AMITY UNIVERSITY
RAJASTHAN

# AMITY SCHOOL OF APPLIED SCIENCES (ASAS)

## CENTER FOR OCEAN-ATMOSPHERIC SCIENCE & TECHNOLOGY (COAST)

## Master of Science

## (Atmospheric and Environmental Sciences)

## Programme Code: 121040

## Duration- 2 Years Full Time

## Programme Structure

# Credit Summary Sheet

| M.Sc. Atmospheric and Environmental Sciences (02 Years/ 04 Semesters) | | | | | | |
|---|---|---|---|---|---|---|
| **Semester** | **Core Course (CC)** | **Domain Electives (DE)** | **Value Added Course (VAC)** | **Open Electives (OE)** | **Non-Teaching Credit Courses (NTCC)** | **Total** |
| I | 21 | 0 | 6 | - | - | **27** |
| II | 18 | 3 | 4 | 3 | - | **28** |
| III | 18 | 3 | 4 | 3 | 3 | **31** |
| IV | - | - | - | - | 25 | **25** |
| **Total** | **54** | **9** | **12** | **6** | **28** | **111** |

**CC = Core Course**

**DE = Domain Elective**

**OE = Open Elective**

**VA = Value Added Course**

**NTCC = Non - Teaching Credit Courses (NTCC)**

# PROGRAMME STRUCTURE

# CENTER FOR OCEAN-ATMOSPHERIC SCIENCE & TECHNOLOGY(COAST)

## Master of Science-(Atmospheric and Environmental Sciences)

**FIRST SEMESTER**

| Course Code | Course Title | Category | Lectures(L) Hours per week | Tutorial (T) Hours per week | Practical (P) Hours per week | Total Credits |
|---|---|---|---|---|---|---|
| MOA 101 | Atmospheric Physics | CC | 3 | - | - | 3 |
| MOA 102 | Introduction to Oceanography | CC | 3 | - | - | 3 |
| MOA 103 | Synoptic Meteorology | CC | 3 | - | - | 3 |
| MOA 104 | Air Pollution Meteorology | CC | 3 | - | - | 3 |
| MOA 105 | Lab 1: Fortran Programming | CC | - | 1 | 4 | 3 |
| MOA 106 | Lab 2: Synoptic Analysis | CC | - | 1 | 4 | 3 |
| MOA 107 | Introduction to Hydrology | CC | 2 | - | 2 | 3 |
| **Domain Elective-I** | | | | | | |
| | | | | | | |
| **Value Added Courses** | | | | | | |
| BCS 111 | Communication Skills – I | VA | 1 | - | - | 1 |
| BSS 111 | Behavioural Science – I | VA | 1 | - | - | 1 |
| FLT 111<br>FLG 111<br>FLS 111<br>FLC 111 | Foreign Language – I<br><br>French<br>German<br>Spanish<br>Chinese | VA | 2 | - | - | 2 |
| AND001 | Anandam | | | | 2 | 2 |
| | **TOTAL** | | | | | **27** |

**SECOND SEMESTER**

| Course Code | Course Title | Category | Lectures(L) Hours per week | Tutorial (T) Hours per week | Practical (P) Hours per week | Total Credits |
|---|---|---|---|---|---|---|
| MOA 201 | Atmospheric Dynamics | CC | 3 | - | - | 3 |
| MOA 202 | Science of Climate and Climate Change | CC | 3 | - | - | 3 |
| MOA 203 | Atmospheric Chemistry and Air Pollution | CC | 3 | | - | 3 |
| MOA 204 | Tropical Meteorology | CC | 3 | - | - | 3 |
| MOA 205 | Lab 1: Climate Data Visualization and Analysis | CC | - | 1 | 4 | 3 |
| MOA 206 | Lab 2: Programming with MATLAB | CC | - | 1 | 4 | 3 |
| **Domain Elective-I:** | | | | | | |
| MOA 207 | Environmental Risk Assessment | DE | 3 | - | - | 3 |
| | **Open Elective-I** | OE | 3 | | | 3 |
| BCS 211 | Communication Skills – II | VA | 1 | - | - | 1 |
| BSS 211 | Behavioural Science – II | VA | 1 | - | - | 1 |
| FLT 211<br>FLG 211<br>FLS 211<br>FLC 211 | Foreign Language – II French<br>German<br>Spanish<br>Chinese | VA | 2 | - | - | 2 |
| | **TOTAL** | | | | | **28** |

