Details of Programs offered Course Syllabus

(Based on UGC – Learning Outcomes-Based Curriculum Framework)

Following programs are being offered in Earth, Ocean and Atmospheric Sciences:

1. Integrated M.Sc. (5-year), Applied Geology
2. M.Sc. (2-year), Ocean and Atmospheric Sciences
3. Ph.D. in Earth, Ocean, and Atmospheric Sciences

Integrated M.Sc. (5-year), Applied Geology

India is facing various challenges in the context of increasing population, depleting mineral and energy resources, natural disasters, environmental hazards, and climate change etc., It is very important to address these issues and find solutions for it. The discipline of Earth Sciences plays a vital role in the understanding of the root causes for these global challenges and also provides issue-specific solutions, which are all linked with the functioning of the Planet Earth. Therefore, there is an extensive need to understand the Earth and its interior, the processes which are operating, and any imbalance that develops in its functioning. This essentially can be achieved by pursuing a course of Integrated MSc in Applied Geology. It is a very important and interesting course that has both fundamental as well as applied aspects of Geology.

Qualification Descriptors (QDs)

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

QD-1: Demonstrate a fundamental understanding of the dynamic processes of Planet Earth including its resources.

QD-2: Students will develop the ability to address societal challenges such as depleting resources, natural hazards, global climate change, and increasing risk of environmental pollution.

QD-3: Develop analytical, logical, and creative thinking and enhanced subject-specific skills with logically based innovative perception to provide solutions for the sustainable management of natural resources, preparedness, and mitigation of natural hazards and climate change.

QD-4: Inculcate and promote ethics and values in applying knowledge of geosciences for sustainable development.

QD-5: Augment student skills in propagating thoughts on future Earth, with a special focus on India-specific issues, by presentations and participation in public forums to create awareness among the general public, policymakers and administrators.

Program Learning Outcomes (PLOs)

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

PLO1: Acquire a strong theoretical framework for understanding various components of Earth system including planetary objects, its origin, and operative processes in the past and present.

PLO2: Develop a thorough understanding of geological materials such as rocks, minerals, and fossils and their applications for welfare of the mankind.

PLO3: Integrate observations and theory for describing geological processes in past and present and achieve a sound understanding of the time scales of geological processes and for future predictions.

PLO4: Demonstrate various geophysical methods for the exploration of the structure of the planet Earth as well as the exploration of water, mineral, and energy resources.

PLO5: Apply the knowledge gained through an integrated study of geology, geophysics, and geochemistry to address sustainability in the context of global environmental and climate change.

PLO6: Design and construct strategies based on the knowledge of Earth dynamics to address natural hazards and their mitigation.

PLO7: Design and implement remote sensing and GIS methods in combination with field data for accurate assessment of natural resources.

PLO8: Acquire knowledge of innovative concepts, powerful data handling and modelling capabilities, refined field methods and advanced laboratory techniques will lead to quantifying the interconnecting influences of various domains of planet Earth.

PLO9: Integrate the multi-disciplinary database to evaluate Earth's natural processes and its resources.

PLO10: To have a holistic understanding of linkages among the different spheres of planet Earth to become leaders in professional careers, academia, and industry.

M. Sc (2-year), Ocean and Atmospheric Sciences

The M. Sc. program consists of a rigorous interdisciplinary approach to ocean and atmospheric science, requiring knowledge of physics, mathematics, chemistry,, and computational methods. It is designed to prepare students for positions in research, academia, environmental protection, and resource development. Ocean and Atmospheric sciences have been expanding to include studies of the effect of the climate on humans and vice versa, using a variety of methods to understand ocean and atmosphere and the coupling between them (e.g. Monsoon). The program aims to provide students with a firm basis for more advanced background knowledge and tools needed for effective careers without additional training.

Qualification Descriptors (QDs)

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

QD-1: To demonstrate a systematic, extensive, and coherent knowledge and understanding of the ocean and atmospheric system, its manifestations, variability, and change, and their applications and implications for society

QD-2: To apply statistical and mathematical time-space methods to process, analyze and visualize geophysical data

QD-3: Equipped with relevant skills in the field of ocean and atmospheric sciences, along with critical thinking of the established theories, latest developments, and the ability to use modern state-of-the-art techniques for observations and analyses

QD-4: To possess demonstrable knowledge and skills on the physical and dynamical processes of the ocean and atmospheric system and their manifestations, and to be enabled to lead as professionals catering to various research and developments, and operational needs in the domain, and contribute to application studies

QD-5: To use the knowledge, understanding, and skills in ocean-atmospheric sciences for a critical assessment of a wide range of societal and economic complex issues such as droughts, floods, extreme events, monsoonal rain changes, global warming, ocean acidification, etc., and communicate their findings

QD-6: To demonstrate critical and analytical thinking to pose and solve relevant scientific problems in ocean and atmospheric sciences, inclusive of weather and climate, in both individual and collaborative settings to address scientific challenges, and effectively communicate to the appropriate level of audience

Program Learning Outcomes (PLOs)

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

PLO-1: To acquire fundamental and coherent scientific knowledge of the ocean-atmospheric system and its interactive components

PLO-2: To utilize state-of-the-art scientific and technical knowledge, and tools such as dynamical models and instrumentation, and remote sensing data to analyze and interpret ocean and atmospheric processes

PLO-3: To develop and apply critical and analytical thinking to address scientific challenges in the ocean and atmospheric sciences in both individual and collaborative settings

PLO-4: The program will provide practical knowledge on collecting ocean and atmospheric observations, carrying out model simulations, and analyzing various observed and reanalyzed datasets for understanding the physics and dynamics of the weather and climate, with a focus on the Indian monsoon, and surrounding seas, and hands-on training in using the instrumentation onboard of an oceanographic research vessel and visiting national observatories to familiarise with operational procedures in data collection and weather forecast

PLO-5: To be able to critically peruse and interpret current path-breaking research papers in ocean and atmospheric sciences and present findings succinctly as a seminar, and in complement, identify, analyse, synthesize, and communicate own scientific findings for the public and professional audience at National and International levels

PLO-6: To describe feedback in Earth's climate system and their potential roles in past, present, and future climatic conditions, to be able to recognize and explain climate change projections and associated uncertaintie

PLO-7: To demonstrate the ability to identify, construct, and analyze the interactions between atmospheric and oceanographic processes through a range of spatial and temporal scales.

PLO-8: To develop an exhaustive process-level understanding of various weather and seasonal phenomenon of India such as monsoons, tropical cyclones, western disturbances, etc., and their variability, and translate the knowledge into the ability to address relevant science challenges pertaining to prediction, and assessment of the impact of climate change in India.

PLO-9: To demonstrate expertise in tropical weather and climate, its variability and change, and evaluate effectively the importance of tropical ocean-atmosphere coupled processes such as ENSO to weather and climate of various regions of the globe

PLO-10: To use the scientific knowledge, from own studies as well as those from elsewhere, to inform policymakers to strengthen climate change adaption and mitigation strategies, and inform applications community for societal needs

PLO-11**:** To demonstrate professional qualities such as being objective, unbiased, and truthful in all aspects of work, the ability to identify the potential ethical issues and appreciation of environmental, sustainability, and societal issues

PLO-12: To demonstrate relevant generic skills and global competencies, in addition to problem-solving skills, investigating skills, and analytical skills, to be able to create manpower to attend to the operational needs of weather through seasonal prediction, forecasting of natural hazards such as tropical cyclones and storm surge, and generating climate change projections