.Global Positioning System.

**(Content – 3 Hrs. Assessment – 2 Hrs.) (5 Hrs.)**

**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 analysis in Geology,Jhon wiley&sons.
4. Gupta G.V.,(1995)Basic Statistics, Chand.5.Ravichandran,D.,(2001)Introduction communication, Tata McGraw Hill Publication Ltd.,


**Reference Books:**


1. D.F .Merriam (1989),Edited Stastical Analysis: A computer Oriented Aproach,Computer Application in the Earth Sciences, A.A.Affi.an international Symposium Pienum Press, New York.
2. Robert L.Miller(1982), Statistical analysis in the Geological Sciences, JohnWiley and Sons,New York.
3. Palk.S.K(1998)Statistics for Geoscientists: Techniques and applications.
4. Gregory,S (1963) Statiscal Methods and the Geographer Long man & Lodon.


**Course Outcomes:**

On completion of the course students should be able to

- Perform proper and efficient sample statistical assessment and to statistically characterize spatially referenced data.
- Apply effective quantitative analysis of spatial and spatio-temporal data
- Demonstrate a basic understanding of computer hardware and software.
- Implement the algorithms and draw flowcharts for solving mathematical problems.
- Create maps, images to communicate spatial data in a meaningful way to others.

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**CORE COURSE-VII**
**IGNEOUS PETROLOGY**

| | | | |
|---|---|---|---|
| **Internal** | **: 25** | **Semester** | **: VI** |
| **External** | **: 75** | **No. of Hours/Week** | **: 6** |
| **Exam Hours** | **: 3** | **Credit** | **: 5** |

**Course Objectives:**

- To give a basic understanding of the mechanisms which control the diversity of igneous rocks
- To emphasis the relationship between tectonic setting and igneous rock suites
- To study the intrusive and extrusive igneous rocks
- To study the various classification
- To study the magmatic differentiation

**Unit I**

Definition of Petrology – Earth zones. Composition and constitution of magmas – Primary and Parental Magmas. Forms of Intrusive igneous rocks: Concordant forms - Sill, Laccolith, Lopolith and Phacolith, Discordant forms - Dykes, Cone Sheets, Volcanic neck, Ring dyke, Batholiths, Stocks, Bosses and Psymaliths. Forms of Extrusive igneous rocks: Lava flows, Pyroclastic deposits - Agglomerate, Lapilli, volcanic ash and volcanic froth

**(Content – 15 Hrs. Assessment – 3 Hrs.) (18 Hrs.)**

**Unit II**

Structures vesicular and Amygdaloidal structures – block lava – Ropy lava – pillow structure – flow structure – sheet joints- mural jointing – columnar jointing – rift and grain. Textures: Definition and description - crystallinity: crystallites and microlites – Devitrification – Granularity – shapes of crystals , mutual relations – Equigranular textures: allotriomorphic hypidimorphic, Panidiomorphic. inequigranular Textures: porphyritic and Intergrowth texture – Trachytic texture – Intergrowth texture strctures orbicular structure Spherulitic structure – Perlitic fracture. , Directive textures, Overgrowth textures, Reaction textures - Micro Structures

**(Content – 15 Hrs. Assessment – 3 Hrs.) (18 Hrs.)**

**Unit III**

Classification: bases of classification – megascopic classification – classification based on colour index – based on the proportion of Alkali to plagioclase feldspars. Based on silica saturation – based on alumina saturation – A short account of CIPW classification , Normative minerals, salic and femic groups – mention of the main divisions, classes, orders, suborders, rangs and subrangs only. Merits and defects of CIPW classification – Tyrrels tabular classification.

**(Content – 15 Hrs. Assessment – 3 Hrs.) (18 Hrs.)**

**Unit IV**

Texture, Mineralogy, Classification, and Modes of occurrence of: Granite, Granodiorite, Syenite, Diorite, Gabbro, their hypabyssal and volcanic equivalents. Petrographic

characters, distribution in India and origin of Pegmatites, Lamprophyres, Alkaline rocks, Dunite, Peridotite and Anorthosites.

**(Content – 15 Hrs. Assessment – 3 Hrs.) (18 Hrs.)**

**Unit V**

Crystallization of Unicomponent magma – Crystallization and petrogenetic significance of Binary magmas: Diopside – Anorthite Eutectic system, Albite – Anorthite Solid-Solution system, Forestrite – Silica incongruent melting system and Ternary system (Ab – An – Di). Reaction principle and Bowen's reaction series - Causes for the diversity of Igneous rocks – Magmatic Differentiation: Fractional Crystallization, Liquid immiscibility, Assimilation - Short notes on: Consanguinity, Variation diagrams and petrographic provinces.

