

**DEPARTMENT OF ATMOSPHERIC SCIENCE
SCHOOL OF EARTH SCIENCES**

**M.Sc.
Atmospheric Science
(Course Structure and Syllabus)**



Central University of Rajasthan

JUNE 2020

**(Approved by the Board of Studies, School Board and Academic Council)
(Academic Year: 2020-2021)**

CO-PO Mapping

Table 1. CO-PO Mapping for Elective Courses

Courses	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
Simulation of Atmospheric Processes	1	3	2		2	3			2
Upper and Middle Atmosphere	1	3	2		2	3			2
Advances in Instrumentations related to Atmospheric Studies	3	3	2	3	1	2	3	3	2
Computational Fluid Dynamics	3	3	2	2	2	2	3	2	2
Satellite Meteorology	3	2			1				
Atmospheric Chemistry, Air Pollution & Climate	3	1	2		1	2	3	2	1
Cloud Physics and Dynamics	3	2	1		1	2	3	2	1
HPC applications in Atmospheric Sciences	3	3			2		2	2	
Boundary Layer Meteorology	3	3			2		2	2	
Desert Meteorology and Climate	3	1				1	1		1
Hydrometeorology	3	2	1	1		1			
Radar Meteorology	3	1	1			1			
Aviation Meteorology	3	2	1	1		1			

Semester -1

Core Courses

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 401	Fundamentals of Earth System Sciences	The student will acquire an understanding of the basic tenets governing the structure, constitution, physics and dynamics of the Earth's atmosphere.	3				3	3	3		3
		Understanding the functioning and inter-relationships of Earth System Science components and their impacts on climate.	3		2			3	3		3
		The student should be able to acquire knowledge of atmospheric and oceanic circulations, atmosphere ocean interaction, aerosol cloud interaction, hydrologic and biogeochemical cycles.	3		2		2	3	1		1
		The student should be able to know important aspects of vegetation as well as ocean dynamics including the El Nino/Southern Oscillation and Indian Ocean Dipole.	3		1		1	2	1		1

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 402	Physics of the Atmosphere	Students can demonstrate knowledge of the physical processes in the atmosphere	3	3	3		3	1	2		2
		Students can apply the knowledge of thermodynamic diagrams, calculate thermodynamic parameters	3	2	3		2	2	1		
		Students can demonstrate knowledge of the moist convection, atmospheric instability, formation of clouds.	3	2	1		3	3	3	2	3
		Students will obtain a fundamental understanding of the atmospheric thermal structure, radiative transfer for solar and terrestrial wavelengths, global energy balance, and cloud physics at the graduate level.	3	3	2		1	3	2	1	1

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 403	Dynamics of the Atmosphere	Students can demonstrate the ability to apply the equations of motion to the quantitative description of a variety of atmospheric motions including the general circulation.	3	2	3			1			
		Students can demonstrate knowledge of the balanced and unbalanced flows that form the basis for the depiction of atmospheric motions	3		3			1		2	
		Students can demonstrate knowledge of the rotational aspects of large-scale atmospheric motions as described by vorticity and circulation	3				2	1	2		
		Students can demonstrate the ability to understand wave motions and stability concepts to atmospheric problems	3		3			1			

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 404	Mathematical and Statistical Methods for Earth Sciences	Students can use and demonstrate the ability to conduct different statistical verification methods of weather forecasts.	3								
		Students will learn and apply numerical technique and various statistical skills score to evaluate the model forecast and analysis.	2	3	2		3				

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 405	Instrumentation and Data analysis for Atmospheric Observations	Development of basic laboratory etiquette and understanding laboratory protocols.	3				2				
		Familiarity of working with common instrumentation used in Atmospheric Studies.			2	2				2	
		Experience of operating and calibrating instruments and generating quality data.	3	2		3		2			1
		Ability to partake and integrate easily in experimental setups w.r.t. both field and laboratory based experiments.	3	2	2	3	3	3	3	3	
		Analysing atmospheric data	3	2	2		3	3	3	3	1

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 406	Programming Techniques for Atmospheric Sciences	Can be able to compute meteorological variables	3	3	3				2		
		Read and modify code			3					2	
		Learn a new programming language on their own.				3			2		

Elective Courses

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 407	Simulation of Atmospheric Processes	Students will analyze and demonstrate the visualization of the different types of atmospheric data sets with the UNIX and shell programming.	3	3			2				
		Students can familiarize with the post-processing and visualization software (GrADs, Ferret and NCAR Graphics		3			2	3			
		The students would be able to familiarize with the multiple data formats and implementations of weather model such as WRF.			3			3			3

