DEPARTMENT OF GEOLOGY
ANNA UNIVERSITY, CHENNAI

VISION

- To lead in providing quality education and research programmes in Geology and to motivate our students to be responsible scientists and engineers in the society

MISSION

- To provide quality education and research in various fields of Geology
- To provide human resources to the state and country in the field Geology.
- To bring in technologies to understand and manage the Earth and its resources for the future.
- To improve innovative thinking and entrepreneurship skills in cutting-edge technology for Geological Engineering.
ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
M. Sc. APPLIED GEOLOGY (2 YEARS)
REGULATIONS 2023
CHOICE BASED CREDIT SYSTEM

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

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<th>PEO</th>
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<td>PEO1</td>
<td>Imparting geological knowledge and skills to gain employment in Industry, Science and research organizations and service sectors.</td>
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<td>PEO2</td>
<td>Produce quality manpower in geology that can elevate and lead the organization effectively</td>
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<td>PEO3</td>
<td>Enable the students to understand and bring solutions to societal problems related to Geology.</td>
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<td>PEO4</td>
<td>Motivate students to pursue higher studies and research in Geology</td>
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<tr>
<td>PEO5</td>
<td>Create an environment to auger entrepreneurial skills that will innovate and market geology related products.</td>
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2. PROGRAMME OUTCOMES (POs):

After going through the two years of study, our Master of Science in Applied Geology graduates will exhibit the ability to:

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<th>PO</th>
<th>Graduate Attribute</th>
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<td>PO1</td>
<td>Conceptualize/develop solutions</td>
<td>Conceive and develop solutions to societal problems related to geological processes and to understand their origin and nature.</td>
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<td>PO2</td>
<td>Modern tool usage</td>
<td>Apply various mapping tools and techniques, usage of geological, geophysical and geochemical equipment to improve the understanding of the earth system science.</td>
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<td>PO3</td>
<td>Problem analysis</td>
<td>Identify, formulate and solve Geological and technical problems.</td>
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<td>Environment and sustainability</td>
<td>Develop policies with environment consciousness that can provide sustainable development.</td>
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<td>PO5</td>
<td>Ethics</td>
<td>Interact in industry, business and society in a professional and ethical manner.</td>
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<td>PO6</td>
<td>Life-long learning</td>
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3. **PEO / PO Mapping:**

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4. **Mapping of Course Outcome and Programme Outcome**

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## M.Sc. APPLIED GEOLOGY (TWO YEARS)

### REGULATIONS 2023

**CHOISE-BASED CREDIT SYSTEM**

**CURRICULA AND SYLLABI**

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*Attested*

Signatures and Details:

- **Director**
- **Promoted**
- **Centre for Academic Courses**
- **Anna University, Chennai-600 025**
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### SUMMARY

**NAME OF THE PROGRAMME: M. SC. APPLIED GEOLOGY**

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OBJECTIVES:
- Give better understanding on the applications of geomorphology in geological and engineering fields,
- Providing adequate knowledge on groundwater and natural hazards Management.
- To gain the knowledge about the planetary geomorphology.

UNIT I  INTRODUCTION TO GEOMORPHOLOGY  9
Evolution of Earth, Earth’s internal structure, principles of geodesy, isostasy, weathering - processes and products, Basic geomorphological concepts, endogenous and exogenous processes, Davisian/Geomorphic cycle, Planation surfaces, Processes of weathering, Weathering Indices and their significance.

UNIT II FLUVIAL AND COASTAL AND MARINE PROCESSES AND LAND FORMS  9

UNIT III AEOLIAN AND GLACIAL PROCESSES AND LANDFORMS  9

UNIT IV APPLIED GEOMORPHOLOGY  9
Geomorphology in resources exploration; Hydro-geomorphology: Role of geomorphic processes and land forms in localization of ores and minerals - Coastal, alluvial and elluvial placers - Residual deposits; Engineering geomorphology – concept and applications, Geomorphology in natural hazard management – floods, landslides, coastal erosion, Volcanoes and earthquakes, tsunami and other natural disaster.

UNIT V PLANETARY GEOMORPHOLOGY  9
Need for the study. Comparison of terrestrial and planetary landforms. Description and origin of Lunar, Martian and other planetary landforms and processes, methods of mapping planetary landforms.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of this course, the students expected to be able to:

CO1: Understand the endogenetic and exogenetic processes of the Earth.
CO2: Have better understanding of geological actions of wind, river, sea and glaciers and their related landforms.
CO3: Appreciate and comprehend the advanced concepts of geomorphology and its applications in Geology and engineering.
CO4: Gain knowledge on role of geomorphology in geological hazards and its mitigation
CO5: Understand the planetary geomorphology

REFERENCES
Mapping of CO with PO

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AG3102 ADVANCED MINERALOGY AND CRYSTALLOGRAPHY

OBJECTIVES:
- To impart fundamentals of crystals and crystallization processes.
- Teach students on formation of minerals and their physical, chemical and the optical characteristics of minerals.
- To understand the advanced analytical techniques for crystallography

UNIT I CRYSTALLOGRAPHY
Classification of crystals-systems and classes of symmetry- International system of crystallographic notation- Use of projection diagrams to represent crystal symmetry-Unit Cells, Motifs and Lattices-Bravais Lattices-Miller Indices-Point groups and space groups.

UNIT II ELEMENTS AND MINERALS
Stoichiometry, atomic substitution-polymorphism, isomorphism and solid solution series – exsolution-Chemical bonding types and mineral properties-chemical classification of minerals-Rules governing atomic close-packing in crystalline solids and co-ordination number. Pauling’s rules governing the ionic structures- coordination polyhedral-Crystal imperfections-defects, twinning and zoning Positioning of trace elements in minerals

UNIT III DESCRIPTIVE MINERALOGY

UNIT IV OPTICAL MINERALOGY

UNIT V X- RAY CRYSTALLOGRAPHY

TOTAL: 45 PERIODS
OUTCOMES:
On completion of this course, the students expected to be able to:
CO1: Understand the crystallography and crystal symmetry
CO2: In-depth knowledge on the elementary properties of minerals.
CO3: Better understanding on the physical and chemical properties of various rock forming minerals and their identification.
CO4: Gain knowledge on identification of minerals through their optical properties.
CO5: Understand various x-ray techniques for and their applications in mineralogy.

REFERENCES
8. Berry, L.G., Mason, B, and Dietrich, R.V. Mineralogy, CBS Publ. 1982
10. Dexter Perkins, Mineralogy, Prentice Hall, USA, 2002

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AG3103 STRATIGRAPHY AND PALAEONTOLOGY

OBJECTIVES:
- To understand the geological setting of Indian continent to its mineral deposits
- To understand the events paleoclimate and paleoenvironment of the geological past
- To understand the evolution of invertebrate and vertebrate paleontology

UNIT I PRINCIPLES OF STRATIGRAPHY
Practical component: Geological events, evolution of life and mass extinctions in Indian stratigraphic scale, Order of superposition studies. Description of a litho profile.

UNIT II  PRECAMBRIAN STRATIGRAPHY OF INDIA  9+6
Archaean cratonic nuclei of Peninsular India (Dharwar, Singhbhum, and Aravalli cratons); Proterozoic mobile belts (Central Indian Tectonic Zone, Aravalli-Delhi and Eastern Ghats); Southern Granulite terrain, Central Indian Tectonic zone, Aravalli-Delhi belt, North Singhbhum Mobile belt. Mineral deposits of Precambrian rocks.
Practical component: Locating the Archean cratons, mobile belts, CTZ, Precambrian terrain on India map. Spotting the Precambrian mineralized zones on the map.

UNIT III  PHANEROZOIC STRATIGRAPHY OF INDIA  9+6
Geological setting and important stratigraphic features of Phanerozoic formations in India. Paleozoic; Spiti, Kashmir and Kumaon. Mesozoic; Spiti, Kutch, Narmada valley and Trichinopoly. Gondwana Super group. Cenozoic; Assam, Bengal basin, Garhwal-Shimla Himalayas. Siwaliks; Stratigraphic boundary problems in Indian stratigraphy.
Practical component: Locating the Phanerozoic formations in India, Demarcation of stratigraphic boundary based on fossil assemblages. Field study in Cretaceous Formations of India.

UNIT IV  INVERTEBRATE AND VERTEBRATE PALEONTOLOGY  9+6

UNIT V  MICROPALAEONTOLOGY AND PALYNOLOGY  9+6

TOTAL: 75 PERIODS

COURSE OUTCOMES:
On completion of this course, expected outcomes are:
CO1: A comprehensive knowledge of mineral wealth of India; a guide for exploration and Exploitation of mineral deposits.
CO2: Education to “past is key to the present” concept for correlation and enhancement the mineral and fossil fuel mineral exploration
CO3: Indexing the fossil system for paleoenvironment, paleotemperature, paleoecology, paleobathymetry in taking the stock of past sea level changes and global warming.
CO4: Bio-indicator clue in pollution and bio-mineralization.
CO5: A guide to the environment analysis by microfossil assemblages.

Attested

[Signature]
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025
REFERENCES
2. Krishnan, M.S., Geology of India and Burma III Ed. IBH Publishers, New Delhi, 1984
3. Ravindra Kumar, Fundamentals of historical Geology and stratigraphy of India, Wiley Eastern Ltd. New Delhi, 1985
4. Shorock and Twenhofel, Principles of Invertebrate Paleontology, IBH New Delhi, 1983

Mapping of CO with PO

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AG3104 STRUCTURAL GEOLOGY AND GEOTECTONICS

OBJECTIVES:
- To impart knowledge their significance in geological setup and exploration of geological resources.
- To understanding of plate tectonics and its role in geological processes such as seismicity and volcanism.
- To gain the knowledge on geological and structural mapping and its application in geo resource exploration.