**(Content – 15 Hrs. Assessment – 3 Hrs.) (18 Hrs.)**

**Text Books:**


1. Tyrrel, 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, New York.
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. Petrology of Igneous Rocks, Thomas Murby & Wells, M.K. – 1949
7. Johannesen, A – 1962 Descriptive petrography of Igneous Rocks, Vols. I to IV - Allied Pacific.


**Course outcome:**

- Student would understand the paragenesis of minerals of the Igneous rocks
- This course presents a broad review of igneous rocks, emphasizing their tectonic associations, interrelationships and petrogenesis.
- After successful completion of this course you will have an integrated understanding of the range, composition and petrogenesis of the major igneous rock groups and will be able to identify them in thin section and deduce their tectonic association and mode of origin.
- Students will become familiar with the key skills used to aid the interpretation of igneous rocks.

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## CORE COURSE-VIII
## SEDIMENTARY AND METAMORPHIC PETROLOGY

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|---|---|---|---|
| **Internal** | **: 25** | **Semester** | **: VI** |
| **External** | **: 75** | **No. of Hours/Week** | **: 6** |
| **Exam Hours** | **: 3** | **Credit** | **: 5** |

**Course Objectives:**

- Knowing the basic concepts in the classification of sedimentary rocks.
- Knowing the processes that erode, transport, and deposit sediments.
- Observing physical characteristics of sedimentary rocks, especially mineral composition and texture.
- To become familiar with the petrographic nomenclature of sedimentary rocks.
- To learn about the occurrence, origin, classification and environments of sedimentary rocks.

**Unit I**

Sedimentary process – disintegration & decomposition of rocks – transportation – deposition – diagenesis. A broad classification of sedimentary rocks into residual mechanical, chemical and organic Groups. Structures of sedimentary rocks. mechanical, chemical and organic structures. Textures of sedimentary rocks – clastic and non – clastic textures.

**(Content – 15 Hrs. Assessment – 3 Hrs.) (18 Hrs.)**

**Unit II**

Residual deposits – terra rossa , clay, laterite and bauxite and soils. Mechanical deposits – rudaceous, arenaceous and argillaceous groups. Heavy minerals in sand and sandstones. A descriptive study of Conglomerate, Breccia, Sandstones and Shales.

**(Content – 15 Hrs. Assessment – 3 Hrs.) (18 Hrs.)**

**Unit III**

Chemical deposits – siliceous , carbonaceous, ferruginous and salt deposits. organic deposits – calcareous, siliceous, phosphatic, ferruginous and carbonaceous deposts. A breief study of Flinit, Chert, Siderite, Gypsum, Rock Salt, Caliche. Guano and Kiesellgher. Descriptive study of different types of calcareous and carbonaceous deposits.

**(Content – 15 Hrs. Assessment – 3 Hrs.) (18 Hrs.)**

**Unit IV**

Definition of metamorphism –Agents and kinds of metamorphism – facies, zones and grades of metamorphism – metamorphic structures and textures. cataclastic metamorphism and its products. Retrograde metamorphism. Thermal metamorphism of pelitic sediments, pure and impure calcareous rocks. A brief study of Breccia, Flaser, Mylonite, Hornfels, Marble, Ophicalcite.

**(Content – 15 Hrs. Assessment – 3 Hrs.) (18 Hrs.)**

**Unit V**

Dynamorthermal metamorphism of pelitic sediments. plutonic metamorphism petrography and origin of charnockites – metamorphic differentiation – pnumatolitic and injection metamorphism – anataxis and palingenesis. Brief study of Slate, Phyllite, Quartzite, Schist. Gneiss, Granulite, Leptynite, Charnockite, Ecologite, Amphibolite, Schorl, Adinole, Lit-Par- Lite – gneiss and Migmatite.

**(Content – 15 Hrs. Assessment – 3 Hrs.) (18 Hrs.)**

**Text 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,

**Reference Books**

1. Turner,F,J &Verhogen,J -Igneous and Metamorphic Petrology, MC Graw Hill.

2. Williams, H, Turner, F.j. & Gillibert, C.M. - Petrography, Freeman.

3. Winkler, A. G.F. - Petrogenesis of Metamorphic Rocks, Mc Graw Hill.

**Course Outcome:**

- Student would understand the weathering, provenance, depositional environments, climate and tectonics of the sedimentary rocks
- Demonstrate proficiency in common practical skills in Sedimentary Geology.
- Interpret the processes responsible for the deposition of the sediment from the nature of the sediment and sedimentary structures present within the sedimentary rock.
- Understand the depositional environment of a sedimentary rock package based on recognition of facies associations.