**THIRD SEMESTER**

| Course Code | Course Title | Category | Lectures(L) Hours per week | Tutorial (T) Hours per week | Practical (P) Hours per week | Total Credits |
|---|---|---|---|---|---|---|
| MOA 301 | Earth System Modelling | CC | 3 | - | - | 3 |
| MOA 302 | Land-Ocean-Atmospheric Interaction | CC | 3 | - | - | 3 |
| MOA 303 | Urban Environment | CC | 3 | - | - | 3 |
| MOA 304 | Statistical Methods in Atmospheric Sciences | CC | 3 | | - | 3 |
| MOA 305 | Lab 1: Environmental Simulations | CC | 0 | 1 | 4 | 3 |
| MOA 306 | Lab 2: Statistical Analysis | CC | 0 | 1 | 4 | 3 |
| MOA 308 | Summer Internship | | - | - | - | 3 |
| **Domain Elective-II:** Choose any one from the following courses | | | | | | |
| MOA 307 | Agriculture Meteorology | DE | 3 | - | - | 3 |
| | **Open Elective- II** | OE | 3 | | | 3 |
| BCS 311 | Communication Skills – III | VA | - | - | - | 1 |
| BSS 311 | Behavioural Science – III | VA | - | - | - | 1 |
| FLT 311<br>FLG 311<br>FLS 311<br>FLC 311 | Foreign Language – III French<br>German<br>Spanish<br>Chinese | VA | - | - | - | 2 |
| | **TOTAL** | | | | | **31** |

**FOURTH SEMESTER**

| Course Code | Course Title | Lectures( L) Hours per week | Tutorial (T) Hours per week | Practical (P) Hours per week | Total Credits |
|---|---|---|---|---|---|
| MOA 401 | Research Project & Dissertation | - | - | - | 25 |
| | **TOTAL** | - | - | - | **25** |

# COURSE OUTCOMES

# CENTER FOR OCEAN-ATMOSPHERIC SCIENCE & TECHNOLOGY(COAST)

## Master of Science-(Atmospheric and Environmental Sciences)

**1st Semester**

**MOA 101** ***Atmospheric Physics***

After completing the course, the students will be able to:

1) Present an overview of the fundamental concepts of atmospheric physics.
2) Understand the basic thermodynamic concepts for the atmosphere related to atmospheric stability and cloud formation, and to be able to explain weather phenomena.
3) Demonstrate an understanding of solar and terrestrial radiation.
4) Understand the energy transfer processes between the surface of the Earth and Atmosphere.

**MOA 102** ***Introduction to Oceanography***

After completing the course, the students will be able to:

1) Identify fundamental concepts in physics, chemistry, biology, geology, mathematics and engineering technologies as applicable to the study of modern oceanography.
2) Describe the common tools and techniques used in oceanography.
3) Demonstrate knowledge of the ocean's role within the Earth System Science.

4) Describe the natural and anthropogenic impacts on the oceans.

**MOA 103** ***Synoptic Meteorology***

After completing the course, the students will be able to:

1) Understand and explain the dynamic and thermodynamic characteristics of synoptic-scale weather systems.

2) Explain and apply numerous meteorological principles and concepts in synoptic-scale systems.

3) Critically evaluate multi-platform meteorological data (e.g., observations, models, satellite, radar etc.).

4) Apply knowledge of forecasting techniques and map interpretation.

**MOA 104** ***Air Pollution Meteorology***

After completing the course, the students will be able to:

1) Present knowledge of basic atmospheric chemistry and its role in air pollution.

2) Understand how organic compounds, such as Sulphur and Nitrogen-containing compounds, are converted and produces photochemical oxidants, smog, and acidification.