UNIT I INTRODUCTION
Concept, approach and scope of structural geology-primary and secondary Structures-Principles of geological mapping and map reading-V-rules and outcrop patterns-projection diagrams. Concepts of Stress, Strain and rheological properties of rocks-Behaviour of minerals, sediments and rocks under deformation conditions and their controlling factors

UNIT II DEFORMATION MECHANISMS & MICROSTRUCTURES
Planar and linear structures- cleavage, foliation, lineation and Unconformities-Structural behaviour of igneous Intrusions-Introduction to petro fabrics-Theories of rock failure-Kinematic analysis and Dynamic analysis – strain markers and method of strain measurements in naturally deformed rocks-deformation at microscale -controls of strain rate and development of microfabrics.
UNIT III JOINTS AND FAULTS
Joints and shear fractures - brittle and ductile shear zones - Mohr's circle and criteria for failure of rocks- Fault in rocks-recognition in field -classification of faults and fault surfaces on the basis of slip sense and surface effects- Dynamic analysis of faults- measurement of strain in deformed rocks- time relationship between crystallization and deformation - Normal faults, strike-slip faults and thrust faults terminology-role of fluid pressure- calculation of paleo-stress-Geometry and products of shear zones-Mylonites and Cataclastites.

UNIT IV FOLDS
Elements of fold geometry-classification of folds. Folding mechanisms- Regional fold styles-structural analysis of folds –Strain within buckled layer-Study of Superimposed folding-Type 1, 2 and 3 interference pattern. S and Z patterns-Stereoplot for different interference pattern-Distinction between F1 and F2 folds.

UNIT V GEOTECTONICS

TOTAL: 45 PERIODS

OUTCOMES:
On completion of this course, the students expected to be able to:
CO1: Identify primary and secondary structures
CO2: Have knowledge on behaviour of minerals and rocks during stress
CO3: Acquire skills on field recognition of faults, folds and their types
CO4: Understanding of plate tectonics and its role in geological processes such as seismicity and volcanism.
CO5: Have knowledge on geological and structural mapping and its application in geo resource exploration.

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AG3105 APPLIED GEOCHEMISTRY L T P C 3 0 0 3

OBJECTIVES:
- To understand chemistry of magma and evolution of various rock types through geochemical differentiation.
- To collect geochemical data for exploration of earth resources.
- To analyze and interpret geochemical data for exploration for minerals, oil and groundwater.

UNIT I PRINCIPLES OF GEOCHEMISTRY

UNIT II GEOCHEMISTRY OF MINERALS, ROCKS AND WATERS

UNIT III ISOTOPE GEOCHEMISTRY

UNIT IV EXPLORATION GEOCHEMISTRY
Introduction – Primary dispersion pattern, Secondary dispersion pattern – background values. Geochemical anomaly – geochemical sampling-Principles and techniques used in the design and implementation of an exploration geochemical survey-Nernst’s partition coefficient (compatible and incompatible elements)-Nernst-Berthelot partition coefficient and bulk partition coefficient-Fick’s laws of diffusion and activity composition relation (Roult's and Henry’s law).
UNIT V  ENVIRONMENTAL GEOCHEMISTRY


TOTAL: 45 PERIODS

OUTCOMES:
On completion of this course, the students are expected to:

CO1: Familiarized with chemical properties of earth and its layers
CO2: Understand the geochemical characteristics of minerals and rocks
CO3: Have knowledge on isotopic methods and age determination
CO4: Collect geochemical data for exploration of earth resources
CO5: Analyze and Interpret geochemical data for exploration for minerals, oil and groundwater.

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MA3101  APPLIED MATHEMATICS FOR GEOLOGISTS

OBJECTIVES:
- To enable the students, understand the numerical methods of solving systems of linear algebraic equations and the ideas of interpolation.
- To train the students to address the mathematical problems involved in geological science and understand various sampling, quantitative and statistical problems pertaining to geology.
- To make them understand the importance of estimation theory and introduce them to various tests of hypothesis.
UNIT I  SYSTEM OF LINEAR EQUATIONS AND INTERPOLATION  12
Simultaneous linear equations – Direct method – Gauss elimination, Gauss Jordan methods –
iterative method – Jacobi and Gauss Seidal methods - Difference table – Newtons forward and
backward interpolation – Newtons divided differences – Lagrangian interpolation.

UNIT II  NUMERICAL INTEGRATION AND ORDINARY DIFFERENTIAL
EQUATIONS  12
Numerical integration – Trapezoidal and Simpson’s 1/3 rules – Taylor series and Euler’s methods –

UNIT III  EMPIRICAL STATISTICS  12
Types of sampling – Description of discrete and continuous data – Measures of Central tendency
and dispersion for grouped and ungrouped data – measures of position – Box and Whisker plot.

UNIT IV  ESTIMATION THEORY  12
Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation – Curve fitting by
principle of least squares – Regression lines.

UNIT V  TESTING OF HYPOTHESIS  12
Sampling distributions – Type I and Type II errors – Test based on Normal, t, χ² and F distributions
for testing mean, variance and proportions – Tests for independence of attributes and Goodness
of fit.

TOTAL :60 PERIODS

OUTCOMES:
At the end of the course, students will be able to
CO1: Develop the ideas of numerical and statistical methods of solving various applications
involving resource evaluation and assessment.
CO2: Solve systems of equations numerically and also learn interpolation techniques.
CO3: Solve numerically the differential equations occurring in their field of study.
CO4: Apply estimation theory to various engineering problems.
CO5: Use various tests of hypothesis for their future work.

REFERENCES:
1. Devore, J. L, “Probability and statistics for Engineering and Sciences”, Thomson and

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OBJECTIVES:
- To give hands-on exercise on identification of crystals and minerals
- To impart practical training on optical mineralogical techniques
- To impart knowledge on minerals calculation practice

UNIT I  CRYSTALLOGRAPHY
Stereographic projections – axial ratios – Napier’s theorem and problems

UNIT II  PROPERTIES OF MINERALS IN HAND SPECIMENS

UNIT III  PROPERTIES OF ORE MINERALS IN HAND SPECIMENS

UNIT IV  PROPERTIES OF MINERALS IN THIN SECTION
Systematic microscopic study of common rock forming minerals – RI – Birefringence – extinction angles – optic sign etc.

UNIT V  MINERAL CALCULATION AND 4- AXES UNIVERSAL STAGE
Calculation of structural formula for important rock forming mineral groups. Determination of anorthite content and twin law in plagioclase feldspars.

TOTAL: 30 PERIODS

OUTCOMES:
On completion of this course, the students expected to be able to:
CO1: Familiar with uses of stereographic projection in crystal interface angle
CO2: Have knowledge on identification of minerals in hand specimens
CO3: Have knowledge on identification of ore minerals in hand specimens
CO4: Have knowledge on identification of minerals in thin section
CO5: Familiar with mineral cation calculations

REFERENCES
2. Berry, L.G., Mason, B, and Dietrich, R.V. Mineralogy, CBS Publ. 1982
3. Winchel and Winchel, Elements of Optical Mineralogy, John Wiley & Sons
5. Dexter Perkins, Mineralogy, Prentice Hall, USA, 2002

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AG3112  STRUCTURAL GEOLOGY AND GEOLOGICAL MAPPING TECHNIQUES  L T P C  0 0 2 1

OBJECTIVES
- To teach field measurements of attitude of rocks
- To impart geological mapping techniques.
- Provide skills to determine bed thickness and depth

UNIT I  STRIKE, DIP AND THICKNESS PROBLEMS  6
Studies of contours and different land forms – Strike, true dip and apparent dip problems - Measurement of thickness and width of the outcrops

UNIT II  STRUCTURAL MAPS  6
Completion of outcrops in geological maps - Three point problems - Drawing of profiles and studies of geological maps

UNIT III  STEREOSCOPIC PROJECTIONS  6
Determination of true and apparent dip, plunge and pitch of linear structures

UNIT IV  GEOLOGICAL MAPPING TECHNIQUES  6
Map, toposheet, study of topographic features, map scale mapping instruments – Clinometer, brunton compass, odometer, altimeter, GPS, Map measurer, and Geologist's kit. Procedures for geological mapping at Igneous, Sedimentary and Metamorphic terrains. Outcrop study, method of traverses, Preparation of geological map and structural mapping.

UNIT V  FIELD WORK and GEOLOGICAL INVESTIGATIONS  6
Identification of lithological units, structural identification, joints pattern measurements, faults identification, fold analysis, sample collection. Field studies in the important geological exposures of India and report writing.

COURSE OUTCOMES:
On completion of this course, the students expected to be able to:
CO1: Students familiar with find out the strike, dip and thickness of bed
CO2: Prepare structure geological mapping.
CO3: Familiar with find out the true and apparent dips by using stereographic projections
CO4: Gained knowledge on geological mapping techniques
CO5: Carry out geological field work individually and as a team

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OBJECTIVES:
- To familiarize students with the various surveying instruments.
- To impart practical skills on various surveying techniques.
- Provide skills to do individual and group surveys for geological explorations.

