ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

Programme: B.Sc. Honours in Geology (Major)

w.e.f. AY 2023-24

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	I	1	Essentials and Applications of Mathematical, Physical and Chemical Sciences	3+2	4
	I	2	Advances in Mathematical, Physical and Chemical Sciences	3+2	4
	II	3	Geology and Branches of Geology	3	3
			Geology and Branches of Geology Practical Course	2	1
	II	4	Physical Geology and Soil Science	3	3
			Physical Geology and Soil Science Practical Course	2	1
II	III	5	Crystallography & Mineralogy	3	3
			Crystallography & Mineralogy Practical Course	2	1
		6	Palaeontology	3	3
			Palaeontology Practical Course	2	1
		7	Fossil Fuels	3	3
			Fossil Fuels Practical Course	2	1
		8	Field Geology	3	3
			Field Geology Practical Course	2	1
	IV	9	Elements of Petrology	3	3
			Elements of Petrology Practical Course	2	1
		10	Igneous, Metamorphic & Sedimentary Petrology	3	3
			Igneous, Metamorphic & Sedimentary Petrology Practical Course	2	1
		11	Structural Geology	3	3
			Structural Geology Practical Course	2	1

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
III	V	12	Economic Geology	3	3
			Economic Geology Practical Course	2	1
		13	Indian Geology & Stratigraphy	3	3
			Indian Geology & Stratigraphy Practical Course	2	1
		14 A	Geodynamics & Geochronology	3	3
			Geodynamics & Geochronology Practical Course	2	1
		OR			
		14 B	Drilling & Sampling methods	3	3
			Drilling & Sampling methods Practical Course	2	1
		15 A	Hydrologeology	3	3
			Hydrologeology Practical Course	2	1
		OR			
		15 B	Groundwater Exploration	3	3
			Groundwater Exploration Practical Course	2	1
IV	VII	16 A	Atmospheric Science	3	3
			Atmospheric Science Practical Course	2	1
		OR			
		16 B	Fundamentals of Geophysics	3	3
			Fundamentals of Geophysics Practical Course	2	1
		17 A	Geochemistry	3	3
			Geochemistry Practical Course	2	1
		OR			
		17 B	Geotectonics	3	3
			Geotectonics Practical Course	2	1
		18 A	Marine Geology	3	3
			Marine Geology Practical Course	2	1
		OR			
		18 B	Mineral Economics	3	3
			Mineral Economics Practical Course	2	1
		SEC			
		19 A	Mining Methods & Mine Planning	2	1
			Mining Methods & Mine Planning Practical Course	3	3
		OR			
		19 B	Introduction to Remote Sensing and Digital Image Processing	2	1
			Introduction to Remote Sensing and Digital Image Processing Practical Course	3	3

		20 A	Basics of Geographical Information System	2	1
			Basics of Geographical Information System Practical Course	3	3
		OR			
		20 B	Sampling and Geological Mapping	2	1
			Sampling and Geological Mapping Practical Course	3	3
	VIII	21 A	Micropalaeontology	2	1
			Micropalaeontology Practical Course	3	3
		OR			
		21 B	Energy Resources	2	1
			Energy Resources Practical Course	3	3
		22 A	Natural Hazards and Management	2	1
			Natural Hazards and Management Practical Course	3	3
		OR			
		22 B	Mineral Exploration	2	1
			Mineral Exploration Practical Course	3	3
		23 A	Ore Beneficiation	2	1
			Ore Beneficiation Practical Course	3	3
		OR			
		23 B	Engineering Geology	2	1
			Engineering Geology Practical Course	3	3
		SEC			
		24 A	GIS & GPS Applications	3	3
			GIS & GPS Applications Practical Course	2	1
		OR			
		24 B	Petroleum Geology	3	3
			Petroleum Geology Practical Course	2	1
		25 A	Remote Sensing Applications in Natural Resource Exploration	3	3
			Remote Sensing Applications in Natural Resource Exploration Practical Course	2	1
		OR			
		25 B	Visual & Digital Interpretation	3	3
			Visual & Digital Interpretation Practical Course	2	1

SEMESTER-I

COURSE 1: ESSENTIALS AND APPLICATIONS OF MATHEMATICAL, PHYSICAL ANDCHEMICAL SCIENCES

Theory Credits: 4 5 hrs/week

Course Objective:

The objective of this course is to provide students with a comprehensive understanding of the essential concepts and applications of mathematical, physical, and chemical sciences. The course aims to develop students' critical thinking, problem-solving, and analytical skills in these areas, enabling them to apply scientific principles to real-world situations.

Learning outcomes:

1. Apply critical thinking skills to solve complex problems involving complex numbers, trigonometric ratios, vectors, and statistical measures.

2. To Explain the basic principles and concepts underlying a broad range of fundamental areas of physics and to Connect their knowledge of physics to everyday situations

3. To Explain the basic principles and concepts underlying a broad range of fundamental areas of chemistry and to Connect their knowledge of chemistry to daily life.

4. Understand the interplay and connections between mathematics, physics, and chemistry in various applications. Recognize how mathematical models and physical and chemical principles can be used to explain and predict phenomena in different contexts.

5 To explore the history and evolution of the Internet and to gain an understanding of network security concepts, including threats, vulnerabilities, and countermeasures.

UNIT I: ESSENTIALS OF MATHEMATICS:

Complex Numbers: Introduction of the new symbol i – General form of a complex number – Modulus-Amplitude form and conversions

Trigonometric Ratios: Trigonometric Ratios and their relations – Problems on calculation of angles**Vectors:** Definition of vector addition – Cartesian form – Scalar and vector product and problems **Statistical Measures**: Mean, Median, Mode of a data and problems

UNIT II: ESSENTIALS OF PHYSICS:

Definition and Scope of Physics- Measurements and Units - Motion of objects: Newtonian Mechanics and relativistic mechanics perspective - Laws of Thermodynamics and Significance- Acoustic waves and electromagnetic waves- Electric and Magnetic fields and their interactions- Behaviour of atomic and nuclear particles- Wave-particle duality, the uncertainty principle- Theories and understanding of universe

UNIT III: ESSENTIALS OF CHEMISTRY: :

Definition and Scope of Chemistry- Importance of Chemistry in daily life -Branches of chemistry and significance- Periodic Table- Electronic Configuration, chemical changes, classification of matter, Biomolecules- carbohydrates, proteins, fats and vitamins.

UNIT IV: APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY:

Applications of Mathematics in Physics & Chemistry: Calculus , Differential Equations & Complex Analysis

Application of Physics in Industry and Technology: Electronics and Semiconductor Industry, Robotics and Automation, Automotive and Aerospace Industries, Quality Control and Instrumentation, Environmental Monitoring and Sustainable Technologies.

Application of Chemistry in Industry and Technology: Chemical Manufacturing, Pharmaceuticals and Drug Discovery, Materials Science, Food and Beverage Industry.

UNIT V: ESSENTIALS OF COMPUTER SCIENCE:

Milestones of computer evolution - Internet, history, Internet Service Providers, Types of Networks, IP, Domain Name Services, applications.

Ethical and social implications: Network and security concepts- Information Assurance Fundamentals, Cryptography-Symmetric and Asymmetric, Malware, Firewalls, Fraud Techniques- Privacy and Data Protection

Recommended books:

1. Functions of one complex variable by John.B.Conway, Springer- Verlag.

2. Elementary Trigonometry by H.S.Hall and S.R.Knight

3.Vector Algebra by A.R.Vasishtha, Krishna Prakashan Media(P)Ltd.

4.Basic Statistics by B.L.Agarwal, New age international Publishers

5. University Physics with Modern Physics by Hugh D. Young and Roger A. Freedman

6. Fundamentals of Physics by David Halliday, Robert Resnick, and Jearl Walker

7. Physics for Scientists and Engineers with Modern Physics" by Raymond A. Serway and John W. Jewett Jr.

8. Physics for Technology and Engineering" by John Bird

9. Chemistry in daily life by Kirpal Singh

10. Chemistry of bio molecules by S. P. Bhutan

11. Fundamentals of Computers by V. Raja Raman

12. Cyber Security Essentials by James Graham, Richard Howard, Ryan Olson

STUDENT ACTIVITIES

UNIT I: ESSENTIALS OF MATHEMATICS:

1: Complex Number Exploration

Provide students with a set of complex numbers in both rectangular and polar forms.

They will plot the complex numbers on the complex plane and identify their properties

2: Trigonometric Ratios Problem Solving

Give students a set of problems that require the calculation of trigonometric ratios and their relations.

Students will solve the problems using the appropriate trigonometric functions (sine, cosine, tangent, etc.) and trigonometric identities.

3: Vector Operations and Applications

Provide students with a set of vectors in Cartesian form.

Students will perform vector addition and subtraction operations to find the resultant vectors.

They will also calculate the scalar and vector products of given vectors.

4: Statistical Measures and Data Analysis

Give students a dataset containing numerical values.

Students will calculate the mean, median, and mode of the data, as well as other statistical measures if appropriate (e.g., range, standard deviation).
They will interpret the results and analyze the central tendencies and distribution of the data.

UNIT II: ESSENTIALS OF PHYSICS:

1. Concept Mapping

Divide students into groups and assign each group one of the topics.

Students will create a concept map illustrating the key concepts, relationships, and applications related to their assigned topic.

Encourage students to use visual elements, arrows, and labels to represent connections and interdependencies between concepts.

2. Laboratory Experiment

Select a laboratory experiment related to one of the topics, such as motion of objects or electric and magnetic fields.
Provide the necessary materials, instructions, and safety guidelines for conducting the experiment.
Students will work in small groups to carry out the experiment, collect data, and analyze the results.

After the experiment, students will write a lab report summarizing their findings, observations, and conclusions.

UNIT III: ESSENTIALS OF CHEMISTRY

1: Chemistry in Daily Life Presentation

Divide students into groups and assign each group a specific aspect of daily life where chemistry plays a significant role, such as food and nutrition, household products, medicine,or environmental issues.
Students will research and create a presentation (e.g., PowerPoint, poster, or video) that showcases the importance of chemistry in their assigned aspect.
2: Periodic Table Exploration

Provide students with a copy of the periodic table.

Students will explore the periodic table and its significance in organizing elements based on their properties.
They will identify and analyze trends in atomic structure, such as electronic configuration, atomic size, and ionization energy.

3: Chemical Changes and Classification of Matter

Provide students with various substances and chemical reactions, such as mixing acids and bases or observing a combustion reaction.
Students will observe and describe the chemical changes that occur, including changes in color, temperature, or the formation of new substances.
4: Biomolecules Investigation

Assign each student or group a specific biomolecule category, such as carbohydrates,proteins, fats, or vitamins.
Students will research and gather information about their assigned biomolecule category, including its structure, functions, sources, and importance in the human body.

They can create informative posters or presentations to present their findings to the class.

UNIT IV: APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY

1: Interdisciplinary Case Studies

Divide students into small groups and provide them with interdisciplinary case studies that involve the interdisciplinary application of mathematics, physics, and chemistry.

Each case study should present a real-world problem or scenario that requires the integration of concepts from all three disciplines.

2: Design and Innovation Project

Challenge students to design and develop a practical solution or innovation that integrates mathematics, physics, and chemistry principles.

Students can choose a specific problem or area of interest, such as renewable energy, environmental conservation, or materials science.

3: Laboratory Experiments

Assign students laboratory experiments that demonstrate the practical applications of mathematics, physics, and chemistry.

Examples include investigating the relationship between concentration and reaction rate, analyzing the behavior of electrical circuits, or measuring the properties of materials.

.4: Mathematical Modeling

Present students with real-world problems that require mathematical modeling and analysis.

UNIT V: ESSENTIALS OF COMPUTER SCIENCE:

1. Identifying the attributes of network (Topology, service provider, IP address and bandwidth of

2. your college network) and prepare a report covering network architecture.

