

M. Sc., Earth Science and Resource Management Program Course Outcome.

Program Specific Outcomes

After successful completion of program, students will be able to:

1. Understand the Earth's major systems and how they interact with each other
2. Identify common minerals, rocks and ores and their genesis, occurrence and distribution in earth.
3. Describe and interpreting the development of landforms and geologic structures due to natural agents.
4. Constructing and interpreting geologic and topographic maps, cross-sections, and topographic profiles for understanding earths exterior and interior.
5. Understand the composition of the Earth's atmosphere and its processes.
6. Understand the Earth's place in the solar system.
7. Understand the impact of humans on climate change, factors responsible for climate and roles of which play in controlling climate change.
8. Understand foundational geologic principles and theories and their impact on Earth systems
9. Understand the Earth's dynamics and the processes involved in dynamic development of earth.
10. Being familiar with technologies and their application used in solving geologic problems.
11. Map geological materials, features and processes in the field using appropriate tools and techniques, including compass, hand drafting, GPS, GIS and Remote Sensing.

I Semester

Paper Title- ESH 101: Mineralogy, Crystallography and Thermodynamics

Student Learning Course Outcomes

After successful completion of this course, students will be able to: -

1. Gain knowledge on mineral identification, their crystallography, chemical composition, physical properties, genesis, their classification.
2. Understand the basics of crystallography and mineralogy
3. Learning how to identify and recognize minerals under thin section
4. Understand the importance of minerals to society and their economic value.
5. Explain how the properties of chemical elements and their bonds regulate the structure and composition of minerals
6. Demonstrate how the crystal structure of minerals affects the external morphology

7. Understand the facts, concepts, principles, theories, classification systems, and language associated with minerals.
8. Interpret stability fields in terms of pressures and/or temperatures using a phase diagram.
9. Comprehensive Knowledge of Mineralogy: Students will gain knowledge about the physical and chemical properties of various mineral groups. They'll be able to classify and recognize the occurrence and uses of different minerals, and understand concepts like isomorphism, polymorphism, pseudomorphism.
10. Application of Optical Mineralogy: Students will gain knowledge on the principles of optics, isotropism and anisotropism, refractive indices, double refraction, extinction, pleochroism, and interference colors in the context of mineral identification. They will also develop practical skills to use a polarizing microscope and study the optical properties of common rock-forming minerals.
11. Understand the relations between heat and mechanical energy, and of the conversion of either into the other. Thermodynamics as the science that tells us which minerals or mineral assemblages will be stable under different conditions.

Paper Title- ESH 102: Physical Geology and Oceanography

Student Learning Course Outcomes

After successful completion of this course, students will be able to: -

1. Fundamentals of Geology and Earth Sciences: Students will gain a comprehensive understanding of the origins and physical properties of Earth, the principles of geology, and its place within the solar system.
2. Understand of Natural Processes and Phenomena: Students will gain knowledge of internal and surface processes of Earth, such as weathering, erosion, seismic activity, and volcanism, and their environmental impact.
3. Mastery of Geomorphology and Dynamic Earth Concepts: Students will understand the fundamental principles of geomorphology and will learn about Earth as a dynamic system, encompassing theories of continental drift, sea-floor spreading, paleomagnetism, and plate tectonics.
4. Practical Skills in Geomorphological Analysis: Students will develop practical skills for understanding and analyzing geomorphic features, including the use of topographical maps and toposheets, understanding landform contour maps, and field study of important landforms.
5. Understand the basic chemical, geological, physical, and biological features and processes of the oceans.
6. Students will learn about Marine life and ecosystems, Ocean circulation, Plate tectonics and the geology of the seafloor