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**CORE COURSE-IX**
**ECONOMIC GEOLOGY**

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|---|---|---|---|
| **Internal** | **: 25** | **Semester** | **: VI** |
| **External** | **: 75** | **No. of Hours/Week** | **: 6** |
| **Exam Hours** | **: 3** | **Credit** | **: 6** |

**Course Objectives:**

- To study the basic terminology and classification of ore localization
- To study the magmatic processes
- Geochemical properties of earth's crust, mantle and core, and the fundamentals of geochemical measurements for the exploration and energy resources
- To study the physical properties of ore minerals
- To study the occurrence and distribution of ore minerals

**Unit I**

Historical development of ecnonmic Geology. Materials of mineral deposits – ore minerals, gangue minerals, tenor and grade or ores. classification of mineral deposits. Outline of Lindgren's and Bateman's classification. Controls of ore localization – structural controls, stratigraphic physical and chemical – brief study of metallogenetic epochs and provinces – geologic thermometers.

**(Content – 15 Hrs. Assessment – 3 Hrs.) (18 Hrs.)**

**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 – immiscible liquid segregation and injection – sublimation. Contact Metasomatic processes – the process and 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, pore space and vesicular filling – replacement deposits, the process and deposits – criteria of replacement.

**(Content – 15 Hrs. Assessment – 3 Hrs.) (18 Hrs.)**

**Unit III**

Sedimentary processes and cycles – principles involved in sedimentation – cycles of Iron and manganese, weathering processes – principles- Residual concentration process and deposits – mechanical concentration principles – evluvial, alluvial, beach and eolian placers – paystreak and bonanza. 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.

**(Content – 15 Hrs. Assessment – 3 Hrs.) (18 Hrs.)**

**Unit IV**

Diagnostic physical properties, chemical composition, uses, modes of occurrence and distribution in India of the following economic minerals. Graphite, Realgar, Orpiment,

Stibinite, Molybdenite, Cinnabar, Anglesite, Barite, Gypsum, Celestite, Corundum, Ochre, Ilmenite, Chromite, Franklinite, Cassiterrite, Magnesite, Cerussite, Halite, Fluorite, Phosphatic Nodule, Monazite, Wollastonite, Colembite, Tantalite, Samarskite, Asbestos, Steatite and Vermiculite. Mineralogy, mode of occurrence, uses and distribution in India of the following precious metals and minerals. Gold deposits – Gem stones. Character, distribution and mode of occurrence of structural and building materials.

**(Content – 15 Hrs. Assessment – 3 Hrs.) (18 Hrs.)**

**Unit V**

Mineralogy, mode of occurrences, uses and distribution in India of the following metalliferous deposits – Iron, Manganese, aluminium, copper, lead, Zinc – chromium. Fossils fuels – coal – uses, classification, constitution, origin and distribution in India. Petroleum- composition, uses, theories of origin, oil traps, and important oil fields of India.

**(Content – 15 Hrs. Assessment – 3 Hrs.) (18 Hrs.)**

**Text Books:**


1. Bateman Allan .M. -Economic Mineral Deposits, Asian Publishing House, 2nd Edition 1962.
2. Lindgren W. -Mineral Deposits, MCGraw Hill, 1933.


**Reference Books:**


1. Coggin, B. and Dey, A.K. - India's Mineral Wealth, oup 1955.
2. Park, C.F. and Macdiarmid, R.A- Ore deposits, Freeman, 1970
3. Krishnaswamy ,s. - India's Mineral Resources, oxford and IBH.
4. Deb.S. - Industrial Minerals and Rocis of India, Allied, 1980.
5. Gokhale, K.V.G.K. and Rao , T.C- Ore deposits of India, their distribution and processing, Thosmson press, 1978.


**Course Outcome:**

- An understanding of the socio-economic drivers for mining and exploration activities.
- Detailed knowledge and the ability to interpret the strength, of the various genetic models associated with each class of mineralization; with emphasis on the mineralogy, geology and geochemical controls on mineralization of ore deposits.
- An understanding of the roles of a geologist in the mining and exploration industries.
- Students able to understand the ore minerals in the field

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## CORE PRACTICAL-IV
## PETROLOGY AND ECONOMIC GEOLOGY

| | | | |
|---|---|---|---|
| **Internal** | **: 40** | **Semester** | **: VI** |
| **External** | **: 60** | **No. of Hours/Week** | **: 6** |
| **Exam Hours** | **: 3** | **Credit** | **: 5** |

**Course Objectives:**

- To study the megascopic identification of igneous, sedimentary and metamorphic rocks
- To study the microscopic identification of igneous, sedimentary and metamorphic rocks
- To study the megascopic identification of ore minerals
- To study the occurrence and distribution of rocks and ore minerals.