3. Identify the types of malwares and required firewalls to provide security.

4. Latest Fraud techniques used by hackers**.**

SEMESTER-I

COURSE 2: ADVANCES IN MATHEMATICAL, PHYSICAL AND CHEMICAL SCIENCES

Theory Credits: 4 5 hrs/week

Course Objective:

The objective of this course is to provide students with an in-depth understanding of the recent advances and cutting-edge research in mathematical, physical, and chemical sciences. The course aims to broaden students' knowledge beyond the foundational concepts and expose them to the latest developments in these disciplines, fostering critical thinking, research skills, and the ability to contribute to scientific advancements.

Learning outcomes:

1. Explore the applications of mathematics in various fields of physics and chemistry, to understand how mathematical concepts are used to model and solve real-world problems.

2. To Explain the basic principles and concepts underlying a broad range of fundamental areas of physics and to Connect their knowledge of physics to everyday situations.

3. Understand the different sources of renewable energy and their generation processes and advances in nanomaterials and their properties, with a focus on quantum dots. To study the emerging field of quantum communication and its potential applications. To gain an understanding of the principles of biophysics in studying biological systems. Explore the properties and applications of shape memory materials.

3. Understand the principles and techniques used in computer-aided drug design and drug delivery systems, to understand the fabrication techniques and working principles of nanosensors. Explore the effects of chemical pollutants on ecosystems and human health.

4. Understand the interplay and connections between mathematics, physics, and chemistry in various advanced applications. Recognize how mathematical models and physical and chemical principles can be used to explain and predict phenomena in different contexts.

5 Understand and convert between different number systems, such as binary, octal, decimal, and hexadecimal. Differentiate between analog and digital signals and understand their characteristics.Gain knowledge of different types of transmission media, such as wired (e.g., copper cables, fiber optics) and wireless (e.g., radio waves, microwave, satellite)..

UNIT I: ADVANCES IN BASICS MATHEMATICS

Straight Lines: Different forms – Reduction of general equation into various forms – Point ofintersection of two straight lines

Limits and Differentiation: Standard limits – Derivative of a function –Problems on product ruleand quotient rule

Integration: Integration as a reverse process of differentiation – Basic methods of integration

Matrices: Types of matrices – Scalar multiple of a matrix – Multiplication of matrices – Transpose ofa matrix and determinants

UNIT II: ADVANCES IN PHYSICS:

Renewable energy: Generation, energy storage, and energy-efficient materials and devices. **Recent advances in the field of nanotechnology**: Quantum dots, Quantum Communication- recent advances in biophysics- recent advances in medical physics- Shape Memory Materials.

UNIT III: ADVANCES IN CHEMISTRY:

Computer aided drug design and delivery, nano sensors, Chemical Biology, impact of chemical pollutants on ecosystems and human health, Dye removal - Catalysis method

UNIT IV: ADVANCED APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY

Mathematical Modelling applications in physics and chemistry

Application of Renewable energy: Grid Integration and Smart Grids,

Application of nanotechnology: Nanomedicine,

Application of biophysics: Biophysical Imaging, Biomechanics, Neurophysics,

Application of medical physics: Radiation Therapy, Nuclear medicine

Solid waste management, Environmental remediation- Green Technology, Water treatment.

UNIT V: Advanced Applications of computer Science

Number System-Binary, Octal, decimal, and Hexadecimal, Signals-Analog, Digital, Modem, Codec, Multiplexing, Transmission media, error detection and correction- Parity check and CRC, Networking devices- Repeater, hub, bridge, switch, router, gateway.

Recommended books:

1. Coordinate Geometry by S.L.Lony, Arihant Publications

2. Calculus by Thomas and Finny, Pearson Publications

3. Matrices by A.R.Vasishtha and A.K.Vasishtha, Krishna Prakashan Media(P)Ltd.

4. "Renewable Energy: Power for a Sustainable Future" by Godfrey Boyle

5. "Energy Storage: A Nontechnical Guide" by Richard Baxter

6. "Nanotechnology: Principles and Applications" by Sulabha K. Kulkarni and Raghvendra A. Bohara

7. "Biophysics: An Introduction" by Rodney Cotterill

8. "Medical Physics: Imaging" by James G. Webster

9. "Shape Memory Alloys: Properties and Applications" by Dimitris C. Lagoudas

10. Nano materials and applications by M.N.Borah

11. Environmental Chemistry by Anil.K.D.E.

12. Digital Logic Design by Morris Mano

13. Data Communication & Networking by Bahrouz Forouzan.

STUDENT ACTIVITIES

UNIT I: ADVANCES IN BASIC MATHEMATICS

1: Straight Lines Exploration

Provide students with a set of equations representing straight lines in different forms, suchas slope-intercept form, point-slope form, or general form.

Students will explore the properties and characteristics of straight lines, including theirslopes, intercepts, and point of intersection.

2: Limits and Differentiation Problem Solving

Students will apply the concept of limits to solve various problems using standard limits.

Encourage students to interpret the results and make connections to real-world applications,such as analyzing rates of change or optimizing functions.

3: Integration Exploration

Students will explore the concept of integration as a reverse process of differentiation andapply basic methods of integration, such as the product rule, substitution method, or integration by parts.

Students can discuss the significance of integration in various fields, such as physics and chemistry

4: Matrices Manipulation

Students will perform operations on matrices, including scalar multiplication, matrix multiplication, and matrix transpose.

Students can apply their knowledge of matrices to real-world applications, such as solving systems of equations or representing transformations in geometry.

UNIT II: ADVANCES IN PHYSICS:

1: Case Studies

Provide students with real-world case studies related to renewable energy, nanotechnology, biophysics, medical physics, or shape memory materials.

Students will analyze the case studies, identify the challenges or problems presented, and propose innovative solutions based on the recent advances in the respective field.

They will consider factors such as energy generation, energy storage, efficiency, sustainability, materials design, biomedical applications, or technological advancements.

2: Experimental Design

Assign students to design and conduct experiments related to one of the topics: renewable

energy, nanotechnology, biophysics, medical physics, or shape memory materials.
They will identify a specific research question or problem to investigate and design an experiment accordingly.

Students will collect and analyze data, interpret the results, and draw conclusions based on their findings.

They will discuss the implications of their experimental results in the context of recentadvances in the field.

3: Group Discussion and Debate

Organize a group discussion or debate session where students will discuss the ethical, social, and environmental implications of the recent advances in renewable energy, nanotechnology, biophysics, medical physics, and shape memory materials.

Assign students specific roles, such as proponent, opponent, or moderator, and provide them with key points and arguments to support their positions.

UNIT III: ADVANCES IN CHEMISTRY:

1. Experimental Design and Simulation

In small groups, students will design experiments or simulations related to the assigned topic.

For example, in the context of computer-aided drug design, students could design a virtual screening experiment to identify potential drug candidates for a specific disease target.

For nano sensors, students could design an experiment to demonstrate the sensitivity and selectivity of nano sensors in detecting specific analytes.
Chemical biology-related activities could involve designing experiments to study enzyme-substrate interactions or molecular interactions in biological systems.
Students will perform their experiments or simulations, collect data, analyze the results, and draw conclusions based on their findings.

2. Case Studies and Discussion

Provide students with real-world case studies related to the impact of chemical pollutants on ecosystems and human health.
Students will analyze the case studies, identify the sources and effects of chemical pollutants, and propose mitigation strategies to minimize their impact.

Encourage discussions on the ethical and environmental considerations when dealing with chemical pollutants.
For the dye removal using the catalysis method, students can explore case studies where catalytic processes are used to degrade or remove dyes from wastewater.
Students will discuss the principles of catalysis, the advantages and limitations of the catalysis method, and its applications in environmental remediation.

3: Group Project

Assign students to work in groups to develop a project related to one of the topics.

The project could involve designing a computer-aided drug delivery system, developing anano sensor for a specific application, or proposing strategies to mitigate the impact of chemical pollutants on ecosystems.
Students will develop a detailed project plan, conduct experiments or simulations, analyze data, and present their findings and recommendations.
Encourage creativity, critical thinking, and collaboration throughout the project.

UNIT IV: ADVANCED APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY

1: Mathematical Modelling Experiment

Provide students with a mathematical modelling experiment related to one of the topics. For example, in the context of renewable energy, students can develop a mathematical model to optimize the placement and configuration of solar panels in a solar farm.
Students will work in teams to design and conduct the experiment, collect data, and analyze the results using mathematical models and statistical techniques.
They will discuss the accuracy and limitations of their model, propose improvements, and interpret the implications of their findings in the context of renewable energy or the specific application area.

2: Case Studies and Group Discussions

Assign students to analyze case studies related to the applications of mathematical modellingin nanotechnology, biophysics, medical physics, solid waste management, environmental remediation, or water treatment.
Students will discuss the mathematical models and computational methods used in the case studies, analyze the outcomes, and evaluate the effectiveness of the modelling approach.
Encourage group discussions on the challenges, ethical considerations, and potential advancements in the field.

Students will present their findings and engage in critical discussions on the advantages and limitations of mathematical modelling in solving complex problems in these areas.

3. Group Project

Assign students to work in groups to develop a group project that integrates mathematical modelling with one of the application areas: renewable energy, nanotechnology, biophysics, medical physics, solid waste management, environmental remediation, or water treatment.

The project could involve developing a mathematical model to optimize the delivery of radiation therapy in medical physics or designing a mathematical model to optimize waste management practices.
Students will plan and execute their project, apply mathematical modelling techniques, analyze the results, and present their findings and recommendations.
Encourage creativity, critical thinking, and collaboration throughout the project.

UNIT V: Advanced Applications of computer Science

Students must be able to convert numbers from other number system to binary numbersystems

1. Identify the networking media used for your college network
2. Identify all the networking devices used in your college premises.

SEMESTER-II

COURSE 3: GEOLOGY & BRANCHES OF GEOLOGY

Theory Credits: 4 5 hrs/week

Programme Objectives

The paper is designed to learn about the subject Geology and various branches of geology. In every unit all the branches of Geology were briefly discussed and a gist of complete geology is given. It is an optional under Minor Subject.

Programme outcomes

The paper will give a brief picture of subject Geology and its branches. The student will get a complete knowledge of what are the different branches that make the subject Geology.

Unit 1

Introduction – Scope of Geology – Physical Geology & Geomorphology – Definition, origin and age of earth, interior of earth – geomrophological cycle, weathering and erosion, geological work of wind, river, glacier, ocean, underground water – Geodynamics – Definition, continental drift, sea-floor spreading, brief idea of plate techtonics – Environmental Geology – Concept, definitionsof atmosphere, hydrosphere, lithosphere, biosphere. 15 hours

Unit 2

Crystallography – Definition, Crystal parameters, symmetry elements, description of crystal classes, systems – Mineralogy – Definition and characters of mineral, chemical composition and diagnostic physical properties of minerals – Petrology – Definition, Igneous Petrology, types, origin, forms textures, structures of igneous rocks – Sedimentary rocks – origin, classification, textures, structures – Metamorphic rocks – process and products of metamorphism, factors, zones, grades, textures and structures of Metamorphic rocks. 15 hours

Unit 3

Structural Geology – Definition, Elementary idea of types of deformation, Folds, Faults, Joints, unconformity, outcrop, dip, strike – Economic geology – Definition, ore and ore deposits, gangue minerals, classification of economic minerals, brief outline of process of formation of mineral deposits – Stratigraphy & Indian Geology – Principles, Geological Time Scale, Physiographic divisions of India, out line of Precambrian successions, Dharwar, Cuddapah, Vindhyan, Dhilhi Supergroups. 15 hours

Unit 4

Palaeontology – Definition, Fossils, mode of preservation, significance of fossils, definition and geological distribution of brachiopods, pelecypods, cephalopods, trilobite, echinoidea - Hydrology – Definition, Hydrological cycle, precipitation, evaporation, transpiration, infiltration, porosity, permeability, vertical distribution of groundwater, aquifers, types of aquifers.