Paper Title- ESH 103: Geoinformatics

Student Learning Course Outcomes

After successful completion of this course, students will be able to: -

1. Understand of Photo Geology and Aerial Photography: Students will acquire a fundamental understanding of aerial photography, including knowledge of the electromagnetic spectrum, types and geometry of aerial photographs, and factors affecting aerial photography.
2. Proficiency in Remote Sensing Fundamentals: Students will learn about the basics of remote sensing, remote sensing systems, and sensors. They will be able to understand the signatures of rocks, minerals, and soils, and apply remote sensing knowledge in geosciences and geomorphological studies.
3. Knowledge of Remote Sensing Satellites and Image Processing: Students will gain knowledge about various Indian and foreign remote sensing satellites. They will understand digital image processing and its essential steps, including elements of pattern recognition and image classification.
4. Competence in Geographic Information System (GIS): Students will be introduced to the Geographic Information System (GIS), its components, product generation, and map analysis tools. They'll also learn about the integration of GIS.

Paper Title- ESS 101: Earth and Atmospheric Science

Student Learning Course Outcomes

After successful completion of this course, students will be able to: -

1. Explain the physical laws governing the structure and evolution of atmospheric phenomena spanning a broad range of spatial and temporal scales.
2. Apply mathematical tools to study atmospheric processes.
3. Students will have the knowledge and skills to: Critically analyze the interactions between the atmosphere and the surface (topography, vegetation, built structures), and apply this understanding in an environmental decision-making context.
4. Explain the principles behind, and use of, meteorological instrumentation.
5. Study the fluid dynamics that drive the circulation of the ocean and the atmosphere.
6. Understand the physical and mathematical descriptions of various atmospheric phenomena.
7. Gain experience on how to ask relevant weather-related questions, and how to use weather information to make decisions.
8. Study of the atmosphere, atmospheric phenomena, and atmospheric effects on our weather.

II Semester

Paper Title- ESH 201: Petrology and Geochemistry

Student Learning Course Outcomes

After successful completion of this course, students will be able to: -

1. Understand of Igneous Petrology: Students will understand the fundamentals of igneous petrology, including the composition, types, and origin of magma. They'll comprehend various igneous rock forms, textures, structures, and the principles of differentiation and assimilation, as well as Bowen's reaction series.
2. Knowledge of Sedimentary Petrology: Students will understand the processes that form sedimentary rocks and will be able to classify them based on their textures and structures. They will gain detailed knowledge of the petrography of important siliciclastic and carbonate rocks such as conglomerate, breccia, sandstone, greywacke, shale, limestone.
3. Comprehensive Study of Metamorphic Petrology: Students will comprehend the processes and products of metamorphism, including types, factors, zones, and grades of metamorphism. They will learn to identify the textures, structures, and classifications of metamorphic rocks and perform detailed petrographic analyses of key metamorphic rocks.
4. Practical Skills in Petrography: Students will develop practical skills for identifying igneous, sedimentary, and metamorphic rocks based on their physical properties in hand specimens and optical properties in thin sections. This will involve hands-on experience with rock samples and the use of a microscope.
5. Insight into Cosmic Element Abundance and Planetary Composition: Students will learn about the cosmic abundance of elements and the composition of planets and meteorites. They will gain a holistic understanding of the geochemical evolution of the earth and geochemical cycles.
6. Proficiency in Geochemical Thermodynamics and Isotope Geochemistry: Students will grasp the key principles of geochemical thermodynamics, isomorphism, polymorphism, and isotope geochemistry, providing them with a comprehensive and nuanced understanding of geochemical phenomena.
7. Students will understand Goldschmidt's geochemical classification of elements and the distribution of major, minor, and trace elements in different types of rocks - igneous, metamorphic, and sedimentary.