EXERCISES:
1. Chain traversing 8
2. Compass traversing 8
3. Plane table surveying – Method of intersection 4
4. Plane table surveying – Three point problem (any one method) 4
5. Plane table surveying – Two point problem 4
6. Plane table traversing 4
7. Fly levelling using dumpy/tilting level 4
8. Check levelling using dumpy/tilting level 4
9. Measurement of horizontal and vertical angles using theodolite 8
10. Determination of tacheometric constants using horizontal and inclined line of sight. 4
11. To determine the elevation of an object using single plane method when base is accessible and inaccessible 4
12. GPS and Total Station – demonstration only. 4

OUTCOMES:
On completion of this course, the students expected to be able to:
CO1: Use various surveying instruments individually
CO2: Have knowledge on different survey method with its merits and demerits
CO3: Do individual field surveys
CO4: Understand applications of Survey in geological explorations.
CO5: Have up-to-date knowledge on advanced surveying instruments and methods

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OBJECTIVES:
- To familiarize the students on the igneous processes and chemical characteristics of magma and its various rock types.
- Provide information on occurrence and geological setting of igneous rocks and metamorphic rocks.
- To understand the concept of metamorphic facies and metasomatic processes.

UNIT I MAGMA GENERATION AND IGNEOUS ROCKS
Textures and structures of igneous rocks. General classification of igneous rocks. Interior of the earth and formation of magmas, Ascent and emplacement of magmas. Concept of primary and secondary magma, Crystallization of magma, Magma series, Dynamics Magmatic differentiation. Magma mixing, mingling and immiscibility.

UNIT II PHASE EQUILIBRIA IN IGNEOUS SYSTEMS
Phase Rule – Two component eutectic systems - diopside-anorthite system - incongruent melting – forsterite-silica system – Solid solution systems – albite-anorthite system – Exsolution – Albite-Orthoclase system. Crystallization in ternary systems: (Di-Ab-An, Di-Fo-Si, Di-Fo-An, Fo-An-Si) and their relation to magma genesis and crystallization.

UNIT III PLATE TECTONICS AND IGNEOUS PETROGENESIS
Igneous rocks of ocean basins: Ophiolites & Basalts - Igneous rocks of Continental Lithosphere: Granitic rocks; terrestrial anorthosites, carbonatites & Alkaline rocks; Mafic dyke swarms, boninites and layered complexes. Continental Rhyolites; Continental Flood Basalts - Igneous rocks of convergent margins, Variation diagrams- Distribution and tectono magmatic setting of important igneous complexes of India.

UNIT IV METAMORPHIC PETROLOGY

UNIT V METAMORPHIC FACIES & METASOMATISM
Concept and Classification of Metamorphic Facies and Facies Series, Introduction to Ultrahigh Temperature and Ultrahigh Pressure Metamorphism, Description of each Facies of Low – Medium

TOTAL: 45 PERIODS

OUTCOMES
On completion of this course, the students are expected to
CO1. Have better understanding on magma and magmatic processes
CO2. Understand the crystallization processes of minerals and rocks
CO3. Differentiate various Igneous types and their tectonic settings
CO4. Understand clearly on metamorphic processes and formation of metamorphic rocks.
CO5. Interpret magmatic and geodynamic processes and their signatures worldwide.

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AG3202 SEDIMENTOLOGY AND SEDIMENTARY PETROLOGY

OBJECTIVES:
- To familiarize the students on Sedimentary processes
- To provide knowledge on sedimentary structure and tectonic settings
- Describe on occurrence and geological setting of igneous rocks and metamorphic rocks.
UNIT I ORIGIN AND CLASSIFICATION OF SEDIMENTS
Weathering and erosion process, products, principles of sedimentation process, scope, applications, classification of sedimentary rocks, sedimentary textures-grain size, roundness, sphericity, shape and fabric, quantitative grain size analysis.

UNIT II SEDIMENTARY PROCESS AND STRUCTURES
Sediment transport and deposition- fluid and sediment gravity flows, lamellar and turbulent flows, Reynold number, Froude number, grain entrainment, Hjulstrom diagram, bed and suspension load transport. Primary, penecontemporaneous deformation structures and biogenic structures. Paleoecurrent analysis.

UNIT III SEDIMENTARY BASINS AND TECTONICS
Evolution of sedimentary basins. Sedimentation in major tectonic setting; principles of sequence stratigraphy- concepts and factors controlling base level changes, parasequence, clinoform, system tract, unconformity and sequence boundary. Sedimentary basins of India.

UNIT IV SEDIMENTARY ENVIRONMENT AND FACIES

UNIT V SEDIMENTARY PETROLOGY

TOTAL: 45 PERIODS

OUTCOMES:
On completion of this course, the students are expected to

CO1. Have better understanding on sediments and classification
CO2. Understand the processes of sedimentation and sedimentary structures
CO3. Differentiate various tectonic settings and sedimentary processes
CO4. Understand clearly on sedimentary environment and provenance
CO5. Identify and distinguish sedimentary rocks on the basis of their mode of formation.

REFERENCES

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[Signature]

Director

Centre for Academic Courses
Anna University, Chennai-600 025
AG3203 EXPLORATION GEOPHYSICS AND FIELD TECHNIQUES

OBJECTIVES:
- To study the physical properties of earth and application of physics in geology,
- To understand subsurface features and structures for better understanding of subsurface geology.
- To Familiarize the students on geophysical techniques and their field setup, data processing and interpretation.

UNIT I INTRODUCTION & ELECTRICAL METHODS

FIELD TECHNIQUES: - Resistivity surveys – Wenner and Schlumberger methods – electrical sounding and profiling — problems on these methods

UNIT II GRAVITY METHODS

Field Techniques: Field investigation on resistivity – sounding and profiling – SP methods - Interpretation of data – standard computer packages in interpretation – Problems on gravity methods

UNIT III MAGNETIC METHODS
Magnetic methods – principle - field procedure – magnetometers – interpretation of magnetic data – size and shape of bodies – correction of magnetic data - applications - airborne geophysical surveys – Factors affecting magnetic anomalies -case studies

Field Techniques: Problems on magnetic methods – preparation of anomaly maps – methods of corrections

UNIT IV SEISMIC METHODS
determination of attitude and depth of formations – applications- various types of shooting – case studies

**Field Techniques:** Problems on refraction and reflection methods – 3 layer and inclined beds – calculation based on intercept time and cross over distance

**UNIT V: RADIOACTIVITY METHODS AND WELL LOGGING**


**Field Techniques:** Radioactive methods - problems on well logging – interpretation of data.

**OUTCOMES:**

On completion of this course, the students are expected to be able to:

CO1. Have better understanding on the physical properties of earth and its layers
CO2. Understand the geophysical anomalies and their significance in subsurface exploration
CO3. Acquire skills on various geophysical methods and their field surveys
CO4. Collect data using various geophysical techniques and do analysis
CO5. Interpretation of data for exploration for minerals, oil and groundwater

**REFERENCES:**

2. Dobrin, M.B An introduction to geophysical prospecting, McGraw Hill, New Delhi, 1984
8. Surface Geophysical Methods Volume 1, Fall 2004

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**TOTA: 75 PERIODS**
OBJECTIVES:

- To study the origin of Coal, petroleum and Nuclear minerals
- To teach Indian occurrences of hydrocarbons.
- To teach students geological and geophysical exploration techniques

UNIT I ORIGIN OF COAL AND ITS PROPERTIES


UNIT II INDIAN COAL FIELDS


UNIT III ORIGIN AND PROCESS OF HYDROCARBON FORMATION


UNIT IV GEOLOGICAL, GEOPHYSICAL AND GEOCHEMICAL METHODS

Sedimentary basin analysis to its Petrophysical properties, depositional environment and time line and bathymetry analysis. Seismic method of hydrocarbon reservoir exploration. Seismic reflection patterns and to decipher the depositional and structural features. Well logging techniques, interpretation of logs, geochemical parameters; determination of TOM, TOC, VRO, TTI, and TAMR

UNIT V NUCLEAR MINERALS


TOTAL: 45 PERIODS

OUTCOMES:

On completion of this course, the students expected to be able to:

CO1. Understand the processes of formation of coal, petroleum and nuclear minerals.
CO2. Have knowledge on different rank of coals and Indian occurrence
CO3. Do independent geological mapping for hydrocarbon exploration
CO4. Gain skills on geophysical and geochemical exploration methods.
CO5. Understand the scope of geology in strategic mineral exploration

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CY3211 APPLIED GEOCHEMISTRY LABORATORY L T P C

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OBJECTIVES:
- To develop analytical skill and practical exposure on geochemistry
- To understand the chemical properties of water, sediments and minerals in geology
- To train the students on sophisticated analytical instrument handling in geochemistry and their application

UNIT I ANALYSIS OF ORES 12
- a) Analysis of Dolomite ore by Titrimetry method
- b) Analysis of Haematite ore by Titrimetry method

UNIT II ANALYSIS OF METALS IN SOLUTIONS 16
- a) Estimation of Iron and Copper in the given sample by Spectroscopy method
- b) Estimation of Sodium and Potassium in the given sample by Flame Spectrophotometer
- c) Estimation of Zinc and Nickel in the given sample Gravimetric method

UNIT III ANALYSIS OF WATER 12
- a) Estimation of Acidity, Alkalinity and Hardness of the water sample by Titrimetry method
- b) Determination of Total Dissolved Solids (TDS) of the water sample by Gravimetry method
- c) Determination of Dissolved Oxygen (DO) of the water sample by Winkler’s method

UNIT IV ELECTROANALYTICAL METHODS 12
- a) Determination of strength of a acid by pH meter
- b) Determination of strength of mixture of acids by Conductometry method
- c) Estimation of amount of Iron in the given sample using Potentiometer

UNIT V DEMONSTRATION EXPERIMENTS 8
- a) Identification of functional groups in a compound by IR Spectroscopy
- b) Determination of thermal stability of the given sample by TGA and DSC techniques
- c) Study the surface morphology of a material by SEM analysis
- d) Determination of surface area, pore size and pore volume of a material by BET analysis
- e) Separation and identification of individual components present in a mixture by Chromatographic technique

TOTAL: 60 PERIODS

OUTCOMES
After completion of the laboratory course, the student will be able to –
- CO1. Analyze different type of ores
- CO2. Estimate the percent of metals in solution using chemical methods
- CO3. Determine the quality of water
- CO4. Calculate the strength of acid using analytical techniques
- CO5. Study the surface morphology and surface of a material by analytical instruments
REFERENCES
1. Laboratory Manual - Department of Chemistry, CEGC, Anna University, 2023.