15 hours

Unit 5

Geochemistry – Introduction, idea of periodic table, cosmic abundance of elements, Geochemical cycle, Gold Schmidt's geochemical classification of elements, major, minor and trace elements in igneous, metamorphic and sedimentary rocks, isomorphism, polymorphism – Mineral Exploration – Brief idea on geological, geochemical and geophysical prospecting –

Remote Sensing and GIS – Fundamentals of Remote Sensing, Sensors, brief idea of Digital Image processing – Introduction to GIS , components of GIS, tools for map analysis.

15 hours

Suggested Readings

Text Book of Geology – G.B.Mahapatra

Engineering and General Geology – Parbin Singh

SEMESTER-II

COURSE 4: PHYSICAL GEOLOGY AND SOIL SCIENCE

Theory Credits: 4 5 hrs/week

Programme Objectives:

To give knowledge about the solar system, origin of the earth, age of the earth and various physical phenomenon occurring on the planet earth.

To give knowledge about the Soil types and their parent material, distribution of various soils in India. Physical and chemical characteristics different soil types.

Programme Outcomes:

The student will learn how the solar system originated and about the planet earth in particular, Age of earth. Student will get a complete idea about the various physical phenomenon occurring for shaping the planet earth.

Student also get the complete picture of soils and their parent material, physical and chemical properties of the soils, their distribution in India.

Unit 1

General characteristics and origin of the Universe, Solar System and its planets. The terrestrial and jovian planets. Meteorites and Asteroids. Earth in the solar system - origin, size, shape, mass, density, age of the Earth. Seismology and internal structure of the earth; Formation of core, mantle, crust; Convection in Earth's core and its magnetic field.

15 Hours

Unit 2

Volcanoes: Types, products and distribution. Earthquakes - intensity, causes, earthquake belts and distribution. Oceanic current system - Land-air-sea interaction. Atmospheric circulation, Weatherand climatic changes; Earth's heat budget. Volcanoes: Types, products and distribution.

15 hours

Unit 3

Earthquakes - intensity, causes, earthquake belts and distribution. Oceanic current system and effect of Coriolis force; Concept sofeustasy; Land-air-sea interaction. Atmospheric circulation, Weatherand climatic changes; Earth's heat budget. - Weathering and Erosion, Mass wasting; Geological works of river, glacier, wind, underground water, ocean and landforms produced by them. Wave erosion and beach processes. 15 hours

Unit 4

Soil – Introduction origin of various types of soils with emphasis on parent rocks, distribution of various types of soils in India - Soil structure – genesis, types, characterization and management Soil aggregation, aggregate stability; soil tilth, characteristics of good soil tilth; soil crusting – mechanism – Soil Physical Properties. 15 hours

Unit 5

Water flow in saturated and unsaturated soils, Poiseuille's law, Darcy's law; hydraulic conductivity, permeability and fluidity, hydraulic diffusivity; measurement of hydraulic conductivity in saturated and unsaturated soils. Soil suitability analysis for various land use patterns. 15 hours

Suggested Readings

Baver LD, Gardner WH & Gardner WR. 1972. Soil Physics. John Wiley & Sons.
Ghildyal BP & Tripathi RP. 2001. Soil Physics. New Age International.
Hanks JR & Ashcroft GL. 1980. Applied Soil Physics. Springer Verlag.
Hillel D. 1972. Optimizing the Soil Physical Environment toward Greater Crop Yields. Academic Press.

SEMESTER-III

COURSE 5: CRYSTALLOGRAPHY & MINERALOGY

Theory Credits: 4 5 hrs/week

Programme Objectives:

To study crystal systems, 32 crystal classes and their consecutive minerals. To study the Physical and chemical and optical properties of minerals for their identification. It is an optional under Minor Subject.

Programme outcomes:

After completion of the paper, students will be acquainted with the knowledge of identification of Minerals through their physical, chemical and optical properties and the crystal system which they have developed during their origin.

Unit 1

Elements of Crystallography – Derivation of 32 Crystal classes and Herman-Maughn Symbols, twin laws and twin crystals, X-ray crystallography and irregularities in crystals, Etch figures.

15 hours

Unit 2

Structures of silicates, isomorphism and polymorphism. Physical, chemical and optical properties, mode of occurrence of the following mineral groups: Quartz, Feldspars , Feldspathoids and Zeolites. **15 hours**

Unit 3

Physical, chemical and optical characters and mode of occurrence of the following mineral groups -- olivine, pyroxene, amphibole, mica, Garnet and Aluminum silicates.

15 hours

Unit 4

Nature of light rays and their propagation, internal reflection, double refraction, interference andmpolarization. Nicol Prism and polaroids. Petrological microscope - parts and their functions.Preparation of thin section of minerals and rocks. **15 hours**

Unit 5

Snell's Law – Critical angle – Total Reflection, Pleochroism, Extinction, Determination of retardation with Berek compensator, optic axial angle, Uniaxial and biaxial minerals, Gypsum plate, Quartz wedge and mica plate **15 hours**

Reference Books

1. A Text Book of Mineralogy by E.S.Dana
2. Elements of Crystallography by F.A.Wade and R.B.Matrox.
3. Elements of Mineralogy by Rutleys
4. Optical mineralogy by Paul F.F. Kerr
5. Mineral Optics by Philips W.R.
6. Elements of Optical Mineralogy by Winchell A.N.

SEMESTER-III

COURSE 6: PALAEONTOLOGY

Theory Credits: 4 5 hrs/week

Programme Objectives:

To inculcate knowledge of fossils, process of fossilization, their identification and uses.

Programme Outcomes:

Students will get a complete knowledge about fossils, fossilization process, types, distribution and uses of fossils

Unit 1

Fossilization and fossil record - Nature and importance of fossil record; Fossilization processes - and modes of preservation - Species concept with special reference to paleontology, Taxonomic hierarchy Theory of organic evolution interpreted from fossil record. 15 hours

Unit 2

Brief introduction to important invertebrate groups (Bivalvia, Gastropoda, Brachiopoda) and their biostratigraphic significanceSignificance of ammonites in Mesozoic biostratigraphy and their paleobiogeographic implications. Functional adaptation in trilobites and ammonoids. 15 hours

Unit 3

Origin of vertebrates and major steps in vertebrate evolution. Mesozoic reptiles with special reference to origin diversity and extinction of dinosaurs. Evolution of horse and intercontinental migrations. Human evolution. 15 hours

Unit 4

Scope of paleobotany, taxonomy of plants, Gondwana flora and their significance. Separation of spores and pollens and mounting for study. Utility of palynological studies in different fields. 15 hours

Unit 5

Application of fossils in Stratigraphy - Biozones, index fossils, correlation - Role of fossils in sequence stratigraphy - Fossils and paleoenvironmental analysis - Fossils and aleobiogeography, biogeographic provinces, dispersals and barriers - Paleoecology – fossils as a window to the evolution of ecosystems. 15 hours

Suggested readings

1. Raup, D. M., Stanley, S. M., Freeman, W. H. (1971) Principles of Paleontology
2. Clarkson, E. N. K. (2012) Invertebrate paleontology and evolution 4th Edition by Blackwell Publishing.
3. Benton, M. (2009). Vertebrate paleontology. John Wiley & Sons.
4. Shukla, A. C., & Misra, S. P. (1975). Essentials of paleobotany. Vikas Publisher
5. Armstrong, H. A., & Brasier, M.D. (2005) Microfossils. Blackwell Publishing

SEMESTER-III

COURSE 7: FOSSIL FUELS

Theory Credits: 4 5 hrs/week

Programme objectives:

The paper defines the fossil fuels, types of fossil fuels, physical and chemical properties of fossil fuels, host rocks, host rock properties, advantages and disadvantages of extraction, utilization of fossil fuels to the man kind and environmental impacts.

Programme outcomes:

Student will get a complete knowledge about fossil fuels, their origin, occurrence, physical and chemical composition, advantages and disadvantages, host rock properties, and distribution of fossil fuels.

Unit 1

Introduction – History, Definition, Importance, types of fossil fuels – Types of Fossil Fuels – Coal, Crude Oil, Natural Gas – Advantages and Disadvantages – Types of Host rocks – Host rock properties. 15 hours

Unit 2

Petroleum – Origin- inorganic and organic theories – migration and accumulation of oil, Composition of Oil – Geological age of reservoir rocks – Classification of traps. Petroliferous basins of India. Geology of the productive oil fields of India. Status of Oil and Natural Gas in India- Gas Hydrates. 15 hours

Unit 3

Coal – Origin and classification – Chemical characterization – Proximate and ultimate analysis – Gelogical and Geographical distribution of coal deposits in India. Detailed Geology for important coal fields of India. 15 hours

Unit 4

Natural Gas – Origin – biogenic and thermogenic theories – chemical characterization – Reservoir rocks – Process of formation of natural gas - Types of natural gas based on host rock – shale gas, Tight gas, Coal Seam gas – Composition of Natural Gas – Important occurrences in India. 15 hours

Unit 5

Oil & Natural Gas Exploration Techniques – Surveying and Mapping, Determination of Formation, Drilling, Logging – Role of Seismology – Onshore Seismology, Offshore Seismology – Role of Microfossils – Exploratory wells and Logging – Brief idea of Extraction methods of Oil, Natural gas and Coal. 15 hours

Suggested Readings

1. Fossil fuel". ScienceDaily. Retrieved 29 October 2021.
2. Fossil fuels". Geological Survey Ireland. Retrieved 29 October 2021.
3. Jump up to:[a] [b] "thermochemistry of fossil fuel formation" (PDF). Archived (PDF) from the original on 20 September 2015.

4. Paul Mann, Lisa Gahagan, and Mark B. Gordon, "Tectonic setting of the world's giant oil and gas fields", in Michel T. Halbouty (ed.) Giant Oil and Gas Fields of the Decade, 1990–1999, Tulsa, Okla.: American Association of Petroleum Geologists, p. 50, accessed 22 June 2009.
5. Ritchie, Hannah; Roser, Max (28 November 2020). "Energy". Our World in Data.

SEMESTER-III
COURSE 8: FIELD GEOLOGY

Theory Credits: 4 5 hrs/week

Programme objectives:
Geology in general is a kind of subject, which has an equal part of study in the field on par with the class room learning. The paper Field Geology is designed to provide complete knowledge of field study starting from the equipment required in the field, up to the criteria of mapping various features in the field.

Programme outcomes:
Student will get a complete real time knowledge what he learned in the class room. He will get an idea about the field equipment, technique of sampling, locating himself in the field, use of Toposeet in the field, Field mapping etc.

Unit 1
Introduction – Importance of Field Geology – Basic Field equipment – Compass & Clinometer – principle and uses, Magnetic declination, Bearing and reading directions, measuring attitude, Finding directions without compass. 15 hours

Unit 2
Topographic Maps – Survey of India Maps, Scale of Maps, Numbering the Toposheets – Conventional, Advanced numbering - Depiction of Relief – Latitudes and Longitudes – Map Grids – Measurement of Mapped areas – Mounting and Folding of Field Maps – Marking on Maps. 15 hours

Unit 3
Field guides - Preliminary observations – Status of the area, Topography of the terrain – Regional Geology – Structures of the terrain – Strike & Dip – Contacts & Boundaries – Correlation – Geological Cross sections – Marking the map. 15 hours

Unit 4
Specimens and Samples – Significance – Trimming of hand specimens – Fossil Specimens, Mineral Specimens – Samples and Sampling – Numbering and labeling of specimens, Packing and storage of samples – Field identification of Rocks – Basic Field Observation, Documentation 15 hours

Unit 5
Basic Field Procedures – Location – Outcrops, Soil colour, rock type – Measuring distances – Compass and Tape Traversing – Determination of Slopes and Gradients – Measuring Difference in Elevation – Triangulation Method — Field Sketches and Drawings – Field Photographs. 15 hours

Suggested Readings

Field Geology – F.H.Lahee
Guide to Field Geology – S.M.Mathur

SEMESTER-IV

COURSE 9: ELEMENTS OF PETROLOGY

Theory Credits: 4 5 hrs/week

Programme objectives:

The paper is designed to provide a brief knowledge about petrology and its three divisions viz., Igneous Petrology, Sedimentary Petrology and Metamorphic Petrology and description of rocks belonging to each branch. It is an optional under Minor Subject.