Paper Title- ESH 202: Hydrogeology and Structural Geology

Student Learning Course Outcomes

After successful completion of this course, students will be able to: -

1. Students will grasp the concept of the distribution of water on the earth's crust, types of groundwater, zones of aeration and saturation, and the water table. They'll also learn about the classification of aquifers, hydrological properties of rocks and soil, and principles governing groundwater movement.
2. Students will gain knowledge in surface and sub-surface investigations of groundwater, including geophysical exploration and test drilling. They'll learn about the fluctuations of water levels, the quality of groundwater, well hydraulics, water wells, and various recharging methods. The course will also cover details about spring wells.
3. Proficiency in Environmental and Hydrological Applications: Students will develop skills in generating seismic and land degradation maps, interpreting satellite imageries, measuring water pollution levels, and performing field studies of geo-environmentally sensitive zones. They'll also practice water quality analysis and study borehole drilling in the field.
4. Students will comprehend the fundamental concepts of structural geology, including contouring, reading geological maps, and understanding bed, dip, strike, and outcrop.
5. They'll learn to use instruments like clinometer/Brunton compass and identify various geological structures, deformations, and faults.
6. Students will gain an understanding of different types of geological discontinuities like joints and unconformities, and understand their significance in the context of structural geology.

Paper Title- ESH 203: Paleontology, Indian Stratigraphy, Geology of Karnataka

Student Learning Course Outcomes

After successful completion of this course, students will be able to: -

1. Students will understand the basic principles and nomenclature of stratigraphy and learn about the stratigraphic distribution of various rock groups throughout different geological periods in India and special reference to Karnataka.
2. They'll gain practical experience in preparing stratigraphic columns and conducting field studies in type areas.
3. Students will acquire a detailed understanding of the distribution and classification of Paleozoic, Mesozoic, and Cenozoic rocks in India and Karnataka, their marker fossils, and significant geological formations associated with these periods.
4. Understand of Paleontology and Fossil Study: Students will comprehend the nature, preservation, and significance of fossils, learn about the taxonomy of various phyla

including Mollusca, Brachiopoda, Arthropoda, and Echinodermata, and understand the geological history and morphological characteristics of these groups.

5. Evolution and Plant Kingdom: Students will learn about the evolution of key species including man, horse, and elephant, as well as an introduction to reptiles, particularly focusing on the Mesozoic period.
6. In addition, they will gain a foundational understanding of the plant kingdom, including the classification and morphology of notable plant fossils. They'll get hands-on experience studying fossils and models of significant fauna and flora from various geological periods.

Paper Title- ESS 201: Digital image processing and GIS Data Analysis

Student Learning Course Outcomes

After successful completion of this course, students will be able to: -

1. Learn and understand the digital image processing
2. Study the image fundamentals and mathematical transforms necessary for image processing.
3. Learn and understand various image enhancement technique used in digital image processing
4. Study image restoration procedures.
5. Study the image compression procedures.
6. Perform image enhancement techniques in spatial and frequency domain.
7. Elucidate the mathematical modelling of image restoration and compression
8. Apply the concept of image segmentation.
9. Describe object detection and recognition techniques.
10. Learn and understand various image transform used in digital image processing
11. Learn and understand various image restoration technique and methods used in digital image processing
12. Learn and understand various image compression and segmentation used in digital image processing

III SEMESTER

Paper Title- ESH-301: Economic and Engineering Geology

Student Learning Course Outcomes

After successful completion of this course, students will be able to: -

1. Knowledge of Economic Geology: Students will understand the scope of economic geology, including syngenetic and epigenetic mineral deposits, and the classification of mineral deposits. They'll gain an understanding of ore genesis, control of ore mineralization, magmatic and hydrothermal processes, and the geographical and geological distribution of various ore deposits in India. Additionally, they will acquire skills in the megascopic study and identification of various ore minerals
2. They will also develop an understanding of the engineering properties of rocks and other structural materials with implications for design of dams, tunnels, bridges, canals, and highways.
3. Significance of geology in major engineering projects
4. Method of assessing geological perspective of major infrastructure projects
5. Rock properties related to the strength and bearing capacities of rocks and soils
6. Learn major techniques for ameliorating engineering properties of earth material
7. Understand the effect and relationship of natural hazards on engineering projects

Paper Title- ESH- 302: Exploration Geology - Geological, Geochemical and Geophysical