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AG3211 PETROLOGY LABORATORY L T P C 0 0 4 2

OBJECTIVES:
- To develop practical exposure and skills on Petrography of rocks
- To understand the index chemical and physical properties for mineral and rock identification
- Training on sophisticated microscopes and analytical instrument handling in Petrology

UNIT I IGNEOUS PETROGRAPHY
Study of textures and structures of igneous rocks. Systematic megascopic and microscopic study of the following igneous rocks: granite, granodiorite, syenite, diorite, gabbro, dolerite, basalt and rhyolite.

UNIT II SEDIMENTARY PETROGRAPHY
Megascopic and microscopic identification of common sedimentary rocks, structures, textures

UNIT III METAMORPHIC PETROGRAPHY
Study of textures and structures of important metamorphic rocks - Systematic megascopic and microscopic study of important and common metamorphic rocks: Microscopic study of hornblende schist, mica-granite-schist, marble, quartzite, amphibolite, Charnockites etc.

UNIT IV PETROCHEMICAL CALCULATIONS

UNIT V SEDIMENTARY TECHNIQUES
sedimentary structures and its interpretations. Interpretation of SEM – recognition of physical and chemical etch marks- determination of transportation and porosity. Identification of heavy minerals and interpretation of provenance history. Sediment core logging, staining technique and identification of carbonate minerals.

**OUTCOMES:**
On completion of this course, the students are expected to be able to:
CO1. Identify different types of megascopic rock samples.
CO2. Distinguish rock types under microscope and identify constituent minerals
CO3. Determine the chemical composition of rocks and classify them.
CO4. Have skills on sedimentary analysis of rocks
CO5. Have up-to-date knowledge on modern and advanced equipment

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**AG3212**

**FIELDWORK REPORT AND SEMINAR**

**OBJECTIVES:**
- To gain the fieldwork knowledge in various geological sites
- To acquire the skills of writing and oral presentation of specific technical topic in Geology
- To develop the skills for geological field report and presentation

**Syllabus**

Students will undergo Geological fieldwork during first/second semester and submit the fieldwork reports.

The student will work for two hours per week guided by a group of staff members. They will be asked to give a presentation on any topic of their choice related to Geology and to engage in
discussion with the audience. A brief copy of their presentation also should be submitted. Similarly, the students will have to present a seminar of not less than fifteen minutes and not more than thirty minutes on a technical topic. They will defend their presentation. Evaluation will be based on the technical presentation and the report and also on the interaction shown during the seminar.

TOTAL: 30 PERIODS

OUTCOMES:
CO1. The students will be trained to carryout geological fieldwork.
CO2. The students will be able to measure geological section and structures
CO3. The students will be prepare fieldwork reports.
CO4. The students will be trained to face an audience.
CO5. The students will be able to handle the situation during the group discussion and interviews.

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AG3301 ECONOMIC GEOLOGY
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OBJECTIVES:
- To familiarize the students with the ore forming processes and mode of occurrences of ores and minerals
- To understand geological setting of Indian and global ore deposits
- To familiarize the students with National mineral policy and industrial uses of minerals

UNIT I PRINCIPLES OF ECONOMIC GEOLOGY 9
Introduction to ore and industrial minerals- Physical and optical properties of ore minerals-The nature and morphology of the principal types of ore deposit- Textures and structures of ore and gangue minerals- Classification of ore deposits Fluid inclusion studies-Wall rock alteration-Geothermometry, Geobarometry, Paragenetic Sequence, Zoning and dating of ore deposits.

UNIT II SURFACE AND INTERNAL PROCESSES 9
Internal processes: Porphyry, skarn and hydrothermal mineralization-Mineralisation associated with (i) Ultramafic, mafic and acidic rocks, (ii) greenstone belts, (iii) komatiites, anorthosites and kimberlites and (iv) submarine volcanism

UNIT III GLOBAL TECTONICS AND METALOGENY 9
Patterns in the distribution of mineral deposits – continental growth rates - crustal evaluation and metallogeny through time – plate tectonics and ore deposits. Application of fluid inclusion study and stable isotope geochemistry in understanding ore forming processes.
UNIT IV  MINERAL DEPOSITS OF INDIA

Occurrence and distribution of various minerals used in industries - metalliferous deposits in India — base metals, iron, manganese, aluminiums, chromium, nickel, gold, silver, molybdenum. Indian deposits of non-metals — mica, asbestos, barytes, gypsum, graphite, apatite and beryl-Gemstones, refractory minerals, abrasives and minerals used in glass, fertilizer, paint, ceramic and cement industries and building stones-Phosphorite deposits, Placer deposits, rare earth minerals - Strategic, critical and essential minerals.

UNIT V  MINERAL ECONOMICS


TOTAL: 45 PERIODS

OUTCOMES

On completion of this course, the students are expected to be able to:

CO1: Distinguish various ore minerals and gangue.
CO2: Understand internal processes of economic ore formation
CO3: Comprehend surface processes and related ore deposits.
CO4: Understand global occurrence of economic minerals through geologic time
CO5: Have up-to-date knowledge on Indian ore deposits and National mineral policy

REFERENCES

6. Anthony Evans, Ore Geology and Industrial Mineral, Jhon Wiley & sons, USA, 1993

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OBJECTIVES:
- To provide the knowledge of geological investigation for site selection for engineering projects.
- To provide the knowledge to understand the recent trends in geotechnical engineering.
- To provide the knowledge on various engineering properties of rocks and their suitability for site selections for dam, tunnel, coastal structure constructions.

UNIT I SURFACE AND SUBSURFACE GEOLOGICAL INVESTIGATIONS
Field investigations-electrical and seismic geophysical methods in subsurface geological investigations for foundation engineering-Description of discontinuities-bed rock attitudes, thickness, calculation of True thickness and vertical thickness of bed rock-Geological information for slope stabilization.

UNIT II ENGINEERING PROPERTIES OF ROCKS AND SOILS
Elementary concepts of rock mechanics and soil mechanics. Concepts of stress, strain, Mohr circle and failure theories. Rock description and engineering classification of rocks, Geological studies and evaluation in planning, design and construction of major civil structures. weathering and its significance in engineering site- Engineering properties of rocks and soils, RMR, RQD methods-determination of engineering properties in field and laboratory.

UNIT III GEOLOGICAL INVESTIGATIONS FOR DAMS&TUNNELS
Dams -geological investigations- suitability of site, geological profile from catchment area to Dam site- lithology, structures, topography, slope, drainage system- groundwater studies in reservoir sites-reservoir site investigations, siltation analysis-Geological investigations for soft rock and hard rock tunnels construction.

UNIT IV GEOLOGICAL INVESTIGATIONS FOR COASTAL DEVELOPMENT

UNIT V GEOTECHNICAL STUDIES OF MASS MOVEMENTS

OUTCOMES:
CO1: Students will understand the field investigation techniques
CO2: Students will able to understand the rock mechanics and soil mechanics and engineering properties of rocks and soils
CO3: Students will understand the importance of geological considerations in dams and tunnel site investigations
CO4: Students will understand the coastal processes and coastal protection structures
CO5: Students will able to understand the recent trends in geotechnical engineering

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AG3303 HYDROGEOLOGY

OBJECTIVES:
- To teach the occurrence and distribution of groundwater in various geological formations
- To educate on estimation of various aquifer parameters in the field
- To give knowledge on groundwater quality assessment and sources of contamination.

UNIT I GROUNDWATER OCCURRENCE AND DISTRIBUTION

Introduction and scope; hydrologic/water cycle; hydrographs; origin and source; distribution of groundwater; porosity and types; hydraulic conductivity and transmissivity; specific yield and specific retention; storage coefficient; aquifers – types of aquifers; groundwater occurrence in various geological formations.

UNIT II GROUNDWATER FLOW AND RESOURCES ESTIMATION

Darcy’s law – validity of Darcy’s law – hydraulic gradient; Field and laboratory tests to find out hydraulic conductivity; flow nets; homogeneity and heterogeneity; isotropic and anisotropic formations; Water budgeting - groundwater resources estimation – static and dynamic reserve.

UNIT III ESTIMATION OF AQUIFER PARAMETERS

General groundwater flow equations – steady and unsteady radial flow towards wells – confined and unconfined aquifers; effect of aquifer boundaries; estimation of aquifer parameters by recovery tests; slug tests; introduction to groundwater modelling techniques.

UNIT IV GROUNDWATER QUALITY EVALUATION

Physicochemical parameters of groundwater – major ions and trace elements; water quality standards; groundwater quality representation charts and diagrams; suitability of groundwater for various uses; calculation of ion balance error; sources of contaminants – geogenic and anthropogenic; radiation in groundwater; groundwater pollution vulnerability mapping; seawater intrusion – causes and remediation; Groundwater quality case studies.

UNIT V GROUNDWATER RESOURCES DEVELOPMENT

Well construction and completion - shallow and deep well design; horizontal wells; infiltration galleries and collector wells; rainwater harvesting and artificial recharge of groundwater; hydrogeology of India; land subsidence. Groundwater development case studies.