Programme outcomes:

Student will get a brief knowledge about

Unit 1

Introduction – Scope of Study of rocks – Composition and Constitution of Magma - Differentiation, Assimilation – Rock Definition - Rock Cycle – Process of formation of Rocks – Brief outline of Bowens Reaction principle. 15 hours

Unit 2

Igneous Rocks – General Characters, Main Igneous rock groups, composition, colour, texture, grain size and crystallanity – Flows – Dykes and Sills – Pipes – Pegmatites – Pyroclastic rocks. 15 hours

Unit 3

Metamorphic Rocks – Definition – Conditions for the formation of Metamorphic rocks – Main Metamorphic rock groups – cleavage, texture, foliation, lineation – Metamorphic folding, grain size – Definition of Metamorphic Facies. 15 hours

Unit 4

Sedimentary Rocks – Definition – Processes of Formation – Classification – Bedding – Particle size – Sorting – Shape of the particles – Matrix and Cement – Sedimentary structures – Sedimentary Facies – Cyclic Sedinentation – Rudaceous Rocks – Arenites, Argillites, Lutites, Turbidites, Calcareous rocks, Organic deposits. 15 hours

Unit 5

Physical Properties of Igneous rocks - Granites, granodiorites, gabbro, phorphories, Dolerites, Rhyolites, Basalts – Metamorphic Rocks - Schist, Gneiss, Amphibolite, Quartzite, Marble, Slate, Phyllite – Sedimentary Rocks - Breccia, Conglomerate, Lime Stone, Sand Stone, Shale, Silt, Shell Lime Stone. 15 hours

Suggested Readings

1. Igneous and Metamorphic Petrology – Turner and Verhoogen
2. Petrology of Igneous and Metamorphic rocks – Hyndman
3. The petrography of Igneous and Metamorphic rocks in India – S.C.Chatterjee.
4. Metamorphic petrology- B. Bhaskara Rao
5. Sedimentary Rocks – Pettijohn, F.J.
6. Origin of Sedimentary Rocks – Blottt, H., Middleton, G. and Murray, R.
7. Introduction to Sedimentology – Sengupta, S.M.
8. An Introduction to Sedimentology – Shelly, R.C.

SEMESTER-IV

COURSE 10: IGNEOUS, SEDIMENTARY AND METAMORPHIC PETROLOGY

Theory Credits: 4 5 hrs/week

Programme objectives:

To give a complete knowledge on Igneous, Sedimentary and Metamorphic rocks. To provide information on classification, textures, structures, origin, forms of Igneous, Sedimentary and Metamorphic Rocks.

Programme outcomes:

Student will get a complete knowledge on origin, classification, textures, structures, forms of Igneous, Sedimentary and Metamorphic rocks and their physical, chemical characteristics.

Unit 1

Introduction to Igneous Petrology – Formation of igneous rocks – Crystallization of unicomponent, Bicomponent and ternary magmas. Origin, composition and constitution of magmas. 15 hours

Unit 2

Bowen's reaction principle – Magmatic Differentiation – Fractional crystallization and assimilation - Forms, structures and textures of igneous rocks. Classification of Igneous rocks. 15 hours

Unit 3

Metamorphism, metamorphic processes, Agents of metamorphism, kinds of metamorphism, classification and nomenclature of metamorphic rocks, structures and textures of metamorphic rocks - Grades and zones of metamorphism – Concept and types of metamorphic facies – ACF, AKF and AFM diagrams.

15 hours

Unit 4

Sedimentology – Origin of Sedimentary of rocks. Structures and textures of Sedimentary rocks. Provenance, lithification and digenesis of Sedimentary rocks - Classification of sedimentary environments – Non-marine environments – Glacial, Aeolian, Lacustrine and Fluvial environments. 15 hours

Unit 5

Marine environments – Shelf and Deep sea sediments – Classification and origin of Clastic and Non-clastic rocks. Clastic – Rudaceous , Arenaceous and argillaceous rocks. Non-Clastic – Chemical and Organic deposits. 15 hours

Suggested Readings

1. Igneous and Metamorphic Petrology – Turner and Verhoogen
2. Petrology of Igneous and Metamorphic rocks – Hyndman
3. The petrography of Igneous and Metamorphic rocks in India – S.C.Chatterjee.
4. Metamorphic petrology- B. Bhaskara Rao
5. Sedimentary Rocks – Pettijohn, F.J.
6. Origin of Sedimentary Rocks – Blottt, H., Middleton, G. and Murray, R.
7. Introduction to Sedimentology – Sengupta, S.M.
8. An Introduction to Sedimentology – Shelly, R.C.

SEMESTER-IV

COURSE 11: STRUCTURAL GEOLOGY

Theory Credits: 4 5 hrs/week

Programme objectives:

To inculcate knowledge on principles and mechanics of structural deformation of rocks, types of structural deformations, their advantages, disadvantages. It is an optional under Minor Subject.

Programme outcomes:

Student will get a complete knowledge on principles and mechanics of structural deformations of rocks, types of deformations, their advantages and disadvantages.

Unit 1

Mechanical principles and properties of rocks and their controlling factors – Concept of stress and strain – two dimensional stress and strain analyses – Concept of Dip and Strike - Geometric classification of Folds - Mechanics of folding and buckling and recognition of folds.

15 hours

Unit 2

Joints Classification and their importance in Construction projects. Mechanics of faulting. Classification and recognition of faults. Strike slip faults, normal faults. 15 hours

Unit 3

Unconformities – types of unconformities, criteria for recognition and significance of unconformities. Lineation – problem of lineation indicating extension parallel to fold axis, small scale folds. 15 hours

Unit 4

Structural association, salt domes, diapers, nappe, tectonic mélanges. Tectonic aspects of Igneous rocks. Geometric classification of plutonic igneous rocks, tectonic setting of plutons.

15 hours

Unit 5

Structures in metamorphic rocks, Foliation, Axial plane foliation, transported foliation, other metamorphic foliations. 15 hours

Suggested Readings

1. Structural and Tectonic principles - Badgley, P.C.
2. Mechanics in Structural geology, Bayly, B.
3. Structural geology – Billings M.P.
4. Structural geology of rocks and region – Davis G.R.
5. Understanding the Earth – Gass I.B., Peter J.Smith and Smith PGL
6. An outline of Structural geology
7. Global tectonics – Keary. P., and Vine F.J.
8. Modres. E., and Twiss., R.J.
9. Folding and fracturing of rocks : Ramsy, J.G.

SEMESTER-V

COURSE 12: ECONOMIC GEOLOGY

Theory Credits: 4 5 hrs/week

Programme objectives

To provide knowledge on important economic minerals, their classification, origin, occurrence and distribution in Andhra Pradesh and India. Further to give information on physical and chemical properties of important economic minerals. It is an optional under Minor Subject.

Programme outcomes

Students will get full information on classification, origin, occurrence, distribution, physical and chemical properties of economic minerals.

Unit 1

Concept of ore, ore minerals and gangue in economic geology; Tenor of ores; Ore forming minerals – metallic and non-metallic; Common forms and structures of ore deposits; Paragenesis, paragenetic sequence and zoning in metallic ore deposits. 15 hours

Unit 2

Processes of formation of ore deposits; Magmatic, contact metasomatic, pegmatitic, hydrothermal, sedimentation, residual concentration, mechanical concentration, oxidation and supergene suphide enrichment and metamorphism. 15 hours

Unit 3

Study of important industrial minerals of India with particular reference to the industries - cement, glass and ceramics, refractory, fertilizer and building stones, chemicals and gemstones. Mineral Resources of Andhra Pradesh. 15 hours

Unit 4

Chemical composition, diagnostic characters, uses and distribution in India of the following minerals: magnetite, hematite, chromite, psilomalane, pyrolusite, chalcopyrite, galena, sphalerite, native gold, magnesite, bauxite, pyrite, diamond, muscovite, beryl, fluorite, gypsum, barite, halite, phosphorite, talc, kyanite, graphite, asbestos, monazite and corundum. 15 hours

Unit 5

Processes of formation, geological occurrence, uses and distribution of coal and petroleum in India; A brief study of atomic fuels 15 hours

Suggested Readings

1. Jense, M.L., Bateman, and A.M. (1981): Economic Mineral Deposits, John Wiley and Sons.
2. Krishnaswamy, S. (1979): India's Minerals Resources, Oxford and IBH Publ.
3. Brown, C. and Dey, A.K. (1955): Indian Mineral Wealth, Oxford Univ
4. Sharma, N.L. and Ram, K.V.S. (1972): Introduction to India's Economic Minerals, Dhanbad Publ.

SEMESTER-V

COURSE 13: INDIAN GEOLOGY AND STRATIGRAPHY

Theory Credits: 4 5 hrs/week

Programme objectives

To provide information on Indian stratigraphy and world stratigraphy, elements of stratiraphy, important sedimentary basins of India, their age, and geological time scale. It is an optional under Minor Subject

Programme outcomes

Students will get a complete knowledge on Indian stratigraphy and world stratigraphy, elements of stratiraphy, important sedimentary basins of India, their age, and geological time scale

Unit 1

Physiographic and tectonic subdivisions of India Introduction to Indian Shield Introduction to Proterozoic basins of India. Geology of Vindhyan, Pranhita-Godavari and Cudappah basins of India. Paleozoic Succession of Kashmir and its correlatives from Spiti and Zanskar Stratigraphy Structure of Gondwana basins. 15 hours

Unit 2

Mesozoic stratigraphy of India: a. Triassic successions of Spiti, b. Jurassic of Kutch, c. Cretaceous, successions of Cauvery basins Cenozoic stratigraphy of India: a. Kutch basin, b. Siwalik successions, c. Assam, Andaman and Arakan basins. Stratigraphy and structure of Krishna-Godavari basin, Cauvery basin, Bombay offshore basin, Kutch and Saurashtra basins 15 hours

Unit 3

Volcanic provinces of India a. Deccan, b. Rajmahal, c. Sylhet Trap. Important Stratigraphic boundaries in India - a. Precambrian-Cambrian boundary, b. Permian-Triassic boundary, and c. Cretaceous-Tertiary boundary 15 hours

Unit 4

Stratigraphy: Definition, its scope – Principles of stratigraphy; Geological Time Scale; Stratigraphic classificaton; rock units, time units and time- rock units; Physical and structural subdivisions of India and their characteristics. 15 hours

Unit 5

Stratigraphic approaches to study the Precambrian rocks of India with special reference to classification, lithology and economic significance - Dharwar of Karnataka Cuddapah of Telengana and Andhra Pradesh, Vindhyan of Son valley and Marwar Supergroup of Rajasthan. 15 hours

Suggested Readings

1. Krishnan, M. S. (1982) Geology of India and Burma, CBS Publishers, Delhi
2. Doyle, P. & Bennett, M. R. (1996) Unlocking the Stratigraphic Record. John Wiley
3. Ramakrishnan, M. &Vaidyanadhan, R. (2008) Geology of India Volumes 1 & 2, Geological society of India, Bangalore.
4. Valdiya, K. S. (2010) The making of India, Macmillan India Pvt. Ltd.
5. Boggs, S. (2001): Principles of Sedimentology and Stratigraphy, Prentice Hall.
6. Krishnan, M.S. (1968): Geology of India and Burma, Higgibothon, Madras.
7. Kumar, R. (1985): Historical Geology and Stratigraphy of India, Wiley Eastern Ltd.
8. Wadia, D.N. (1966): Geology of India, English language Publ.

SEMESTER-V

COURSE 14A: GEODYNAMICS & GEOCHRONOLOGY

Theory Credits: 4 5 hrs/week

Programme objectives

To provide knowledge on the origin and evolution of earth, age of planet earth and factors influencing phenomenon of shaping the planet earth. Further to provide knowledge of determination of age of different layers of the earth's crust and about the Geological Time Scale.

Programme outcomes

Students will get a complete knowledge on origin and evolution of earth, age of planet earth and factors influencing phenomenon of shaping the planet earth. They will also get knowledge of time period of formation of different layers of earth's crust and formulation of Geological Time Scale.