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 408	Upper and Middle Atmosphere	Understand an overview of middle and upper atmosphere dynamics	3	3			2				
		Understand the interaction of middle and Upper atmosphere with troposphere		3			2	3			
		Explain vertical transport of mass and momentum			3			3			3

Semester -II

Core Courses

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 411	Modelling of Atmospheric Processes	Explain different types of models used for studying atmospheric processes	3								
		Discretize the differential equations used in atmospheric models.		2	3	2	3				
		Describe different physical parameterization methods used in atmospheric models		2	3		3		3	2	3

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 412	Tropical Meteorology and Climatology	Students can demonstrate the ability to analyze and interpret conventional maps of surface and upper air data, reanalysis and IMD gridded data as well as soundings on a thermodynamic diagram.		3			3		3	2	
		Students can demonstrate knowledge of the mechanisms for the formation and evolution of onset and withdrawal of Monsoon, Monsoon trough, monsoon depressions, El Nino/La Nina, Western Disturbances, Indian Ocean Dipole, Cyclones etc.	3		2						

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 413	Physics and Dynamics of the Oceans	understand an overview of physics of oceans in terms of its features, distribution of water masses and their properties, dynamics processes of the oceans, air-sea interactions, importance of currents, waves, tides and other features.	3	3	1	2	2	2	2		

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 414	Weather Analysis and Visualization Laboratory	Students can demonstrate the ability to analyze and interpret conventional maps of surface and upper-air data as well as soundings.	3		2		3				
		Students will learn weather and climate data processing and visualization techniques.		2	3					2	

	They will learn analysis, manipulation and interpretation of the data of the different weather/climate phenomena.					1	3			2
	Explain the use of different data sets for the calculation of different indices of synoptic-scale and tropical weather systems as well as of the general circulation of the atmosphere.		3		1			3		

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 415	Remote Sensing and GIS for Atmospheric Science	know how to use remote sensing data for studies of processes in the atmosphere and climatological studies	3								
		know to acquire satellite images and interpretation for meteorological applications and weather forecasting	3	3	2		2			2	
		perform parameter retrieval processes to study meteorological and atmospheric processes	2	2			2				2
		explain the basics of geographic information systems (GIS)	3								

Elective Courses

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 416	Advances in Instrumentations related to Atmospheric Studies	Explain different meteorological instruments used for observing the atmosphere.	3	3	2	3		3	2	3	
		Understand the applications of SODAR, LIDAR, and RADAR for atmospheric measurements.	2	2		1			1		1
		Describe the methods of measuring atmospheric aerosols and chemical composition.	3	3	2	3	2	3	2	3	2

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 418	Climate Change and Disaster Management	To develop a strong understanding of climate change impacts and disasters with focus on impacts, preparedness and future plans	3								
		To appreciate and comprehend on approaches and measures of disaster management, preparedness and response, and related policies, law and methods	3	2			2				
		To learn various methods, tools and guidelines for better integration of CCA-DRR for better disaster management.	2		2	1					2

Course Code	Course Title	Course Objective	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	
ATS 417	Computational Fluid Dynamics	The students will grasp numerical modelling and its role in the field of fluid flow and heat transfer.	3	3	2	3		3	2	3		
		The students will learn various discretization methods, solution procedures and turbulence modeling to solve flow and heat transfer problems.	2	2		1			1		1	
		It will provide the students with a significant level of experience in the use of modern CFD software for the analysis of complex fluid-flow systems.	3	3	2	3	2	3	2	3	2	
		It will improve the student's understanding of the basic principles of fluid mechanics.	2	2	2		1		3			
		It will improve the student's research and communication skills using a self-directed, detailed study of a complex fluid-flow problem and to communicate the results in written form					1	2	2	2	2	

Course Code	Course Title	Course Objective	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 419	Satellite Meteorology	Students will be able to demonstrate skills for the analysis and interpretation of satellites imagery of the Atmosphere from the different sources.	3								
		Students can extract and analyses for the different extreme weather events (thunderstorms, cyclones, etc.) of the different satellite products available in India Meteorological Department and Indian Space Research Organizations (MOSDAC).	3	2			2				

Semester - III

Core Courses

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 501	Mesoscale Modelling and Extreme Weather Events	Students can learn demonstrate knowledge of a variety of mesoscale and small-scale atmospheric phenomena, including tropical storms, severe thunderstorms, and tornadoes and its modeling.		3	2						3
		Students will demonstrate the implementation the mesoscale models such as Weather research Forecast (WRF) for 1-2 cases of the extreme weather event such as heavy rainfall events, severe thunderstorms, heat and cold wave etc.	3		1			2			