TOTAL: 45 PERIODS
OUTCOMES:
On completion of this course, students are expected to:
1. Understand various types of aquifers and groundwater occurrence.
2. Compute groundwater flow and fluctuation and also groundwater resources.
3. Estimate aquifer parameters using various field methods.
4. Evaluate the suitability of groundwater for various needs.
5. Plan for groundwater resources development and management.

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AG3304 GEOSPATIAL TECHNOLOGY AND ITS APPLICATIONS

OBJECTIVES:
- To teach principles and concepts of Photogrammetry, Remote Sensing and visual interpretation of satellite images.
- To teach various GIS techniques, GPS measurements and digital image processing.
- To learn the applications of geospatial techniques in geological and geomorphological mapping and provide knowledge on role of geospatial techniques in geo-hazards and geo-environmental projects.

UNIT I PHOTOGRAMMETRY AND REMOTE SENSING
Introduction to aerial photography, Aerial and space borne platforms; Photogrammetry – principles and concepts, Scale of vertical aerial photography, Parallax and vertical exaggeration, Flight / Drone mission; Introduction to remote sensing; Types of remote sensing and types of satellites; Global and Indian space missions; Types of resolution; Multispectral and hyperspectral remote sensing; Scanning mechanism; Spectral signatures of natural and geologic features. Visual interpretation of satellite images – importance of image interpretation keys.

Hands on exercise: Study of Survey of India (SOI) toposheets available in different scales; Identification of various features in aerial photos and satellite images. Setting up of stereoscope, orientation of aerial photographs under a stereoscope.
UNIT II  GEOGRAPHICAL INFORMATION SYSTEM  
Types of maps, Map scale, Various georeferencing and map projection systems; Introduction to GIS. Various Components of GIS; Types of data – spatial and non-spatial data; Vector and raster data; Digitization and scanning; Geo database – data input – retrieval – data presentation; Buffering and overlay analysis; Edge matching and rubber sheeting; DEM / DTM and TIN models; Assigning ranks and weights for geologic studies.

**Hands on exercise:** Familiarization with GIS software packages; Georeferencing, Digitization and generation of thematic maps using GIS. Preparation of DEM and TIN Models.

UNIT III  DGPS AND DIGITAL IMAGE PROCESSING  
Introduction to GPS and DGPS, Global and Indian GPS programmes; Applications of GPS. Digital image processing - Pre-processing / image rectification and restoration, Image Enhancement techniques; Image classification – unsupervised and supervised.

**Hands on exercise:** Measurements using GPS and DGPS in the field, Familiarization with Image Processing softwares; Unsuprised and Suprvised classification of satellite images;

UNIT IV  GEOLOGICAL AND GEOMORPHICAL APPLICATIONS  
Geospatial technology for lithological and structural mapping; Geomorphological mapping; Land use/land cover change detection; Mineral targeting, Groundwater prospecting and artificial recharge; Hydrocarbon exploration. Case studies for the above.

**Hands on exercise:** Preparation of geomorphological, geological and land use / land cover maps; Analysis of aerial photos and satellite images for mineral, groundwater and hydrocarbon explorations.

UNIT V  GEOHAZARDS & GEO-ENVIRONMENTAL APPLICATIONS  
Geospatial technology for Route alignment; Site selection for various geological engineering projects. Landslides and earthquake studies, Coastal erosion and Coastal Zone Management; Marine exploration; Surface water and groundwater pollution; Case studies for the above.

**Hands on exercise:** Landslide vulnerability mapping using geospatial technology; Interpretation of satellite data for various geo-hazards and geo-environmental projects. Ground truth / Field verification of maps features.

**OUTCOMES:**

On completion of this course, the student can

CO1: Understand the techniques of acquisition of data using airborne and space borne platforms.

CO2: Prepare various thematic maps using GIS techniques.

CO3: Enhance the quality of satellite images to extract more details

CO4: Interpret satellite images for geological and geomorphological studies

CO5: Apply remote sensing, GIS and GPS for various geo-hazards and geo-environmental studies.

**REFERENCES:**


TOTAL: 75 PERIODS
AG3311 HYDROGEOLOGY LABORATORY L T P C 0 0 4 2

OBJECTIVES:
- To compute water budgeting and determine hydraulic conductivity in the lab.
- To predict groundwater flow, quality and fluctuation using software packages.
- To find out aquifer parameters from the pump test results.

UNIT I WATER BUDGETING AND GROUNDWATER RESOURCES ESTIMATION 12
Determination of porosity and hydraulic conductivity in lab – constant and falling head permeameters. Water budgeting; Groundwater resources and reserve estimation.

UNIT II GROUNDWATER FLOW PREDICTION 12
Groundwater flow prediction based on groundwater head – radial vectors to indicate groundwater flow – contours to represent groundwater head; Preparation of groundwater table elevation model using software packages.

UNIT III AQUIFER PARAMETERS ESTIMATION 12
Problems on groundwater flow to wells - steady and unsteady flow – confined and unconfined aquifers – recovery tests - estimation of transmissivity and storage coefficient of wells. Field visit for conducting pump tests.

UNIT IV GROUNDWATER MODELING 12
Exposure to groundwater modeling software packages – Boundary conditions, Calibration, Validation and Prediction

UNIT V GROUNDWATER QUALITY 12
Measurement of physicochemical parameters of groundwater using water quality kits; determination of ion balance error; preparation of various water quality representation diagrams and charts using different software packages; plotting spatial variation of groundwater quality parameters using software packages.

TOTAL: 60 PERIODS

OUTCOMES:
On completion of this course, students are expected to:
1. Estimate groundwater resources and reserve.
2. Prepare water table elevation model and groundwater flow patterns.
3. Estimate hydraulic conductivity, transmissivity and storativity.
4. Assess the level of groundwater pollution
5. Determine the applicability of groundwater for various needs.
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AG3312 GEOLOGICAL FIELD TRAINING/ INSTITUTIONAL / INTERNSHIP TRAINING

OBJECTIVES:
- To train the students in the field work so as to have a firsthand knowledge
- To understand the practical problems related to geology in carrying out field and industrial geological tasks.
- To develop skills in facing and solving field problems

SYLLABUS
The students individually undertake training in reputed industries during the summer vacation for a specified period of three to four weeks. At the end of training, a detailed report on the work done should be submitted within ten days from the commencement of the semester. The students will be evaluated through a viva-voce examination by a team of internal staff.

TOTAL: 30 PERIODS

OUTCOMES
CO1. Student will be able to choose the field of training
CO2. Student will be able to develop their skills work in any types of geological field
CO3. Student will be able to work on various laboratories.
CO4. Gain knowledge on analytical instrumentation
CO5. Student will be able to prepare the geological training/internship reports individually.

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OBJECTIVES:
- To teach students on surface and underground mining methods
- To teach ore reserve estimation and ore body modeling.
- To teach them mineral prospecting, sampling and drilling techniques.

UNIT I  MINERAL MAPPING

UNIT II  SAMPLING AND ASSAYING
Macro/Micro Economic Considerations - Sampling – Types - Sampling Quantity-Spacing, Sampling error of Mean-Sample Data Processing-Interpretation- Drilling – surface drilling and underground drilling, definition drilling – Core, Diamond Drilling arrangement - Core logging, Preparation of Slice Plan-Maximising Drill Data Vis-à-vis Cost of Drilling-Preparation of Assay Plans/Sections - Cutoff Grade- ROM Grade, Determination of Mineable Limits, Breakeven Stripping Ratio-Ultimate depth-Pit Limit for Different cut-off.

UNIT II  ORE RESERVE ESTIMATION

UNIT IV  OREBODY MODELLING
Integrating Surface/ Underground mapping - Drilling Sampling to evolve a 3D Model – Level plan and slice plan, Fold/Fault Interpretation from Maps and Bore hole Data – Software Applications in 3D orebody modelling including GIS

UNIT V  SURFACE AND UNDERGROUND MINING METHODS
Surface Mining – Development of Bench Mining-Concept-Height/Width/Slope of Benches- Manual and Mechanised Strip/Terrace/Open pit Mining - Initial Mine Cut-Production per Blast, Typical Open cast Layout - Placer and Alluvial Mining - Underground Mining - Various Coal and Metal Mining Methods - Stoping/Development activities – Cut and fill, Block caving – Solution mining and its importance.

OUTCOMES:
On completion of this course, the students expected to be able to:
- CO1. Carry out individual mine survey using surveying methods
- CO2. Do sampling and prepare slice plan.
- CO3. Carry out ore reserve estimation for surface and underground deposits.
- CO4. Gain knowledge on surface mining methods
- CO5. Understand underground mining methods

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**AG3411 PROJECT WORK**

**OBJECTIVES:**
- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature
- To develop the methodology to solve the identified problem
- To train the students in preparing project reports and to face reviews and viva-voce examination.

**SYLLABUS**
The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the Head of the department. The students will be evaluated through a viva-voce examination by a panel of the examiners including one external examiner.

**TOTAL: 360 PERIODS**

**OUTCOMES:**
- CO1. Students will be able to conceptual and identify a scientific problem
- CO2. Able to find a suitable methodology
- CO3. Can do individual fieldwork and sampling related to the project work
- CO4. Students can develop the skills for data analysis and interpretation
- CO5. Students will be able to write a compile their findings and produce a report.
OBJECTIVES:
- To study the chemical properties of Groundwater.
- To understand various reactions and ion exchange processes that affect quality of water.
- Also to understand interactions between water and minerals in surface and subsurface formations.