Unit 1

Earth and its evolution to the present state – Origin and Age of Earth, Earth's interior. Composition of the Earth – Earth's geological process – Exogenous and Endogenous processes, Weathering and Mass-wasting. 15 hours

Unit 2

Deformation of rocks – Stress, strain, Product of deformation – Shape of the Earth – gravity field of the earth, Plate reconstruction – Plate tectonics, quantification earthquakes, Volcanoes, Seismic waves through the earth, Earth quakes in India. 15 hours

Unit 3

Mountain building activity - Orogeny and epirogeny – Geologica action of rivers, glaciers, wind, waves and currents, Groundwater. 15 hours

Unit 4

Geochronology – Definition, scope – Methods of Geochroology – Radioactive isotopes, radioactive decay, half-life period – Palaeomagnetism – Geological hierarchy of chronological periodization - Chronology in relation to Geological Timescale. 15 hours

Unit 5

Chronostratigraphy – Concept, scope, advantages and disadvantages – Biostratigraphy – Definition, methodology, advantages and disadvantages – Lithography – Definition, Concept, Scope – Advantages and disadvantages. 15 hours

Suggested Readings

1. *Cohen, K.M.; Finney, S.; Gibbard, P.L. (2015), International Chronostratigraphic Chart (PDF), International Commission on Stratigraphy*.
2. Dickin, A. P. 1995. *Radiogenic Isotope Geology*. Cambridge, Cambridge University Press. ISBN 0-521-59891-5
3. Faure, G. 1986. *Principles of isotope geology*. Cambridge, Cambridge University Press. ISBN 0-471-86412-9

4. Faure, G., and Mensing, D. 2005. "Isotopes - Principles and applications". 3rd Edition. J. Wiley & Sons. ISBN 0-471-38437-2
5. Ludwig, K. R.; Renne, P. R. (2000). "Geochronology on the Paleoanthropological Time Scale". *Evolutionary Anthropology*. **9** (2): 101–110. doi:10.1002/(sici)1520-6505(2000)9:2<101::aid-evan4>3.0.co;2-w. S2CID 83948790. Archived from the original on 2013-01-05.

SEMESTER-V

COURSE 14B: DRILLING & SAMPLING METHODS

Theory Credits: 4 5 hrs/week

Programme Objectives

To inculcate knowledge on what is drilling, need of drilling as part of exploration, types of drilling methods, type of drilling method used based on rock type, terrain type. Further to provide knowledge on need of sampling in exploration, types of sampling methods and numbering and preservation of samples.

Programme outcomes

Student will be acquainted with the complete knowledge on need of drilling in exploration, types of drilling and utilization of appropriate drilling methods based on rocks type and terrain type. Further he will be trained in collecting samples, numbering samples and preservation of samples during exploration.

Unit 1

Drilling – definition, need of drilling during mineral exploration – Types of drilling – Methods of drilling – Auger Drilling – Types of Auger Drilling - Rotary Air Blasting – Aircore – Reverse Circulating Drilling – Diamond core Drilling – Blast Hole Drilling. 15 hours

Unit 2

Types of Drills – Requirement – Surface Top Hammer Drill Rigs – Surface Down the Hole Drill Rigs – Dimensional Stone Drill Rigs - Rotary Blast Hole Drill Rigs – Development Drill Rigs – Tunneling Jumbos – Top Hammer Long hole Drill Rigs. 15 hours

Unit 3

Rock Support Drill Rigs – In the Hole Longhole Drill Rigs – Low Profile Drill Rigs – Narrow Vein Drill Rigs – Secondary Breaking Drill Rigs – Measuring while drilling – Choosing a drilling method based on topography and lithology of an area. 15 hours

Unit 4

Sampling methods – Surface sampling, Underground sampling – Types of sampling – Chemical sampling, Technological sampling – Technical sampling – Methods of Sampling – Surface sampling – Underground sampling – Channel sampling, Groove sampling, Chip sampling, Grab sampling, Drill hole sampling. 15 hours

Unit 5

Face Sampling –Bulk sampling - Soil Sampling – Disturbed samples – Split-Spoon samples, Direct-Push sampling, Continuous Hydraulic Push Samples, Continuous Sonic Samples, Vibracore samples - Undisturbed samples – Thin-wall Tube sampling – Level samples, Piston samples, Rotary core samples – Fixed (stationary) Piston sampling and its types – Rotary Core Sampling – Denison Sampling. 15 hours

Suggested Readings

1. Text Book of Mining Geology – Arogyaswamy
2. Sampling in Geology – Himadri Samal
3. Sampling Echiques for mineral deposit – Pramoda Raj

SEMESTER-V

COURSE 15A: HYDROGEOLOGY

Theory Credits: 4 5 hrs/week

Programme objectives

What is hydrogeology, what are its principles, what is hydrologic cycle, percolation, recharge, storage, movement of groundwater, potable water, irrigation water etc were discussed.

Programme outcomes

Student will get a complete knowledge on hydrogeology, its principles, hydrologic cycle, precipitation, percolation, recharge, storage, movement of groundwater.

Unit 1

Origin of water – Meteoric Juvenile, magmatic and sea waters – Hydrologic cycle – Precipitation, Runoff, infiltration and evapotranspiration, Subsurface movement and vertical distribution of groundwater, Springs. 15 hours

Unit 2

Classification of aquifers. Occurrence of groundwater, Rocks affecting groundwater occurrence – Hydrological properties of rocks – Specific Yield, Specific Retention, Porosity, Hydraulic conductivity, transmissivity, Storage Coefficient, Hydrographs - Groundwater movement, Darcy's law and its applications. 15 hours

Unit 3

Determination of Permeability in laboratory and in field: Well hydraulics: Confined, Unconfined, Steady, Unsteady and radial flow – Condensation and precipitation, Precipitation processes, Forms of Precipitation, Measurement of rainfall, Types of gauges, Non recording and self-recording gauges, Storage gauges, Radar measurement of rainfall, intensity of rainfall, Rain gauge network. 15 hours

Unit 4

Interpretation of precipitation data - Evaporation from free water surfaces, Factors effecting Evaporation, Measurement of evaporation - Transpiration Determination of transpiration – Water level fluctuations, Types of wells, drilling methods. 15 hours

Unit 5

Groundwater Quality: Physical, Chemical and bacteriological parameters; Quality criteria for groundwater use, graphical presentation of water quality data – National and International water quality standards – potable water, irrigation water – Saline Water intrusion in coastal aquifers. Problem of arsenic and fluoride, case studies. 15 hours

Suggested Readings

1. Groundwater Hydrology – Todd, D.K.
2. Applied Hydrogeology – Fetter C.W.
3. Groundwater Assessment and Development and Management – Karanth, K.R.
4. Hydrology and watershed Management,J NTU by B.Venkateswara Rao,G.Jagan Mohan Das,C..Sarala and M.V.S.S.Giridhar

SEMESTER-V

COURSE 15B: GROUNDWATER EXPLORATION

Theory Credits: 4 5 hrs/week

Programme objectives

To provide knowledge on methods of ground water exploration, geophysical methods, their advantages and disadvantages. Types of drilling methods used in exploration and exploitation of groundwater.

Programme outcomes

Students will get complete knowledge on methods of groundwater exploration, geophysical methods, their advantages and disadvantages. Types of drilling methods used in exploration and exploitation of groundwater.

Unit 1

Basic concepts and scope of geophysical exploration for groundwater. Surface geophysical method: Electrical resistivity method-The schulumberger array, the Wenner array, seismic refraction method, Gravity method and magmetic methods. 15 hours

Unit 2

Sub-surface: Geophysical well logging for delineation of aquifer and estimation of water quality bore hole geophysical logs, their principles and application. Electrical Logging; Resistivity and spontaneous potential logging, Radiation logging. 15 hours

Unit 3

Natural Gamma logging, Gamma-Gamma logging, neutron logging, Calliper logging, Temperature logging, Fluid conductivity logging, Comparison of lithologs in the light of bore hole geophysical data and correlation. Application of well logging in groundwater exploration. 15 hours

Unit 4

Types of Water Well Drilling Methods: Cable tool, direct rotary, reverse rotary, Water well construction in hard rock and unconsolidated rock formations. Drilling fluid and its function. Drill site operation: Preparation of drill time loggs and lithologs. 15 hours

Unit 5

Elements of image interpretation for groundwater exploration. Digital Image Processing Techniques useful in groundwater exploration. GIS: Basic concepts, principle and applications. Application of Remote sensing techniques in groundwater exploration. Case Studies and examples from India. Remote Sensing and GIS applications in site selection of water harvesting structures. Case studies and examples from India. 15 hours

Suggested Readings

1. Driss Coll -Ground Water & Well
2. Karanth.K.R - Ground Water Assessment Development & Management
3. Sabbins, F.F- Remote Sensing-Principles and Applications
4. Lillesand, T.M. and Kieffer, R.W- Remote Sensing and Image Interpretation

SEMESTER-VII

COURSE 16: ATMOSPHERIC SCIENCE

Theory Credits: 4 5 hrs/week

Programme Obectives:
To provide knowledge about meteorology, climatology, atmosphere, Weather forecasting.

Programme outcomes:
Students will get a complete knowledge on meteorology, climatology, atmosphere, Weather forecasting.

Unit 1
Introduction – Branches of Atmospheric Science - Atmosphere – Classification – Mateorology, Climatology - Circulation – Clouds, Precipitation, Acid rains – The Air – Masses.

Unit 2
Structure of the atmosphere and its composition, Thermodynamic state: distribution of temperature, density, pressure, water vapour, salinity, etc., Equations of state, Planetary Atmospheres Basics of Fundamental forces in the atmosphere and ocean, Formation of Cloud droplets and Precipitation, Radiation basics and budget, Aerosol-Cloud interaction and Ozone depletion,

Unit 3
Climate – Types of Climate – Tropical, Dry, Temperate, Continental and Polar - Cyclones – Anticyclones – Tropical cyclones – Tornadoes.

Unit 4
Natural regions of the world – Tropical regions - Warm Temperate regions – Cold temperate regions – Polar regions.

Unit 5
Weather forecasting. Economic importance of weather – Agriculture and Industry.

References Books:

1. An Introduction to Earth and Environment by A.K.Sinha
2. Atmospheric Science, An Introductory Survey, John M. Wallace, Peter V. Hobbs
3. Meteorology, An Atmospheric Science, Dorothy Rambola,

SEMESTER-VII

COURSE 17: FUNDAMENTALS OF GEOPHYSICS

Theory Credits: 4 5 hrs/week

Programme objectives:
To inculcate the knowledge about gravity methods, magnetic methods, seismic methods, electric methods and subsurface geophysical methods.

Programme outcomes:
Students will get a complete knowledge about gravity methods, magnetic methods, seismic methods, electric methods and subsurface geophysical methods

Unit 1
Gravity methods: Gravity potential and field due to different simple bodies and structures - Field procedure - Bouguer gravity anomalies, interpretations & field-cases - Applications of the gravity method.

Unit 2
Magnetic methods: Magnetic properties of rocks, geomagnetic field, field procedure, measurement of magnetic anomalies, interpretation - Applications of the magnetic method – Principle of electromagnetic induction, Magnetic field due to a current carrying loop, Elliptical polarization, plane of polarization, dip and tilt angles

Unit 3
Seismic method: Seismic waves and wave propagation, Wave attenuation and amplitude - Seismic refraction surveying, layered earth refraction studies - Seismic reflection surveying.Study of seismic sections- pattern recognition, mapping geological structures (faults, folds, anticlines), hydrocarbon bearing and water bearing structures, gas hydrates

Unit 4
Electrical method: Self potential, Resistivity Method, different arrays, profiling & sounding techniques, interpretation & field cases - Induced polarization - Telluric & electromagnetic methods - Ground Penetrating Radar (GPR).

Unit 5
Subsurface geophysical methods, Borehole logging: Drilling and its effects on the formations - The measurement of strata dip, borehole inclination and diameter - The self-potential log, Resistivity logs, Radioactivity logs, The sonic log, The temperature log.