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 502	Numerical Weather Prediction - Parameterization schemes and Data Assimilation	Students will learn the methods of acquisition and exchange of global meteorological observations for Weather research and fo recasting.	3	3	3		3				1
		Students will get an exposure on short, medium and long range deterministic weather prediction, atmospheric predictability and ensemble forecasting.	3				3		2	1	
		Students will be able to compute Divergence, vorticity, stream function and simulate simple meteorological events.		3	3		3		2		

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 503	Numerical Simulation and Weather Prediction Laboratory	Development of basic skills for numerical simulation and visualization of atmospheric processes.	3	3	3	2	2				
		Familiarity of working with community weather & climate models and visualization software used in Atmospheric sciences.	3		3			1	2		
		Experience of conducting numerical experiments for sensitivity studies.	3		3		2		2		2
		Ability to partake in field observations and their utilizations in numerical weather prediction models.	3		3					2	

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 510	Internship	Students will learn the different instruments and methodology used for the prediction of weather and climate.	3	3		3	3				
		Students will learn new things and may able to interlink classroom learning with real time application	3		3				3	3	3
		Students will learn to write report of their exposure and learning						3	3	3	

Elective Courses

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 504	Atmospheric Chemistry, Air Pollution & Climate	Understanding the gas phase chemical and photochemical reactions operating in the atmosphere and the chemical evolution of atmospheric aerosols	3	3			2		2	2	
		Learning about the origin and fate of primary and secondary pollutants, self-cleaning mechanisms and ability to think of new ways to mitigate air pollution.	3		3			3	3		
		Understanding the interlinkages of anthropogenic emissions, air pollution and climate	3		3			3	2	2	2
		This course will enable the students to compete for numerous research positions and jobs in this field.							2	2	

Course Code	Course Title	Course Objective	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 505	Cloud Physics and Dynamics	Communicate theoretical and applied topics of cloud and precipitation physics.	3	3			2		2	2	
		Compare and contrast microphysical processes operating in a given cloud/environment	3		3			3	3		
		Analyze datasets and identify distinct/implicative characteristics that confirm theoretical understanding of cloud microphysics or identify areas for improvement	3		3			3	2	2	2

Course Code	Course Title	Course Objective	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 506	HPC applications in Atmospheric Sciences	The students should be able to understand an overview of parallel computing, their architecture and different types of Parallelization. Also the students will able to run the GCMs and RCMs on parallel system.	3	3			2		2	2	

Course Code	Course Title	Course Objective	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 507	Boundary Layer Meteorology	On completion of the course the student should have a basic understanding of the salient features boundary layers in atmosphere and ocean. Also they should have knowledge on sources and mechanisms driving turbulence in ocean and atmosphere, and at the boundary between them. To know how boundary layer is changing throughout the day in different areas.	3	3			2		2	2	

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS508	Desert Meteorology and Climate	Students will learn about the various processes involved in desert meteorology	3					2	1		
		To give exposure to various analysis tools and techniques to aid in understanding meteorology and climate over desert region.	2	2							2

Semester - VI

Core Courses

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS511	Dissertation	Able to identify real existing problem and exposure to problem based learning	3	3	3	3	3	3			3
		Students might publish his/her thesis work in national/internationally reputed journals.	3						3	3	

Elective Courses

Course Code	Course Title	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 513	Hydrometeorology	To introduce students with foundations related to precipitation, meteorology and hydrology	3								
		To enhance skills to measure and prediction of precipitation and stream flow	3	2	2			2			
		To provide understanding of how multiscale hydrometeorological processes affect humans and environment.				1					

Course Code	Course Title	Course Objective	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 514	Radar Meteorology	Students can demonstrate skills for the analysis and interpretation of radar imagery of the atmosphere.	3								
		Students can demonstrate skills for the analysis and interpretation of radar imagery of the atmosphere.	3	2	2			2			

Course Code	Course Title	Course Objective	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
ATS 515	Aviation Meteorology	Understand the impacts of meteorology on Aviation sector	3								
		Understand the techniques used in aviation sector to deal with severe weather	3	2	2			2			
		Prepare for a career in the meteorological services in air force and commercial aviation				1					

Blank = No Relevance 1= Low Relevance 2= Medium Relevance 3= High Relevance