Student Learning Course Outcomes

After successful completion of this course, students will be able to: -

1. Proficiency in Mineral Exploration Techniques: Students will acquire a firm understanding of magnetic, electromagnetic, radiometric, and seismic methods of mineral exploration, as well as principal methods of geological prospecting.
2. They'll also gain exposure to the instruments used in geological prospecting.
3. Understanding of industrial and non-industrial resources and distinction between reserve and resource
4. Understand the Mining Methods and Geological Applications: Students will be introduced to various mining methods, including open cast and underground mining.
5. Learn Natural resource consumption patterns through historical times
6. Gain knowledge on Principles of prospecting of exploration
7. Will learn techniques of mineral exploration and reserve estimation methods

Paper Title- ESH-303: Fuel Geology and Disaster Management

Student Learning Course Outcomes

After successful completion of this course, students will be able to: -

1. Understand Coal as a Fuel Source: Students will gain comprehensive knowledge about coal, its formation, types, and geological significance. They'll understand the role of coal as a primary energy resource, its composition, and extraction methods.
2. Expertise in Coal Liquefaction and Gasification: Students will learn about the processes of coal liquefaction and gasification, where coal is converted into liquid and gaseous fuels.
3. They'll understand the chemical and physical transformations involved, the technologies used, and the advantages and disadvantages of these processes from an energy production and environmental perspective.
4. Proficiency in Petroleum Geology: Students will explore the geological aspects of petroleum, including its formation, composition, and extraction. They'll understand the characteristics of petroleum reservoirs and the geological and structural conditions that create oil traps.
5. Knowledge of Petroleum Distribution in India: Students will learn about the geographical and geological distribution of petroleum in India, exploring major oil-producing regions and the geological characteristics that make them suitable for oil extraction. They'll also get insight into India's oil industry, including extraction techniques, production volumes, and the economic and environmental implications of oil extraction.
6. Understand Environmental Geology: Students will learn fundamental principles of disaster management, including the causes and remedies of geological hazards such as landslides, earthquakes, and volcanic hazards. They'll also gain an understanding of atmosphere pollution, deforestation, global warming, and water pollution.
7. Definition and types of natural disasters
8. Landslide, Earthquakes, Flood, Drought hazard mapping techniques, and forecasting and management of natural hazards

Paper Title- ESS-301: Mineral and Water Resources Management

Student Learning Course Outcomes

After successful completion of this course, students will be able to: -

1. Expand their knowledge of the physical, chemical, biological, and social sciences and learn how to apply this knowledge to the management of water resources.
2. Understand water resource decision-making at governance levels from local to national.
3. Use a wide range of analytical tools to sustainably manage water resources.
4. Have an understanding of professional and ethical responsibility.
5. Describe the fundamental knowledge of hydrological principles, precipitation, evaporation, surface runoff and unit hydrograph.

6. Apply the hydrological principles in flood routing and groundwater.
7. Describe the fundamental knowledge of water demand and supply, water pollution and water quality standards.
8. Apply the knowledge to assess on urban impacts, dissolved oxygen and eutrophication.
9. Apply the knowledge to water and wastewater treatment.
10. Students should understand the technical components and roles of mineral resource management.
11. Students should be able to describe and explain commonly occurring processes for mineral beneficiation.
12. Students should be able to calculate and evaluate reserve estimations provided by different techniques and to report the results.
13. Students should be able to analyze reasons for selection of processes based on raw material properties.

IV SEMESTER

ESPW – 401: Project Work

Student Learning Course Outcomes

After successful completion of this course, students will be able to: -

1. Project-based learning is an immersive, hands-on experience that can help students learn life and career skills. It can also help students prepare for real-world challenges.
2. Will be able to understand Project management, Empathy, Systems thinking, Exploration, Problem-solving.
3. Use effectively oral, written and visual communication. Identify, analyze, and solve problems creatively through sustained critical investigation. integrate information from multiple sources.
4. Students learn and apply relevant concepts from multiple sub-disciplines while addressing real world geoscience problems.