UNIT I  GROUNDWATER SAMPLING AND EQUILIBRIUM

UNIT II  CARBONATE REACTIONS

UNIT III  REDOX REACTIONS

UNIT IV  ION EXCHANGE PROCESSES

UNIT V  SILICATE WEATHERING

OUTCOMES:
On completion of this course, the students expected to be able to:
CO1:  Groundwater sampling and calculation of chemical parameters.
CO2:  Have better understanding on role of carbonate and Redox reactions on mineral stability.

TOTAL: 45 PERIODS

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AG3001  APPLIED HYDROGEOCHEMISTRY
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TOTAL: 45 PERIODS
CO3: Comprehend the ion exchange processes and distribution of coefficients
CO4: Gain knowledge on role of hydrogeochemical sequences
CO5: Understand the relationship between clay minerals and water chemistry during weathering

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AG3002 NATURAL DISASTER AND MITIGATIONS

OBJECTIVES:
- To teach characteristics of natural hazards.
- To teach mitigation methods for natural hazards.
- To provide knowledge on assessment and management of natural hazards.

UNIT I DISASTER PHENOMENON
Disaster threat - characteristics-parameters – mapping aspects for earthquake, landslides, tsunami, cyclones, flood, drought and epidemics.

UNIT II MITIGATION

UNIT III ASSESSMENT

UNIT IV MANAGEMENT
UNIT V  CASE STUDIES AND ADVANCED TOOLS
Post disaster review – role of remote sensing and GIS – National and state level case studies on various disasters.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of this course, the students expected to be able to:
CO1. Gain knowledge on natural hazards and their characteristics
CO2. Have better understanding on geological and hydrological hazards
CO3. Appreciate various mitigation techniques.
CO4. Carryout risk assessment and vulnerability mapping
CO5. Understand the role of remote sensing and GIS in natural hazard risk reduction.

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AG3003  ENVIRONMENTAL GEOLOGY

OBJECTIVES:
- To provide the knowledge on Geology and environment, impacts due to mineral, soil and land degradation.
- To expose the students to assess various geological environments like terrestrial, aquatic, etc.
- To provide knowledge and guidelines to assess and plan various environmental issues.

UNIT I  GEOLOGIC ENVIRONMENTS

UNIT II  TERRESTRIAL ENVIRONMENT
Environmental degradation due to mining and ore beneficiation – Air Pollution - sources of pollution - pollution due to dust and waste disposal-Mining – opencast – underground - disposal of industrial
and radio-active waste - dumping stacking – rehandling – management - mineral processing - tailing ponds - acid mine drainage – siltation - soil and mineral resources and their conservation-National and International standards- impact and management – Indian case studies

UNIT III AQUATIC ENVIRONMENT
Carbonate system and pH control. Water-rock interaction and solubility of minerals; incongruent dissolution of primary silicates; mass balance approach to weathering. Geological factors influencing the formation of surface, groundwater and marine Waters – geological basis of groundwater, surface and marine water pollution and management with Indian case studies

UNIT IV GEOLOGY IN ENVIRONMENTAL PLANNING AND MANAGEMENT
Environmental impact assessment – geological appraisal of waste disposal sites - geology in planning and siting of land fills - problems of deep well disposal, radioactive waste management - land use planning in EIA

UNIT V GEOLOGICAL HAZARDS AND GLOBAL ENVIRONMENTAL CHANGE
Resources – renewable and non-renewable. Natural and man-made hazards; Causes, types, Mitigation and Management of earthquakes, landslides, tsunami and volcanoes; Causes and Indicators of global environmental change

OUTCOMES:
CO1. Students will understand the earth processes and landforms
CO2. Students will able to understand the terrestrial environment issues
CO3. Students will learn about geological factors influencing the aquatic environment
CO4. Students will understand the role of geology in environmental planning and management
CO5. Students will able to understand the mitigation and management on geological hazards

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AG3004 GEOPROSPECTING

OBJECTIVES:
- To familiarize the students with geological mapping techniques.
- To teach geophysical methods of prospecting for ores and minerals
- Also to provide knowledge on geochemical prospecting methods.

UNIT I GEOLOGICAL PROSPECTING
Geological prospecting - field survey and mapping techniques - field equipments - methods of mapping - pits and trenches - sampling-geological map preparation.
UNIT II ELECTRICAL METHODS

UNIT III SEISMIC METHODS

UNIT IV MAGNETIC AND GRAVITY METHODS

UNIT V GEOCHEMICAL PROSPECTING

TOTAL: 45 PERIODS

OUTCOMES:
On completion of this course, the students expected to be able to:
CO1. Carryout individual field study using geological mapping techniques.
CO2. Collect, process and analyse data using various geophysical methods
CO3. Explore the subsurface using geophysical methods
CO4. Gain knowledge on geochemical methods
CO5. Do accurate interpretation of data and locate economical ore reserves.

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AG3005 GROUNDWATER CONTAMINATION

OBJECTIVES:
- To study about the sources of groundwater and its parameters
- To understand various contaminations and its sources.
- To gain knowledge on remediation methods.

Attested

DIRECTOR

Centre for Academic Courses
Anna University, Chennai-600 025
UNIT I  
INTRODUCTION
9
Groundwater occurrence and flow – types of porosity – transmissivity and storage coefficient - significance in groundwater contamination - sources of contamination – landfills

UNIT II 
TYPES OF CONTAMINATION
9
Types – point and non point sources – natural and anthropogenic - organic and poly aromatic compounds – biological – other sources –gasoline spills on the water table - chlorinated solvent spills which sink

UNIT III  
IDENTIFICATION OF CONTAMINATION
9
Application of electrical conductivity measurement for soil and groundwater contamination - Application of Ground Penetration Radar and other methods

UNIT IV  
TRANSPORT PROCESS
9
Advection, dispassion and diffusion-sorption, biodegradation, transformation, retardation and attenuation of solutes – radionuclide transport

UNIT V  
REMEDICATION
9
Waste site characterization-Geochemical modelling-Modeling concepts -Thermodynamics - groundwater quality - Emerging remediation methods, including surfactant and co-solvent soil flushing

TOTAL: 45 PERIODS

OUTCOMES:
On completion of this course, the students expected to be able to:
CO2. Have better understanding various contaminants of groundwater and their sources
CO3. Use geophysics methods to delineate contaminated sites of soil and groundwater.
CO4. Gain knowledge contaminant transport due to groundwater
CO5. Evaluate and suggest remediation for contaminated sites.

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Director
Centre for Academic Courses
Anna University, Chennai-600 025
OBJECTIVES:
- To study the economic importance of minerals and resources
- To teach mining project evaluation and mineral conservation.
- To provide knowledge on mineral policies and environmental protection.

UNIT I ECONOMICS IN MINERAL EXPLORATION 9
Economic Considerations in Mineral Exploration; Systematic approach to Exploration Expenditure; In-situ and Mineable Reserves; Pit Optimization; Bulk Sampling; Pilot Plant Studies; Demand and Price Projections.

UNIT II MINERAL/MINE ECONOMICS AND FINANCE 9
Source of Mine Finance; Factors governing profitability; Concepts of Depreciation, Depletion, Present value, Cash Flow and DCF; Costs-Capital, Fixed / variable, Ownership; P & L Account; Balance Sheet.

UNIT III MINERAL PROJECT EVALUATION 9
Time Value of Money; Project Evaluation Technique-Pay Back, Discounted Pay Back, DCF, IRR; Project Ranking; Sensitivity analysis; Feasibility study-Prospect and Operating Mines; Preparation of Mine Plan under Mineral Concession Rules.

UNIT IV MINERAL CONSERVATION 9
Growth of the awareness; Means of conservation; Limitations in Scope; Wealth from Mineral waste; Co-products and By-products; Substitute for Minerals.

UNIT V MINERAL POLICIES AND ENVIRONMENT 9
National Mineral Policy; Prospecting License and Mining Lease; Mines Act, CMR, MMR, Mines Rules, MMRD Act and Rules, EMP, EIA.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of this course, the students expected to be able to:
- CO1. Understand the economics involved in mineral exploration
- CO2. Have better knowledge on finance and economics of mine operation and production
- CO3. Comprehend mineral project evaluation
- CO4. Adopt methods to conserve minerals and resources
- CO5. Understand the national mineral policy and environmental assessments.

REFERENCES
4. Bruce, A.K. 1990 Surface Mining, Colorado, Society for Mining, Metallurgy and Exploration, Inc. Published Mines/Minerals Legislations

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DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025
OBJECTIVES:
- To study the microfossils and their various types
- To understand different calcareous microfossils belong to different environment.
- To understand siliceous microfossils their role in sequence and biostratigraphic studies

UNIT I INTRODUCTION
Introduction to Micropaleontology- scope. Relationship of micropaleontology with ocean sciences; Modern field and laboratory techniques in the study of microfossils (collection, sampling and processing techniques, scanning electron microscopy and mass spectrometry);

UNIT II CALCAREOUS MICROFOSSILS
(i) Foraminifera - Benthic foraminifera, Planktic foraminifera, their modern biogeography, outline of morphology, significance in Cenozoic oceanic biostratigraphy and paleoceanographic, paleoclimatic interpretations.
(ii) Ostracoda - outline of morphology and wall structure, their significance in environmental studies and oceanic biostratigraphy.
(iii) Pteropoda - a brief introduction, application of pteropods.

UNIT III SILICEOUS MICROFOSSILS

UNIT IV NANNOFOSSILS AND PTEROPODS
Calcareous nannofossils - outline of morphology, modern biogeography and their application in oceanic biostratigraphy and paleoceanographic, paleoclimatic reconstructions; Pteropoda - a brief introduction, application of pteropods.