Reference Books:

1. El Arabi H. Shendi, 2007; Introduction of Geophysics
2. Lowri,W., 2007: Fundamentals of Geophysics, Cambridge University Press.
3. Dobrin, M.B and Savit,C.H.,1988. Introduction to Geophysical Prospecting, McGraw-Hill.
4. Grant, F.S.and West,G.F.,1965. Interpretation Theory in Applied Geophysics, McGraw Hill, New York.
5. Murthy, L.Y.R. and Mishra, D.C., 1989. Interpretation of Gravity Magnetic Anomalies in Space and Frequency Domain, AEG publication, Hyderabad, India

SEMESTER-VII

COURSE 18: GEOCHEMISTRY

Theory Credits: 4 5 hrs/week

Programme objectives:
To provide knowledge cosmic abundance of elements, composition of planets and meteorites, structure and composition of Earth. To provide complete information on geochemistry of hydrosphere, biosphere and atmosphere.

Programme outcomes:
Students will get complete knowledge on cosmic abundance of elements, composition of planets and meteorites, structure and composition of Earth. Further, students will get information on geochemistry of hydrosphere, biosphere and atmosphere

Unit 1

Introduction to geochemistry – its scope. The earth in relation to the solar system and the Universe. Cosmic abundance of elements, composition of planets and meteorites. Structure composition and distribution of elements in the Earth. Geochemical classification of elements. Geochemistry of hydrosphere, biosphere and atmosphere.

Unit 2
Elementary crystal chemistry and thermodynamics. Lattice energy of crystals, Principles of ionic substitution in minerals. Ionization potential, electro negativity, Pauling s rule, Periodic Table with special reference to Rare Earth Elements (REE). Geochemistry of Uranium & Lithium**.**

Unit 3
Introduction to isotope geochemistry, stable isotopes, geochemistry of carbon, oxygen, sulfur Isotopes, Radiogenic Isotopes, Decay scheme of K-Ar, U-Pb and Rb-Sr, Carbon dating and its applications to Geology.

Unit 4
Geochemical prospecting; Fundamental concepts, pathfinder elements. Threshold values, geochemical anomaly. Primary and secondary dispersion Halos sampling. Geochemical cycles and geochemical methods for prospecting of metallic minerals, petroleum and natural gas. Techniques in Geobotanical survey.

Unit 5
The hydrological cycle, inter relationship of surface and ground water, physico-chemical properties of water and its structure and bonding. Solution and solubility, composition of 4 natural waters, some characteristics of river waters and ground water. The mass of the biosphere: composition of the biosphere: biogenic deposits; geochemical cycle of carbon.

Reference books

1. Introduction to Geochemistry – Mason, B. and Mooro
2. Introduction to Geochemistry – Krankopf, K.B.
3. Principles of Isotope Geology – Faure, G.
4. Introduction to Crystal Chemistry - Evans, R.C.
5. Geochemistry- Arthur H. Brownlow.

SEMESTER-VII

COURSE 19: GEOTECTONICS

Theory Credits: 4 5 hrs/week

Programme objectives

To provide knowledge on geometric classification of plutonic igneous rocks, tectonic setting of plutons, structures of metamorphic rocks, foliation, lineations.

Programme outcomes

Students will get a complete knowledge on on geometric classification of plutonic igneous rocks, tectonic setting of plutons, structures of metamorphic rocks, foliation, lineations.

Unit 1

Introduction - Tectonic aspects of Igneous rocks. Geometric classification of plutonic igneous rocks, tectonic setting of plutons.

Unit 2

Structures in metamorphic rocks, Foliation, Axial plane foliation, transported foliation, other metamorphicfoliation.

Unit 3

Lineation – problem of lineation indicating extension parallel to fold axis, small scale folds.Structural association, salt domes, diapers, nappe, tectonic mélanges.

Unit 4

Geotectonics; Concept of Plate tectonics, Mid Oceanic Ridges, Sea floor Spreading, Island arcs, oceanic islands, and volcanic arcs; Concepts of Isostasy, orogeny, epiorogeny, continental drift-geological and geophysical evidence.

Unit 5

Major tectonic features of the oceanic and continental crust; Palaeomagnetism, Present Tectonic divisions of Indian shield Geo-dynamics of Indian plate, evolution of Himalayas, Isostasy and Neotectonics.

Reference Books:

1. Structural geology of rocks and region – Davis G.R.
2. Understanding the Earth – Gass I.B., Peter J.Smith and Smith PGL
3. An outline of Structural geology
4. Global tectonics – Keary. P., and Vine F.J.
5. Modres. E., and Twiss., R.J.
6. Folding and fracturing of rocks : Ramsy, J.G.

SEMESTER-VII

COURSE 20: MARINE GEOLOGY

Theory Credits: 4 5 hrs/week

Programme objectives:
To provide a valuable information on Marine geological investigations, ocean floor topography, physical and chemical properties of sea water.

Programme outcomes
Student will get a complete knowledge in Marine geological investigations, ocean floor topography, physical and chemical properties of sea water.

Unit 1
History of Marine Geology, Scope and Applications of Marine Geological Investigations. Marine sediments, sources and composition, sediment types and distribution. Morphologic and paleocurrents, Heavy minerals. Oceanic profile – Oceanic Zones.

Unit 2
Ocean Floor topography-- Continental margins: continental shelf and slope, its origin, continental rise; Submarine canyon and their origin, Oceanic ridges: Ridges, fracture zones; Ocean basins: Abyssal plains, Abyssal hills, Seamounts and guyots, Marginal trenches.

Unit 3
Origin of oceanic crust, ocean sediments, classification, Near shore Geological Processes, Beach placers, Carbon Compensation Depth (CCD).Shelf deposit, deep ocean Poly Metallic Nodules (PMN) , Hydrocarbon deposits. Concept and causes of Sea level changes and measurements.

UNIT –IV
Physical and chemical properties of sea water. Coral reefs. Coastal Pollution , Mitigation and Management- Coastal Erosion and Protection measures.Submarine volcanism, Tsunamis – causes and effects. Sea level changes, causes and types of sea level changes, methods of study.

UNIT –V
Evolution of Oceans: Structure and evolution of Pacific, Atlantic and Indian Oceans, Red Sea and Mediterranean Sea. Oceanic circulation - Surface, intermediate and deep ocean circulation; forces that produce and effects circulation patterns in world oceans; Important phenomena associated with surface circulation.

Reference Books:

1. Shepard, Submarine geology
2. Krunen, Marine geology
3. King, Introduction to marine geology and geomorphology
4. Keen, Introduction to marine geology
5. James Kennet, Marine geology, 1982, prentice hall
6. Riley and Chester, Introduction to marine chemistry
7. James Drever, The geochemistry of natural waters

SEMESTER-VII

COURSE 21: MINERAL ECONOMICS

Theory Credits: 4 5 hrs/week

Programme objectives

To provide complete information on classification of economic minerals, estimation of reserves, cost of mining, Mineral conservation rules, Economic importance of mineral industry.

Programme outcomes

Students will get a complete knowledge classification of economic minerals, estimation of reserves, cost of mining, Mineral conservation rules, Economic importance of mineral industry.

Unit 1

Introduction: Essential, Strategic and Critical minerals of India - Economic importance of mineral industry, special features of mineral industry, demand and supply analysis, National Mineral Policy

Unit 2

Estimation of reserves: Classification of reserves, tenor, grade. Preparation of assay plans, Basic Principle of ore reserve estimation - various methods of ore reserve estimation – Geometric method – Geostatistical method – Computer application - Problems on ore reserve estimation.

Unit 3

Cost of mining: Capital and operating costs; factors affecting operating cost; methods of estimating future costs; standard cost and forecast; budget and budgetary control. Loss of mineral in mining: Classification and incorporation of losses; coefficient of completeness of mineral extraction; dilution and recovery.

Unit 4

Mineral Concession Rules, Mineral conservation and substitution. Mineral wealth of Andhra Pradesh.Status of mineral production in India. Marine Mineral Resources, Law of Sea.

Unit 5

Economic importance of mineral industry, special features of mineral industry, demand and supply analysis, National Mineral Policy. Mineral Price and Pricing: International Monetary system, Factors affecting mineral price, Kinds of price quotation, Mineral Price Index, Mineral Price.

Reference Books:

1. Ore deposits of India-Gokhale and Rao
2. Mineral economics-R.K.Sinha &N.L.Sharma
3. Ore deposits-ParkJr.C.F.and Mac Diamid

SEMESTER-VII

COURSE 22: MINING METHODS AND MINE PLANNING

Theory Credits: 4 5 hrs/week

Programme objectives

The subject is offered as one of the elective under skill oriented category, it is designed to provide information on types of mining, open cast mining, underground mining, mine planning, mine safety and health administration.

Programme outcomes

Student will get a complete knowledge on types of mining, open cast mining, underground mining, mine planning, mine safety and health administration.

Unit 1

Introduction to Mining- Types of mining methods – Alluvial mining – Pan and Batea – Long tom – Sluicing (Ground Sluicing) – Derrick and cable way – Hydraulicking –Drift mining – Fore poling and Dredging Mine supports, Subsidence, Methods of breaking of rocks, Mine atmosphere, Ventilation, Drainage, Pumping,. Mining hazards and safety measures.

Unit 2

Open cast mining or quarrying – Bench mining , Glory Hole mining, Kaolin mining ; Strip mining – Rippling , Drilling and blasting , Power shovels, Dumpers, Scrapers , land dredges bucket wheel excavators, conveyor belt , Impact on Environment-Health issues –Remedies

Unit 3

Underground Coal Mining – Classification of underground Coal mining methods – Panel system , Board and pillar method, Long wall advancing, Long wall retreating , Horizon mining , Strip mining , mine supports , Lighting, Ventilation.

Unit 4

Underground metal mining – Shaft Sinking methods , Gophering , Breast stopping, Open over hand Stopping , Open underhand Stopping , Underground Glory hole mining , Pillar and Chamber method, Sublevel Stopping method, Drifting.

Unit 5

Mine Planning - Resource Estimation – Geological Modelling – Block model estimation – Nearest neighbor method – Advantages and disadvantages – Resource block model – Mine Site Evaluation – Mine Design, Equipment selection and Layout planning – Production scheduling and control system – Mine Management System – Mine Safety and Health Administration.

Reference Books:

1. Surface and underground excavations – R. R. Tatiya
2. Principles and practices of modern coal mine-R. D. Singh
3. Mineral Deposit Evaluation: A practical approach by Alwyn E. Anne
4. Courses in Mining- Arogya Swamy

SEMESTER-VII

COURSE 23: INTRODUCTION TO REMOTE SENSING AND DIGITAL IMAGE PROCESSING

Theory Credits: 4 5 hrs/week

Programme objectives

The subject is offered as one of the elective under skill oriented category, it provides complete knowledge on Remote Sensing, Satellite data acquisition system, platforms, Sensors, Digital Image Processing.

Programme outcomes

Student who opt this subject will get complete knowledge on Remote Sensing, Satellite data acquisition system, platforms, Sensors, Digital Image Processing

Unit 1

Satellite Remote Sensing – Basic concepts – Electro Magnetic Radiation, Electromagnetic spectrum – Interaction of electromagnetic radiation with atmosphere, Interaction of electromagnetic radiation with Earth surface – Atmospheric widows – Spectral regions useful for Remote Sensing.

Unit 2

Satellite data acquisition systems – Platforms – Airborne and Space borne – Sensors – Passive sensors – Multispectral scanners – Thermal infrared scanner – Microwave, radiowave scanners - Active sensors – Laser scanner, Radar altimeter and image Radar.

Unit 3

Multispectral Remote Sensing – Resolutions – Spectral, Spatial, Radiometric and temporal – Remote Sensing in Thermal Infra Red regions – Basic concepts and characteristics – Geological interpretations and Advantages of thermal imagery – Remote Sensing in Microwave region – Basic concepts, characteristics, advantages and disadvantages.