3) Explain the transformation of air pollution in the particle phase, the chemistry of stratosphere.

4) Describe the effect of weather on air pollution, global influence from air pollution, interaction between troposphere and stratosphere, aerosols and their properties.

5) Describe the air polluting gases measurements and aerosols for making sustainable policy and defining research objectives.

**MOA 105** ***Lab 1: Fortran Programming***

After completing the course, the students will be able to:

1) Familiarizing with the basics of flowchart and then transform into a computer language (FORTRAN).

2) Understand the basics commands of FORTRAN and develop subroutines and functions for statistics, special functions and applied mathematics.

3) Analyze various iterative methods for a nonlinear equation and their convergence analysis in FORTRAN.

4) Developing the FORTRAN program for differentiation, integration and complex differential equations.

**MOA 106** ***Lab 2: Synoptic Analysis***

After completing the course, the students will be able to:

1) Utilize synoptic weather charts and numerical forecasting products in order to acquire skills needed to make competitive weather forecasts.

2) Use these skills for forecasting temperature, precipitation and other meteorological conditions at least for few days in advance.

3) Understand the conceptual models of wave cyclones, including those of their structure and evolution.

4) Explain the role of various physical processes, such as PVA, thermal advection, atmospheric stability, and diabatic heating, in the development and evolution of mid-latitude wave cyclones.

**MOA 107** ***Introduction to Hydrology***

After completing the course, the students will be able to:

1) Understand the hydrologic cycle and related major water quantity and quality challenges

2) Comprehend the basic water properties and can measure basic physical and biochemical aspects of water associated with hydrologic processes.

3) Understand the factors affecting the rainfall-runoff processes between total rainfall, abstraction losses to direct runoff and the formation of streamflow hydrographs.

4) Discuss the basic mechanisms of groundwater storage in confined and unconfined aquifers.

**2nd Semester**

**MOA 201** ***Atmospheric Dynamics***

After completing the course, the students will be able to:

1) Interpret the terms in the governing equations.

2) Understand the relations between variables in the equations.
3) Gain knowledge on when and how to apply assumptions to simplify the equations.
4) Recognize the strengths and limits of simplified solutions to the governing equations.

**MOA 202** ***Science of Climate and Climate Change***

After completing the course, the students will be able to:

1) Critically evaluate current understandings of the science of climate change, including future climate scenario development.

2) Critically appraise information about current and future impacts of climate change on biophysical and social systems, and vulnerability to climate change.

3) Evaluate a range of response strategies to climate change, including international and Indian adaptation and mitigation policy approaches.

4) Critique future climate change policy in the context of the international climate change negotiations, with application to their professional experience.

**MOA 203** ***Atmospheric Chemistry and Air Pollution***

After completing the course, the students will be able to:

1) Predict fate of molecules and radicals under typical atmospheric conditions.

2) Qualitatively explain and quantitatively compute trends in photolysis rate constants with altitude, season, and time of day for photochemistry of known molecules.

3) Qualitatively predict effects of chemical perturbations on catalytic cycles producing and destroying ozone.

4) Explain basic principles of greenhouse effect and compute global warming potentials and predict major atmospheric degradation pathways of natural and anthropogenic trace gases.

**MOA 204** ***Tropical Meteorology***

After completing the course, the students will be able to:

1) Demonstrate knowledge of the climatology in the tropics and the physical processes underlying the tropical general circulation.

2) Demonstrate knowledge of the major sources of spatial, seasonal, and interannual tropical variability including tropical waves, ENSO, and MJO.

3) Demonstrate knowledge of the development, structure, and evolution of tropical cyclones.

4) Demonstrate the ability to analyze diverse data and models to forecast tropical cyclone track and intensity.

**MOA 205** ***Lab 1: Climate Data Visualization and Analysis***

After completing the course, the students will be able to:

1) Understand the fundamental design principles and create types of data visualization.

2) Conduct exploratory data analysis using visualization.

3) Apply the fundamental concepts of data visualization to do a climate data analysis.

4) Demonstrate the process of creating data visualization including data from different sources, refining data quality, and converting raw data into visualizations offering meaningful solutions.