**PETROLOGY:**

**Megascopic identification of the following rocks:**

Granite, Graphic granite, Pegmatite, Aplite, Schorl Rock, Granite Porphyry, Syenite, Syenite porphyry, Diorite, Gabbro, Anorthosite, Dunite, Pyroxenite, Dolerite, Diabase Porphyry, Basalt, Trachyte, Rhyolite, Obsidian, Pumice, Scoria. Conglomerate, Breccia, Sandstone, Arkose, Shale, Limestone, Laterite, Peat, Lignite, Slate, Phyllite, Schists, Gneisses, Quartzite, Marble, Amphibolite, Ecologite, Leptynite, Charnockite, Khondalite, Calc - Granulite and Basic Granulite.

**Microscopic identification and description of the following 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, conglomerate, Breccia, sandstone, Arkose, shale limestone, 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.

**ECONOMIC GEOLOGY:-**

**Megascopic identification and description, Indian occurrences and uses of the following ore and industrial**

**Minerals: -**

Realgar, Orpiment, Stibnite, Molybdenite, Galena, Sphalerite, Cinnabar, Covelite, Bornite, Chalcophyrite, Pyrite, Arsenopyrite, Marcasite, Barite, Celestite, Gypsum, Cuprite, Zincite, Corundum, Hematite, Ilmenite, Magnetite, Chromite, Franklinite, Cassiterite, Rutile, Pyrolusite, Psilomelane, Goethite, Limonite, Bauxite, Calcite, Dolomite, Magnesite, Siderite, Aragonite, Witherite, Strontionite, Cerussite, Azurite, Malachite, Chrysocolla, Columbite, Halite, Fluorite, Phosphatic Nodule, Monazite, Graphite, Coal and its varieties.

**Course Outcome:**

- Students able to identify the megascopic minerals in the field
- Understand the microscopic thin section of rocks
- Students able to identify the ore minerals in the field
- Understand the various uses of economic minerals

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## MAJOR BASED ELACTIVE-III
## MINERAL PROSPECTING AND FIELD GEOLOGY

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|---|---|---|---|
| **Internal** | **: 25** | **Semester** | **: VI** |
| **External** | **: 75** | **No. of Hours/Week** | **: 5** |
| **Exam Hours** | **: 3** | **Credit** | **: 5** |

**Course Objectives:**

- To study the various sampling methods
- To study the various geophysical exploration techniques
- To understand the mapping techniques
- To know the geological symbols and preparation of field reports.

**Unit I**

**Mineral Prospecting:** Geological Exploration: Criteria controlling the choice of sites for geological prospecting- Marginal information of toposheets.. Sampling methods:-channel sampling, bulk sampling and Core sampling, Coning and Quartering. Various types of drilling methods, their applications and limitations.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit II**

Geophysical Exploration: A concise account of limitations and applications of various geophysical exploration methods. The principles involved, instruments used in electrical, magnetic, seismic, gravity and radio active methods of prospecting.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit III**

Geochemical Exploration: Introduction – General principles of geochemical Prospecting. Geochemical dispersion. Geochemical anomaly; background and threshold values; Brief introduction to Pedo-geochemical, Hydro-geochemical, lithogeochemical and Bio-geo chemical methods.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit IV**

Field Geology: Different types of field mapping technique: quarry mapping, structural mapping, lithologic mapping. Sampling techniques – oriented sample collection, paleontological sample collection, sediment sample technique, core sampling, trench sampling, aquatic sampling and soil sampling.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Unit V**

Drilling: Types of drills and methods of drilling. Geological maps, their preparation and uses. Preparation of geological field report- Symbols used for various geological features. Elements of geological field diary.

**(Content – 12 Hrs. Assessment – 3 Hrs.) (15 Hrs.)**

**Text Books:**


1. Mathur S.M. (2001) – Guide to Field Geology: Prentice Hall of India.
2. Ramachandra Rao M.B.(1975) – Outlines of Geophysical Prospecting - English Book
1. Depot, Dehradun.
2. Dobrin M.B.(1981) Introduction to Geophysical prospecting. McGraw – Hill International
3. Book Company.
4. Kearey.P and Brooks.M (1984) An Introduction to Geophysical Exploration- ELBS.
5. Hawkes H.E. and Webb. U.S - (1962) - Geochemistry in mineral Exploration. Harer &
6. Row.
7. Mason.B (1966); Principles of Geochemistry – Willey Toppan.
8. Robinson. E.S. and Coruh.C. (2002)- Basic Exploration
9. Arogyaswamy, R.N.P: Courses in Mining Geology – Oxford &IBH, New Delhi.
10. Thamus, P.J. 1979 An introduction to mining, Methun.
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**Course Outcome:**

- Students able to collect sampling in the field
- To understand and able to interpret the geological map
- Students able to write the field report
- Student would understand the detailed Geophysics and geochemical exploration

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