Unit 4

Digital Image Processing – Introduction, Basic concepts – Image formats and its characteristics. Map projections – Geometric rectification, georeferencing and image to image registration.
Image enhancement – Radiometric enhancement – Spatial enhancement – Spectral enhancement

Unit 5

Image classification – Supervised classification, Unsupervised classification – Pattern of recognition and feature extraction – Image mosaiking and change detection.

Reference Books

1. Remote Sensing Principles and interpretations – Sabins, F.F.Jr.
2. Remote Sensing and Image Interpretation - Lillisand, T.., and Kiefer, P.W.
3. Remote Sensing Geology – R.P. Gupta

SEMESTER-VII

COURSE 24: BASICS OF GIS

Theory Credits: 4 5 hrs/week

Programme objectives

The subject is offered as one of the elective under skill oriented category, it offers knowledge on concept and applications on Geographic Information System (GIS)

Programme outcomes

Student will get a complete knowledge on concept and applications on Geographic Information System (GIS)

Unit 1

Basic concepts: Definition and history, Components of GIS, Recent trends and applications of GIS; Data structure and formats, Spatial data models – Raster and vector, Data base design-editing and topology creation in GIS, Linkage between spatial and non-spatial data, Data inputting in GIS. Rectification, Transformation Methods.

Unit 2

Data Types; Spatial Data; Non-Spatial Data, Data Input; Existing GIS Data, Metadata; Conversion of Existing Data, Creating New Data, Data Models; Vector Data Model; Raster Data Model; Integration and Comparison of Vector and Raster Data Models.

Unit 3

Types of Digitizing Errors, Causes for Digitizing Errors; Topological Editing and Non-topological Editing; Other Editing Operations; Editing Using Topological Rules

Unit 4

Attribute Data in GIS, Attribute Data Entry, Manipulation of Fields and Attribute Data, Data Exploration; Attribute Data Query, Raster Data Query, Map- Based Data Manipulation.

Unit 5

Spatial Data: Definition, Analysis, Processes & Steps, Software and Tools, Geodatabase Model, Role of Databases in GIS, Creating, Editing and Managing, Classification scheme of Vector-Based and Raster- Based GIS Operation Raster- Based Techniques: Methods of reclassification, overlay analysis, Digital Terrain Analysis and Modeling- TIN and DEM, Surface representation and analysis, Slope and Aspect, Geographic Visualization Data Classification, Map Comparison.

Reference Books:

1. Principles of Geographical Information Systems for Land Resources – Borough, P.A.
2. Geographical Information Systems – Kang Tsung Chang.

SEMESTER-VII

COURSE 25: SAMPLING AND GEOLOGICAL MAPPING

Theory Credits: 4 5 hrs/week

Programme objectives

The subject is offered as one of the elective under skill oriented category, it offers knowledge on sampling methods, Toposhheet, map, map scale and Geological mapping techniques.

Programme outcomes

Student will get a complete knowledge on sampling methods, Toposhheet, map, map scale and Geological mapping techniques.

Unit 1

Sampling methods- Chip channel, trench, cutting and underground mine samples. Methods of drilling- diamond, core, rotary, percussion and auger drilling. Evaluation of sampling data Mean, mode, median, standard deviation and variance

Unit 2

Bore hole problems. Preparation of mine plans - Drilling and Logging - Core and non-core drilling Planning of bore holes and location of boreholes on ground Core-logging.

Unit 3

Toposheet and map. Toposheet and map reading. Various methods of locating a point on toposheet and map. Basic field procedure – Strike, Dip, apparent dip, rock trends.

Unit 4

Determination of slopes and gradient, measuring differences in elevation. Basic field observations at a point or out crop. Geological mapping – General considerations, reconnaissance, study of surface features and rocks.

Unit 5

Transfer of field data collected on to a base map, finalization of map, preparation of geological cross section. Contouring – Definition, internal characteristics, direct and indirect methods of contouring and uses. Application of GIS in Mapping.

Reference Books:

1. Field Geology – Lahee
2. Basic Field Guide – S.M.Mathur

SEMESTER-VIII

COURSE 26: Micropalaeontology

Theory Credits: 4 5 hrs/week

Programme objecrives

To provide knowledge on Micro Paleontology, types of micro fossils and uses of micro fossils in identification of natural gas and oil reserves.

Programme outcomes

The subject will give a complete information on Micro Paleontology, types of micro fossils and uses of micro fossils in identification of natural gas and oil reserves

Unit 1

Scope of Micropaleontology – Definition and significance as geological record – Classification of Micro paleontology – Plant microfissils – Animal microfossils - Index fossils

Unit 2

Calcareous microfissils – Phosphatic microfossils – Siliceous microfossils – Organic microfossils. Palaeoecology, Palaeobotony – Plant fossils - Detailed study and significance of Polynomorphs – Pollengrain – Plant Spores – Fungal spores – Chiinozoa – Acritarchs – Archean cells.

Unit 3

Detailed study and significance of mineralized microfossils – Ostracods – Conodonts – Selecodonts – Cloudinids – Dinoflagellate cysts – Sponge spicules

Unit 4

Applications of micropaleontology in the fields of biostratigraphy, palaeoenvironments, petroleum geology and palaeooceonography. Utility of Microfossils in Hydrocarbon Exploration

Unit 5

Application of micropaleontology in hydrocarbon exploration: identification of reservoirs and their correlation. Application of spore and pollens in correlation of coal seams, spore and pollens as indicator of thermal maturity of hydrocarbons reservoirs, fossils associated with mineral deposits, fossils as an indicator of pollution.

Reference Books:

1. “Micropaleontology: Application of Stratigraphy and Paleoceanography” by Devesh K Sinha 4. 2. 2.
2. “Micropaleontology” by Gandhi M Suresh 5. “Elements of Micropalaeontology” by Gérard Bignot

SEMESTER-VIII

COURSE 27: ENERGY RESOURCES

Theory Credits: 4 5 hrs/week

Programme objectives

The subject is designed to provide information on Energy sources on the earth, renewable and non-renewable energy resources, Petroleum, Natural gas, Coal, Atomic minerals.

Programme outcomes

Student will get complete information on Energy sources on the earth, renewable and non-renewable energy resources, Petroleum, Natural gas, Coal, Atomic minerals.

Unit 1

Definition of Energy: Primary and Secondary Energy Difference between Energy, Power and Electricity Renewable and Non-Renewable Sources of Energy The concept and significance of Renewability: Social, Economic, Political and Environmental Dimension of Energy.

Unit 2

Petroleum – Origin- inorganic and organic theories – migration and accumulation of oil and gas – Geological age of reservoir rocks – Classification of traps. Petroliferous basins of India. Geology of the productive oil fields of India. Status of Oil and Natural Gas in India- Gas Hydrates

Unit 3

Coal – Origin and classification – Chemical characterization — Gelogical and Geographical distribution of coal deposits in India. Detailed Geology for important coal fields of India. Hazards of Coal Mining and Safety Measures.

Unit 4

Atomic minerals – Mode of occurrence and association with other radioactive minerals. Methods of prospecting and productive geological horizons in India. Detailed Geology and Distribution of Uranium deposits in India. Atomic fuels and environment.

Unit 5

Renewable Energy resources – Potential of Hydroelectric Power, Solar Energy, Wind, Wave and Biomass Based power and Energy

Reference Books

1. All you wanted to know about Disasters – (Brig) H.K.Kanna
2. Petroleum formations and occurrences – Tissort, B.P. and Welte D.H.,
3. Text book of coal – Chandra, D.
4. Uranium ore deposits – Dahlkamp F.J.
5. Petroleum Geology – Laverson, P.
6. Renewable Energy Resources and Emerging Technologies – Kothari, D.P., Singal, K.C. and Rakesh Ranjan
7. Renewable Energy Resources – John Twidell and Tony Weir

SEMESTER-VIII

COURSE 28: NATURAL HAZARDS & MANAGEMENT

Theory Credits: 4 5 hrs/week

Programme objectives

To inculcate knowledge on natural hazards, manmade hazards, earthquakes, floods, tsunami, volcanic eruption . Further it is designed to taught how these natural hazards can be managed to cause minimum damage to the mankind.

Programme outcomes

Student will get complete knowledge on natural hazards, manmade hazards, earthquakes, floods, tsunami, volcanic eruption . and management natural hazards to cause minimum damage to the mankind.

Unit 1

Hazards Natural, Man Made, Natural Earthquake concepts, hazards mitigation case histories preferably Indian; Classification, causes of landslides, controls of landslides subsidence and its importance, Landslides-concepts hazards mitigation case histories preferably Indian.

Unit 2

Flood types and its management, drought types and its management, landslide, Cyclone Concepts, severe local storms,tornado,lightning Prediction and hazard assessment, mitigation case histories preferably Indian.Drought mitigation Indian case histories.Tsunami: Generation and Movement,Tsunami: Generation and Movement.

Unit 3

Tsunami-concepts, Tsunami Generation and Movement, hazards mitigation case histories preferably Indian;Volcanoes- concepts hazards mitigation case histories preferably Indian. Wildfire - concepts hazards mitigation case histories preferably Indian.

Unit 4

Volcanic hazards, origin and types of volcanic activity, nature of volcanic hazards, Prediction of volcanic eruptions, Mitigation of volcanic hazards.

Unit 5

Classification, causes of landslides, controls of landslides subsidence and its importance, site selection for ghat roads. Determination of causative factors for soil erosion, Soil conservative measures.

Reference Books:

1. Geoff L.Wells,1997, Major Hazards and Their Management,Gulf Publishing Company, 305 p.
2. Environmental Geology- Keller. E.A (1976).
3. Environmental Geology- Indian Context K.S Valdiya (1987)
4. Environmental Geology- C.W Montgomery (1989).
5. Simon Ross, 1998, Natural Hazards,Nelson Thornes Ltd, USA, 96 p.4.
6. David R. Godschalk, 1998, Natural Hazard Mitigation: Recasting Disaster Policy and Planning, Island Press, 591 p.

SEMESTER-VIII

COURSE 29: MINERAL EXPLORATION

Theory Credits: 4 5 hrs/week

Programme objectives

To provide complete knowledge on stages of mineral exploration, sampling techniques, geophysical and geochemical methods of exploration.

Programme outcomes

Student will get complete knowledge on stages of mineral exploration, sampling techniques, geophysical and geochemical methods of exploration.

Unit 1

Stages of Mineral exploration – Methods of choosing target area – Criteria for accepting or rejecting the target area – Guides to ore search – Stratigraphic, Lithological, Geomorphological and Structural. Rock alteration and Geo-botanical guides.

Unit 2

Sampling techniques - : Evaluation of data Evaluation of sampling data Mean, mode, median, standard deviation and variance. Drilling and Logging Core and non-core drilling Planning of bore holes and location of boreholes on ground Core-logging

Unit 3

Detailed study of Geophysical methods of Exploration – Magnetic method, Seismic method, Gravity method, Resistivity method - Geochemical prospecting.

Unit 4

Remote Sensing Applications in various stages of mineral exploration – Spectral characteristics of alteration minerals – Hydroxyl bearing minerals, Carbon and tectosilicates and colour ratio images using digital image processing.

Unit 5

Application of Remote Sensing in exploration of Gold, Base metals (Copper, Lead, Zinc), Diamond, Bauxite, Iron ore and barite.

Reference Books:

1. Introduction to Geophysical prospecting – Dobrin, M.B.
2. Introduction to Exploration Geochemistry – Levinson, A.S.
3. Image Interpretation in Geology – Drury, S.A.
4. Remote Sensing Principles and Interpretation – Sabins, F.F.

SEMESTER-VIII

COURSE 30: ORE BENEFICIATION

Theory Credits: 4 5 hrs/week

Programme objectives

To give knowledge on principles of mineral processing, methods of treatment, crushers, ore beneficiation and bio-processing.

Programme outcomes

Student will be given a complete knowledge on principles of mineral processing, methods of treatment, crushers, ore beneficiation and bio-processing.