UNIT V MICROFOSSILS AND ITS APPLICATIONS
Study of microfossils from Precambrian- Quaternary; applications – age determination, paleofacies; Interpretation of tectonics from micro faunal evidence. A brief account of the concepts and methods for the development of micropaleontological indicators useful in reconstruction of history of past, environmental changes and biostratigraphic correlation. Uses in coal and oil exploration.

TOTAL: 45 Periods

COURSE OUTCOMES:
On completion of this course, the students expected to be able to:
CO1. Understand scope of micro fossils in oil exploration.
CO2. Distinguish and identify various calcareous micro fossils
CO3. Identify nannofossils and pteropods.
CO4. Individually collect and identify microfossils, spores and pollens
CO5. Gain knowledge on role of microfossils in oil exploration

REFERENCES
OBJECTIVES:
- To study the chemical constituents of earth materials and their link to health
- To understand various natural toxicants and contaminants.
- To understand various techniques and tools to identify natural toxicity

UNIT I
INTRODUCTION
The Foundations of Medical Geology, Geochemical Classification of the Elements, Contributions to Medical Geology from Public Health and Environmental Medicine, Development of Medical Geology.

UNIT II
PATHWAYS AND EXPOSURES

UNIT III
GEOLOGY HUMAN HEALTH
Natural Distribution and Abundance of Elements, Anthropogenic Sources, Uptake of Elements from a Chemical Point of View, Uptake of Elements from a Biological Point of View, Biological Functions of the Elements, Geological Impacts on Nutrition, Biological Responses of Elements

UNIT IV
GEOPATHOLOGY AND TOXICOLOGY
Environmental Epidemiology, Environmental Medicine, Environmental Pathology, Toxicology, Speciation of Trace Elements, Geophagy and the Involuntary Ingestion of Soil, Natural Aerosolic Mineral Dusts and Human Health, The Ecology of Soil-borne Human Pathogens, Animals and Medical Geology

UNIT V
TECHNIQUES AND TOOLS
Mapping Geological factors for human health using RS and GIS - Investigating Vector-Borne and Zoonotic Diseases, Mineralogy of Bone, Inorganic and Organic Geochemistry Techniques, Histochemical and Microprobe Analysis in Medical Geology.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
On completion of this course, the students expected to be able to:
CO1. Understand the characteristics of natural materials and their link to public health
CO2. Have better understanding on pathways and exposures to natural toxicity
CO3. Appreciate geology and human health relationship.
CO4. Gain knowledge on natural toxicology and geopathology
CO5. Use different techniques to enable probing of diseases in medical geology

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AG3009 MARINE GEOLOGY L T P C 3 0 0 3

OBJECTIVES:
- To understand the Ocean features, geological resources, Ocean environment, and Ocean geology.
- To understand the exploration and exploiting methods
- To understand the various instrumentations and its techniques.

UNIT I PHYSICAL FEATURES OF THE OCEAN

UNIT II OCEANIC CRUST, SEDIMENTS
UNIT III OCEAN RESOURCES
Classification of marine mineral deposits. Origin and depositional system of marine resources; beach placers, shelf deposits, deep ocean Phosphatic, Polymetallic nodules, sulfate deposits, hydrocarbon deposits, Ocean-energy resources, Tidal energy-potential, Wave energy-potential, Ocean Thermal Energy Conversion (OTEC), Sea water as a resource.

UNIT IV OCEANOGRAPHIC INSTRUMENTATIONS
Descriptions of research vessels, cruise, position fixing in the sea; sampling devices – Grab samplers, bottom samplers, dredges, sediment traps, boomerang samplers, water samplers, Winches, temperature measurement instruments, tools for studying ocean floor topography. POD, COD, GOD and BOD tools kit.

UNIT V OCEAN POLLUTION AND LAW OF THE SEA

TOTAL: 45 PERIODS

OUTCOMES:
CO1. Students will understand the physical features of the ocean
CO2. Students will able to understand the morphologic and tectonic domains of the ocean floor
CO3. Students will learn about the various ocean resources
CO4. Students will understand the various oceanographic instrumentations used for marine exploration
CO5. Students will able to understand the law of the sea

REFERENCES
6. Suzy Bullock, Marine Geology, 2017

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OBJECTIVES:
- To provide information on exploration of mineral and ore petroleum deposits,
- To teach methods of ore reserve estimations, mineral economics and feasibility studies,
- To describe mineral processing and beneficiation and national mineral policies.

UNIT I: PRE FEASIBILITY STUDIES
Application of Geo Statistics Variogram Range, Kriging - Ore body Optimisation- Bulk Sampling, pilot Plant Saturation Prospecting, Categorisation curve- Block Recovery - grade Vis-à-vis In-situ grade

UNIT II: MINE MINERAL ECONOMICS

UNIT III: MINERAL PROJECT FEASIBILITY

UNIT IV: MINERAL PROCESSING/BENEFICIATION

UNIT V: MINERAL POLICIES

TOTAL: 45 PERIODS

OUTCOMES:
On completion of this course, the students expected to be able to:
- CO1. Carry out pre-feasibility studies on mineral prospecting.
- CO2. Have better understanding of mine mineral economics
- CO3. Evaluate and do feasibility studies for operating mines.
- CO4. Gain employment in mineral mining and beneficiation industries
- CO5. Carry out strategic studies for sick mineral based industries

REFERENCES:
AG3011 NUCLEAR ISOTOPE GEOLOGY

OBJECTIVES:
- To study the radioactive elements and different dating methods
- To understand stable isotopes and their use in Geochronology
- To teach on isotopes and their significance in geological studies.

UNIT I INTRODUCTION AND THE PHYSICS OF THE NUCLEUS
Radioactive Decay - Nucleosynthesis Geochronology, Basics of Radiogenic Isotope Geochemistry, The K-Ca-Ar system - The K-Ar and Rb-Sr systems - The Sm-Nd system - The U-Th-Pb system - The U-Th-Pb system: Zircon dating - U-Th decay series dating - Other decay systems.

UNIT II ISOTOPOES IN GEOCHRONOLOGY

UNIT III STABLE ISOTOPE GEOCHEMISTRY

UNIT IV STABLE ISOTOPES AND APPLICATIONS IN PALAEOCLIMATE STUDY
Paleontology and Archaeology, application to paleoclimatology-deep sea, continental records. The Carbon Cycle. Isotopes, and climate Tree ring studies

UNIT V CARBON ISOTOPE AND PETROLEUM GEOCHEMISTRY
Sulphur isotopes, diffusion experiments in isotope geology with case studies.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of this course, the students expected to be able to:
- CO1. Understand the radiogenic isotope geochemistry.
- CO2. Have better understanding of isotopes in geochronology
- CO3. Appreciate role of stable isotopes in geological studies
- CO4. Gain knowledge on stable isotopes and their application for paleoclimate studies
- CO5. Understand the role of carbon isotopes in oil exploration
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AG3012 OIL EXPLORATION AND PRODUCTION

OBJECTIVES:
- To teach prospecting methods for oil exploration.
- To teach reserve estimation for oil production.
- To provide knowledge on logging and reservoir properties.

UNIT I SEISMIC PROSPECTING

UNIT II RESERVE ESTIMATION AND DRILLING OPERATION

UNIT III DRILLING MUD
UNIT IV  CASING AND CEMENTATION
Casing—types, policy, specifications, forces acting—Casing design—preparation of casing to be lowered. Cementation—composition, properties, types, cementation—procedures applications.

UNIT V  WELL LOGGING RESERVOIR ENGINEERING AND PRODUCTION
Well logging—basic concepts—well bore environments—Logging Methods—Interpretation—calculation of saturation, gas saturation, water saturation porosity, permeability—finding oil, gas and water. Perforation techniques—well completion—fittings of well head, casing head housings, casing test, transportation of oil. Reservoir engineering—principles—Oil recovery—primary, secondary enhanced oil recovery techniques—chemical methods—miscible methods—thermal method—Petroleum management and economics.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of this course, the students expected to be able to:
CO1. Understand the seismic method of prospecting for Oil.
CO2. Carry out reserve estimation and understand drilling operations.
CO3. Gain knowledge on drilling mud and its properties.
CO4. Understand procedure involved in casing and cementation.
CO5. Comprehend well logging methods and reservoir engineering.

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OBJECTIVES:
- To teach optical properties and identification ore minerals.
- To provide knowledge on geothermometry studies.
- To teach ore mineral beneficiation methods.

UNIT I  ORE MICROSCOPY

UNIT II  ORE FABRICS

UNIT III  FLUID INCLUSION

UNIT IV  MINERAL TECHNOLOGY
Ore microscopy usage in mineral technology – information from mineralogical studies – mineral dressing processes.

UNIT V  MINERAL BENEFICATION

OUTCOMES:
On completion of this course, the students expected to be able to:
CO1. Identify minerals under reflected light.
CO2. Classify minerals using ore textures and structures.
CO3. Carryout geothrmo-metry studies.
CO4. Gain knowledge on mineral dressing processes.
CO5. Understand the mineral beneficiation methods.

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TOTAL: 45 PERIODS
OBJECTIVES:
- To introduce the concepts of planetary science and Geology.
- To provide information on inner planets of the solar system
- To teach planetary remotesensing

UNIT I INTRODUCTION TO PLANETARY SCIENCE
The sun - vital statistics of the sun - Solar system - origin - physics, chemistry, and the surface features of the solid bodies in the solar system; Solar system - Celestial sphere - the growth of the geocentric system - physical properties of objects in the solar system.