**MOA 206** ***Lab 2: Programming with MATLAB***

After completing the course, the students will be able to:

1) Able to use MATLAB for interactive computations.
2) Able to create and store values in variables, matrices, and their use.
3) Able to write codes/program scripts and functions using MATLAB.
4) Able to generate plots and export them for using in reports and presentations.

**MOA 207** ***Environmental Risk Assessment***
**(DE)**

After completing the course, the students will be able to:

1) Understand the environmental processes that shape the natural world at different temporal and spatial scales and their influence on and by anthropogenic activities.
2) Memorize the terminology, nomenclature, and classification systems used in environmental sciences.
3) Explain the methods of acquiring, analyzing, and interpreting environmental science data with a critical understanding of the appropriate contexts for their use.

4) Comprehend issues concerning the availability and sustainability of natural resources and provide solutions in minimizing human interventions causing loss of such resources.

## 3rd Semester

**MOA 301** ***Earth System Modelling***

After completing the course, the students will be able to:

1) Describe aspects of each component of the earth system that can influence and change climate patterns.

2) Understand the perspective of varying spatial and temporal scales of climate change, projected climate variability, and the range of uncertainties under various distinct radiative forcing scenarios.

3) Use basic numerical methods to solve simple climate equations or model systems of equations.

4) Offer solutions for problems in integration, differential equations, root-finding, and linear algebra with increased confidence using MATLAB (or R/ Python) to program simple numerical methods.

**MOA 302** ***Land-Ocean-Atmospheric Interaction***

After completing the course, the students will be able to:

1) Identify, discuss and compare various components of land, ocean, and atmospheric circulation.

2) Analyze and discuss the physical coupling of momentum, heat, moisture and buoyancy fluxes of the land, ocean, and atmosphere.

3) Explain the causes of shifting of wind and pressure belts across land, ocean, and atmosphere.

4) Understand and differentiate the energy sources and mechanisms in tropics versus mid-latitudes.

**MOA 303** ***Urban Environment***

After completing the course, the students will be able to:

1) Define the city, urban, urbanized and the concepts of environment.

2) Discuss the relationship between elements of the process of urbanization, for instance, management, population, production and emplacement.

3) Explain the characteristics of environment and urbanization internationally and in India.

4) Understand and offer meaningful solutions for a sustainable urban environment.

**MOA 304** ***Statistical Methods in Atmospheric Sciences***

After completing the course, the students will be able to:

1) Understanding the elements and principles of statistical learning.

2) Ability to select the appropriate statistical learning tools to tackle atmospheric research problems.

3) Ability to apply methods of statistical learning to atmospheric research.

4) Critical evaluation of the potential, but also of potential pitfalls and limitations of statistical learning approaches in atmospheric sciences.

**MOA 305** ***Lab 1: Environmental Simulations***

After completing the course, the students will be able to:

1) Categorize the application areas of modeling in Environmental Sciences and Engineering and define the fundamental concepts of modeling.

2) Define well-mixed systems, distinguish the fundamental components of these systems and formulate and solve models dealing with these systems.

3) Recognize regression models and apply them to data.

4) Define fundamentals of uncertainty analysis and apply them to models.

**MOA 306** ***Lab 2: Statistical Analysis***

After completing the course, the students will be able to:

1) Understand basic theoretical and applied principles of statistics needed to enter the job force.

2) Communicate key statistical concepts to non-statisticians.

3) Gain proficiency in using statistical software for data analysis.

4) Demonstrate the ability to summarize a technical report and/or statistical analysis and interpret results; also, show the ability for broader implication of application in the statistical field.

**MOA 307** ***Agricultural Meteorology***
**(DE)**

After completing the course, the students will be able to:

1) Discuss the relevance of soil characteristics and microclimate for agriculture in India

2) Explain about the various agroclimatic zones in India, and interpret the variability of climate in crop production.

3) Understand various instrumentation for use and application in agrometeorology

4) Gain the importance of crop weather models, interpret an important crop
5) weather models available, and be enabled to apply them for the Indian region.