UNIT – I

Principles of mineral processing- methods of treatment- sequence of operations and its importance, Properties of minerals and rocks and their considerations in ore beneficiation techniques.

Unit 2

Primary crushers-. Secondary crusher. Grinding mills. Sizing by screening and sub- sieve sizing. Definition of sieve, screen, mesh. Advantages of wet and dry sieving. Gravity Separation : Separation in Vertical currents – Jigging –Theory and principles, different types of jigs.

Unit 3

Dense Medium separation : Principles, media preparation and stability of media, regeneration of media, Classification of DMS. Flotation fundamentals : Introduction, History. Physical aspects of Flotation.

Unit 4

Magnetic Separation: Principles, types of magnetic separators, wet and dry, low and high intensity, high gradient magnetic separators. Flocculation and Dispersion. Dewatering: Introduction and importance.

Unit 5

BIO PROCESSING – Introduction - Concept and scope of bio-mineral processing. Utility of Microbes for beneficiation and selective dissolution of minerals/metals.

Reference Books:

1. Mining Geology – Arogyaswamy
2. Mining Geology – McKinstry
3. Ore Deposits of India – G.K.Gokhale.

SEMESTER-VIII

COURSE 31: ENGINEERING GEOLOGY

Theory Credits: 4 5 hrs/week

Programme objectives

The subject is designed to provide knowledge on Engineering properties of rocks, construction of civil engineering structures, quarrying, construction of dams, tunnels. It also provide knowledge on Remote Sensing Applications on Engineering Geology.

Programme outcomes

Student will get a complete knowledge on Engineering properties of rocks, construction of civil engineering structures, quarrying, construction of dams, tunnels, Further he will get knowledge on Remote Sensing Applications on Engineering Geology

Unit 1

Engineering properties of rocks, soils - specific gravity, porosity, permeability, compressive strength, hardness, toughness, percentage of wear, tensile strength, modules of elasticity, modules of compression and residual stress and their importance in construction of civil engineering structures. Quarrying.

Unit 2

Definition and parts of dam, types of dams, geotechnical consideration in selection of dam sites, case histories – Nagarjuna Sagar Dam and Srisailam Dam, Characters for investigating relative suitability, geological consideration for reservoir sites.

Unit 3

Types of tunnels, objects for geological investigations, methods of investigation, geological considerations in tunnels types of bridges, Geology for bridge sites, problems of constructing civil engineering structures in areas prone to landslides, faulting, earthquake and coastal erosion.

Unit 4

Application of Remote Sensing and GIS in river valley projects – Dams and reservoirs, site suitability evaluation (lithological, structural, geomorphoogical considerations) – Application of Remote Sensing and GIS canal and pipeline alignment, tunnels constructions. Site suitability evaluation (lithological, structural, geomorphological, slope, gradient, economic considerations.

Unit 5

Application of Remote Sensing and GIS in seismic hazards, landslides, ghat roads, bridges, culverts, route locations (highway and railroads).

Reference Books

1. Engineering materials – S.C. Rangwala
2. Text Book of Engineering Geology – N.Chennakesavulu.
3. Principles of Engineering Geology and Geotectonics – D.P.
4. Engineering Geology – B.S.Satyanarayana Swamy
5. Principles of Engineering Geology – K.V.G.K.Gokhele
6. Remote Sensing and Image Interpretation – Lillisand, T.M., Keifer, R.W.
7. Remote Sensing Principles and Interpretations – Sabins, F.F.

SEMESTER-VIII

COURSE 32: GIS & GPS APPLICATIONS

Theory Credits: 4 5 hrs/week

Programme objectives

This paper is provided as one option under Skill Oriented Subjects. It is designed to provide complete knowledge on working principles and applications of Geographic information (GIS) and Global Positioning System (GPS)

Programme outcomes

Student will acquire complete knowledge on working principles and applications of Geographic information (GIS) and Global Positioning System (GPS)

Unit 1

Spatial Data: Definition, Analysis, Processes & Steps, Software and Tools, Geodatabase Model, Role of Databases in GIS, Creating, Editing and Managing, Classification scheme of Vector-Based and Raster- Based GIS Operation.

UNIT - II

Raster- Based Techniques: Methods of reclassification, overlay analysis, Digital Terrain Analysis and Modeling- TIN and DEM, Surface representation and analysis, Slope and Aspect, Geographic Visualization Data Classification, Map Comparison.

Unit 2I

Introduction to Spatial Interpolation: Control Points, Global Method- Trend surface analysis, regression model, local methods- Thiessen polygons, density estimation, Inverse Distance weighted Interpolation, Kriging- Ordinary Kriging and Universal Kriging, GIS and decision support system, Introduction to AHP, basic principle of AHP. Principal and components of multiple criteria decision making.

Unit 4

Introduction; Basics Geodesy, Geoid/ Datum/Ellipsoid-Definition and Basic Concepts; Datum, Transformations; Map Projections. History of Navigation and Positioning; Objectives, Types of Earth's, Positioning System- GPS, GALILEO, GLONASS and GAGAN.

Unit 5

GPS Components – space segment, control segment, user segment; GPS Receiver and its Types - ; GPS Errors. GPS Positioning Modes: GPS point positioning, GPS relative positioning; RTK GPS, Factor affecting GPS accuracy - Route Navigation, Forestry and Natural Resources, GPS Tracking, Utility, Mapping, Civil Engineering, Cadastral Surveying and Seismic Applications.

Reference Books:

1. Burrough, Peter A. and Rachael McDonnell, (1998), 'Principles of Geographical Information Systems' Oxford University press, New York
2. N.K. Agrawal, (2004), Essentials of GPS, Spatial Network Pvt. Ltd.
3. Sathish Gopi, (2000) , GPS and Surveying using GPS
4. Leica A., (2003), GPS Satellite Surveying, John Wiley & Sons, Use New York.
5. Terry- Karen Steede, (2002), Integrating GIS and the Global Positioning System, ESRI Press

SEMESTER-VIII

COURSE 33: PETROLEUM GEOLOGY

Theory Credits: 4 5 hrs/week

Programme Objectives

This paper is provided as one option under Skill Oriented Subjects. It is designed to provide complete knowledge on Petroleum, its source rocks, exploration techniques, classification of reservoir rocks.

Programme outcomes

Student will acquire required knowledge on Petroleum, its source rocks, exploration techniques, classification of reservoir rocks.

UNIT-I

Source Rocks: Definition of source rock, Organic rich sediments as source rocks, Nature and type of source rocks - Claystone / shale, The process of diagenesis, catagenesis and metagenesis in the formation of source rocks, Subsurface pressure temperature conditions for the generation of oil and gas from the source sediments, Oil window.

UNIT-II

Reservoir Rocks: Characteristics of Reservoir rocks, Classification and nomenclature: Clastic Reservoir Rocks, Carbonate Reservoir Rocks, Unconventional, Fractured and Miscellaneous reservoir rocks, Marine and non-marine reservoir rocks.

UNIT-III

Reservoir Properties and Cap Rocks:Reservoir pore space, porosity- primary and secondary porosity, effective porosity, fracture porosity - permeability – effective and relative permeability, Concept of Shale oil.Cap rocks: Definition and characteristics of cap rocks.

UNIT-IV

Hydrocarbon migration: Geological framework of migration and accumulation, The concept of hydrocarbon migration from source beds to the carrier beds, Carrier beds to the reservoir, Freepath ways for migration-Short distance and long distance migration, Evidence for migration, Oil and gas seepages.

UNIT-V

Entrapment of hydrocarbons: Entrapment and accumulation of hydrocarbons, Classification and types of traps: Structural, stratigraphic and combination type of traps, Traps associated with salt domes. Sedimentary Basins: Sedimentary basins -origin and classification, Types of basins - Tectonic classification, stratigraphic evolution and hydrocarbon accumulations of the following basins:Krishna-Godavari basin, Cambay basin and Mumbai off-shore.

Reference Books:

1. Geology of Petroleum, A.I. Levorsen,2ndEdition. CBS, Publishers, 2006.
2. Elements of Petroleum Geology, Richard, C. Selley,Elsevier, 1997.
3. Sedimentary basins of India- ONGC bulleting.
4. Unconventional Petroleum Geology, CainengZou et al., Elsevier, 2013.

SEMESTER-VIII

COURSE 34: REMOTE SENSING APPLICATIONS IN NATURAL RESOURCE EXPLORATION

Theory Credits: 4 5 hrs/week

Programme objectives

To inculcate knowledge on applications of Remote Sensing in the exploration of natural resources like groundwater, economic minerals, forest cover.

Programme outcomes

It provides accountable knowledge to the students on applications of Remote Sensing in the exploration of natural resources like groundwater, economic minerals, forest cover.

Unit 1

Scope of Remote Sensing applications - potentials and limitations-Resource mapping and integrated information for sustainable development-Resource evaluation: Soils, minerals forest and agriculture.

UNIT - II

Applications in land use and land cover analyses-Land use classification principles and systems-Mapping and monitoring of land use / land cover and regional planning-Urban land use, Urban sprawl and urban planning.

Unit 3

Water Resource Applications-Mapping, monitoring of surface water bodies, tanks, lakes / reservoirs-Hydrogeomorphic mapping, ground water zoning from unconsolidated, semiconsolidated and hard rocks.

Unit 4

Coastal and near shore applications-Satellite sensors for Coastal zone environment-Coastal landforms and evolution-Coastal dynamics and shore line changes and Coastal wetlands.

Unit 5

Environmental and disaster management applications-Mapping and monitoring of Natural hazards a) Cyclones / floods b) Droughts c) Landslides d) Volcanoes e) Earthquakes-Analysis of human-induced hazards a) Deforestation b) Erosion c) Siltation

Referece Books:

1. Applied Remote Sensing, C.P. Lo, Longman, Scientific and Technical Publishers
2. Remote Sensing in hydrology, Engman, E.T. Gurney, R.J.
3. Remote Sensing in water management in command areas, Govardhan, V.
4. Satellite oceanography, An introduction for oceanographers and Remote Sensing Scientists, I.R. Robinson, Ellis Horwood series marine sciences.
5. Remote Sensing - Principles and Interpretation, Sabins F.F. Freeman & Co., 1987.
6. Satellite meteorology Techniques and applications, Vol. I and Vol. 2, Edited by B.M. Rao, et. Al

SEMESTER-VIII

COURSE 35: VISUAL AND DIGITAL INTERPRETATION OF SATELLITE IMAGE

Theory Credits: 4 5 hrs/week

Programme objectives

The paper is designed to provide knowledge on Visual interpretation and Digital interpretation techniques for the extraction of thematic maps from a Satellite Image.

Programme outcomes

Student will get complete knowledge on Visual interpretation and Digital interpretation techniques for the delineation of thematic maps from a Satellite Image

Unit 1

Definition – Types of Image Interpretation – Visual Interpretation, Digital Interpretation –Basic elements of interpretation – Tone, Size, Shape, Pattern, Texture, Shadow, Association - Visual interpretation kays – Selective Kay, Classification Key

UNIT - II

Image enhancements: Linear and non-linear Contrast enhancement techniques, density slicing, pseudo colour images, spatial enhancement techniques (convolution filtering), spectral enhancement techniques, Image algebra, PCA, data fusion techniques

Unit 3

Digital image Spatial filtering – Highpass filtering – Lowpass filtering – Image transformation – Spectral/Band rationing – Principal Component Analysis.

Unit 4

Image classification – Supervised classification – Procedure –Training stage, classification stage, output stage – Unsupervised classification – Spectral classes, information classes.

Unit 5

Introduction to Spatial Interpolation: Control Points, Global Method- Trend surface analysis, regression model, local methods- Thiessen polygons, density estimation, Inverse Distance weighted Interpolation, Kriging- Ordinary Kriging and Universal Kriging, GIS and decision support system, Introduction to AHP, basic principal of AHP. Principal and components of multiple criteria decision making

Reference Books:

1. Remote Sensing - Principles and Interpretation, Sabins F.F. Freeman & Co., 1987
2. Applied Remote Sensing, C.P. Lo, Longman, Scientific and Technical Publishers.