UNIT II PLANETS
Physical properties - optical properties - rotation and magnetic field-surface temperature. Surface features of the terrestrial planets; Inner planets - Geological phenomena - tectonic, volcanic, impact cratering, eolian, fluvial, glacial and possibly lacustrine and marine processes; Outer planets – formation and evolution processes – satellite-characteristic features.

UNIT III EARTH AND MOON
The earth: Planetary evolution - gross properties – solar terrestrial relations - earth in space-interior-geologic process; Moon-origin - basic facts - telescopic studies - internal structure-surface features-environment - surface composition and mineralogy and atmospheric conditions

UNIT IV ASTEROIDS-METEORITES-COMETS
Classification-physical and chemical properties, difference between asteroids-comets-meteors-geochemistry - relationship between earth and meteorite geochemistry; satellites - medium, small and tiny their- geology, interior, surface properties, atmosphere and potential for life.

UNIT V PLANETARY REMOTE SENSING
Study of planetary images, and construction of geological maps from orbital images and Rover (insitu); planetary data formats-Missions to - Moon- Mars-Venus- for geological exploration; Lunar return samples – Apollo-Luna.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of this course, the students expected to be able to:
CO1. Understand the Planetary science.
CO2. Have better understanding of planets and their geomorphologic features
CO3. Comprehend the knowledge on earth and moon and their properties
CO4. Gain knowledge on asteroids, meteorites and comets
CO5. Understand planetary remote sensing and its applications.

REFERENCES:
3. A.M. Davis 2003. Meteorites, Comets, And Planets, Published by University of Chicago, IL, USA.
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AG3015 QUATERNARY GEOLOGY L T P C
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OBJECTIVES:
- To understand the Quaternary period and types of Quaternary deposits.
- To understand the Quaternary Study Techniques
- And to understand the Causes of Quaternary climate change.

UNIT I QUATERNARY IN INDIA
Definition of Quaternary- Introduction to Quaternary deposits in India-Quaternary Stratigraphy – Oxygen Isotope stratigraphy, biostratigraphy and magnetostratigraphy. Quaternary soil types.

UNIT II CHRONOLOGY OF QUATERNARY SEDIMENTS
Relative chronologies and correlation-use of flora and fauna-non-radioactive techniques, dating methods- radiocarbon, U/Th, Pb-Pb with case studies and dendrochronology.

UNIT III QUATERNARY CLIMATE AND EMERGENCE OF HOMINIDS
Causes of Quaternary climate change-manifestation of Quaternary climate change and current issues in climate change-Human and Quaternary climate change-fauna at the Pliocene-Quaternary transition-emergence of hominids and evolution of Man.

UNIT IV GLACIAL AND INTERGLACIAL CYCLES
Glacial-interglacial cycles-eustatic changes-proxy indicators of paleoenvironmental/ paleoclimatic changes - land, ocean and cryosphere (ice core studies)-Responses of geomorphic systems to climate, sea level and tectonics on variable time.

UNIT V NEOTECTONICS
Tectonic geomorphology, neotectonics, active tectonics and their applications to natural hazard assessment with case studies.

TOTAL: 45 PERIODS

OUTCOMES:
CO1. Students will understand the Quaternary period and types of Quaternary deposits.
CO2. Students will able to understand the dating methods and correlation studies.
CO3. Students will learn about the manifestation of Quaternary climate change and current issues in climate change.
CO4. Students will understand the proxy indicators of paleoenvironmental/ paleoclimatic changes.
CO5. Students will able to understand the Neotectonics and deformation during the Quaternary Period.
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AG3016
SEQUENCE STRATIGRAPHY

OBJECTIVES:
- To teach the sequence stratigraphy techniques and its applications
- To understand depositional systems and models.
- To teach stratigraphic cycle and biostratigraphic records.

UNIT I INTRODUCTION
Introduction to sequence stratigraphy, scope, applications in exploration of hydrocarbons, stratigraphic terminology, problems and research trends, stratigraphic architecture, facies and sea level cycles.

UNIT II SEQUENCE STRATIGRAPHY
Construction of sequence framework, importance of unconformities, assessing regional and global changes in sea level, areas and volumes of stratigraphic units, hypsometric curves, back stripping, integrated tectonic stratigraphic analysis.

UNIT III SEQUENCE DEPOSITIONAL MODEL
Depositional systems and systems tracts, sequence boundaries, litho-log analysis, sedimentary facies, fossil assemblages, counts and their controls, paleoecology & Milankovitch processes.

UNIT IV STRATIGRAPHIC CYCLES
Types of stratigraphic cycles, tectno-stratigraphic model, Eustasy, epiorogeny, global cycle chart, tectonic mechanisms.

UNIT V SEQUENCE BIOSTRATIGRAPHY
Determination of the biostratigraphic framework, diachroneity of the biostratigraphic record, dating and correlation of stratigraphic events, time in sequence stratigraphy. Applications of sequence bio stratigraphy.

TOTAL: 45 PERIODS
OUTCOMES:
On completion of this course, the students expected to be able to:
CO1. Understand the scope of sequence stratigraphy.
CO2. Construct sequence framework.
CO3. Carry out litho-log analysis and mark sequence boundaries.
CO4. Gain knowledge techno-stratigraphic models
CO5. Understand the sequence biostratigraphy and its applications.

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AG3017 GEOSTATISTICS

OBJECTIVES:
- To know the fundamental concepts of probability and probability distributions.
- To understand Non-linear and Non-parametric Geostatistics.
- To learn the Geostatistical simulations and applications.

UNIT I INTRODUCTION
Introduction to probability: Random experiments, Events, Sample space, Definitions of probability. Mathematical expectation, Moment generating and Characteristic functions. Binomial, Poisson, Normal, Gamma, Exponential, Hypergeometric, Multinomial Distributions.

UNIT II PROBABILITY DISTRIBUTIONS
Random variables, Discrete and Continuous Probability Distributions, Joint Probability Distributions, Conditional Probability Distributions. Ordinary Kriging: Definition, Point/Block estimation procedures, Techniques of semi-variogram model fitting; Geostatistical evaluation scheme; Effect of Nugget variance on kriged weights.

UNIT III NON-LINEAR AND NON-PARAMETRIC GEOSTATISTICS
UNIT IV GEOSTATISTICAL SIMULATION


UNIT V GEOSTATISTICAL APPLICATIONS

Optimization of exploration drilling, Calculation of mineral inventory, Establishment of grade-tonnage relations, Calculation of planning cut-off grade; Misclassified tonnages; Geostatistical grade control plan. Introduction to Statistical Inference, Sampling Distributions, Point and Interval estimation, Hypothesis testing involving one and two univariate populations.

TOTAL: 45 PERIODS

REFERENCES:

OUTCOMES:
On completion of the course, the student is expected to be able to

CO1: Solve the problems related to the probability.
CO2: Work with probability distributions and Kriging.
CO3: Apply non-linear and non-parametric geostatistics, regression and factor analysis.
CO4: Perform geostatistical Simulations.
CO5: Use geostatistics for geoscience applications.

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DIRECTOR
OBJECTIVES:

- To impart knowledge to classify the soil based on index properties
- To assess their engineering properties based on the classification.
- To familiarize the students about the fundamental concepts of strength of soils

UNIT I  SOIL CLASSIFICATION AND COMPACTION  9

UNIT II  EFFECTIVE STRESS AND PERMEABILITY  9

UNIT III  STRESS DISTRIBUTION AND SETTLEMENT  9
Stress distribution in homogeneous and isotropic medium – Boussinesq theory – (Point land, Line land and udl) Use of New marks influence chart –Components of settlement — Immediate and consolidation settlement – Terzaghi’s one dimensional consolidation theory – Computation of rate of settlement. - \( \sqrt{t} \) and log \( t \) methods– e-log p relationship.

UNIT IV  SHEAR STRENGTH  9
Shear strength of cohesive and cohesion less soils – Mohr-Coulomb failure theory – Measurement of shear strength - Direct shear, Triaxial compression; UCC and Vane shear tests – Pore pressure parameters – Cyclic mobility – Liquefaction.

UNIT V  SLOPE STABILITY  9

OUTCOMES:

On completion of the course, the student is expected to be able to

CO1. Demonstrate an ability to identify various types of soils and its properties, formulate and solve engineering Problems
CO2. Show the basic understanding of flow through soil medium and its impact of engineering solution
CO3. Understand about the basic concept of stress distribution in loaded soil medium and soil settlement due to consolidation
CO4. Show the understanding of shear strength of soils and its impact of engineering solutions to the loaded soil medium and also will be aware of contemporary issues on shear strength of soils.
CO5. Demonstrate an ability to design both finite and infinite slopes, component and process as per needs and specifications.

REFERENCES:


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MA3001 DATA SCIENCE AND ANALYTICS

OBJECTIVES:
- To know the fundamental concepts of data science and analytics and data analysis using R.
- To understand various data modeling techniques and stream data.
- To learn the basic and advanced features of open source big data tools and frameworks.

UNIT I INTRODUCTION TO DATASCIENCE AND BIG DATA

UNIT II DATA ANALYSIS USING R

UNIT III DATA MODELING
UNIT IV  DATA ANALYTICAL FRAMEWORKS  

UNIT V  STREAM ANALYTICS  

TOTAL : 45 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to
CO1 : Convert real world problems to hypothesis and perform statistical testing.
CO2 : Work with big data platform and its analysis techniques.
CO3 : Select and employ mechanisms for tracking the software projects and maintaining quality.
CO4 : Write efficient MapReduce programs for small problem-solving methods.
CO5 : Implement suitable data analysis for stream data.

REFERENCES:

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