UNIVERSITY OF KERALA

Department of Environmental Sciences

SYLLABUS FOR M.Sc. PROGRAMME IN

CLIMATE CHANGE AND DISASTER MANAGEMENT

Programme Specific Outcomes (PSO) for M.Sc. Climate Change and Disaster Management	
PSO 1	To create a broad base of knowledge about two important environmental issues facing humanity - climate change and environmental disasters
PSO 2	To understand the fundamentals and science of climate change (CC), impacts, adaptation, mitigation.
PSO 3	To enable the student to understand weather forecasting and modelling.
PSO 4	To understand the governance, polices and institutions working on CC.
PSO 5	To enable the student to understand the fundamentals and science, causes, perception, impacts and management of various natural and man-made disasters. Also the various aspects of disaster management.
PSO 6	To create necessary skills by means of practicals, hands on training, field trips, internship, dissertation, mock drills etc. in CC & DM inorder to tackle the environmental issues effectively.
PSO 7	To develop professionally competent students in the field of climate change adaptation, mitigation, and disaster management.
PSO 8	To help students to prepare for a successful career in environmental departments, research institutes, industries, academic institutes and NGOs.
PSO 9	To orient the students for entry to M.Phil. / Ph.D. programmes by assuring research background.

M.Sc. CLIMATE CHANGE AND DISASTER MANAGEMENT						
Sem. No.	**Course Code**	**Name of the Course**	**No. of hours per week**			**Credits**
			L	**T**	**P/F/I**	
I	**Core Courses (CC)**					
	CDM-CC-511	Fundamentals of Atmospheric Science	3	1	2	4
	CDM-CC-512	Environmental Geosciences	3	1	2	4
	CDM-CC-513	Introduction to Climate Change	3	1	2	4
	CDM-CC-514	Introduction to Disasters and Disaster Management	3	1	2	4
	CDM-CC-515	Fundamentals of Oceanography	3	1	0	3
	Discipline-Specific Elective (DE)					
	CDM-DE-516	Climate Related Services	2	1	0	2
II	**Core Courses**					
	CDM -CC-521	Research Methodology	2	1	2	3
	CDM -CC-522	Remote Sensing and GIS in Disaster Management	3	1	2	4
	CDM -CC-523	Governance and Polices of Climate Change and Disaster Management	2	1	2	3
	CDM -CC-524	Natural and Man-made Disasters - I	4	1	0	4
III	**Core Courses**					
	CDM -CC-531	Natural and Man-made Disasters - II	4	1	0	4
	CDM -CC-532	Climate Change- Impacts, Adaptation and Mitigation	4	1	0	4
	CDM -CC-533	Community Based Disaster Management	3	1	0	3
	CDM -CC-534	Field Study	0	0	4	2
	Discipline-Specific Elective (DE)					
	CDM -DE-535	Modelling of Disasters and Early Warning System	2	1	0	2
IV	CDM -CC-541	Weather and Climate Modelling	4	1	0	4
	CDM -CC-542	Internship	0	0	4	2
	CDM -CC-543	Green Skill Programme	0	0	4	2
	CDM -CC-544	Dissertation	0	0	12	6

Skill Enhancement Elective (SE)							
Any Semester	CDM -SE-501	Communication and writing skills	2	0	0	2

Programme Structure of M.Sc. Climate Change and Disaster Management

Note: L- Lecture, T- Tutorial, P- Practical, F- Field, I- Internship; Credits for Core course: 60 (Including field study, green skill program, internship and dissertation); Credits for Electives (Internal + External): 12; Total Credits: 72. 1 hour of Lecture= 1 credit hour, 2 hours of practical= 1credit, 3 to 4 sessions of field visit= 1 credit.

SEMESTER – I

NAME OF THE COURSE: FUNDAMENTALS OF ATMOSPHERIC SCIENCE

COURSE OUTCOMES:

Sl. No.	Course outcome (CO) *At the end of the course, the student will be able to:*	Taxonomic Level (TL)
1.	**CO1**: To understand the fundamentals of Earth, seasons and Earth-Sun relationship	Un
2.	**CO2:** Can acquire comparative and basic knowledge on atmospheric particles, stratification, global warming and ozone layer depletion	An
3.	**CO3:** To understand and compare the elementary concepts on the composition of atmosphere, pressure-temperature variation with altitude and basic ideas on precipitation, humidity, radiation and wind velocity	Un,An
4.	**CO4:** Develop knowledge on classification of clouds, atmospheric aerosols, relate the mechanism of condensation and morphology of clouds	Re
5.	**CO5**: Prepare students for the measurement and recording of meteorological parameters with the help of advanced systems like radars and satellites.	Ap
6.	**CO6:** Understand the general principles on circulation of air, heat transport mechanisms by applying appropriate laws and climatology for interpreting the seasons	Ap, Un

MODULE 1: Fundamentals of Meteorology: Motions of the earth and seasons; Earth-Sun relationship; Insolation and its latitudinal and seasonal variation.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Understand the fundamentals of earth motions (Un)
MO2: Create knowledge on Earth-Sun relationship (Cr)
MO3: Understanding on seasons (Un)
M04: Understanding on insolation (Un)
M05: Understanding on spatial variation of insolation (Un)

MODULE 2: Structure and composition of atmosphere: Particles, radicals and ions in atmosphere; Vertical stratification of atmosphere based on composition; Greenhouse gases, greenhouse effect and global warming, ozone depletion. Earth's radiation balance.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Compare and distinguish particles, radicles and ions in atmosphere (Un,An)
MO2: Distinguish the stratification of atmosphere (Un)
MO3: Understand greenhouse gas effect and global warming (Un)
MO4: Create knowledge on ozone layer depletion and its consequences (Ev)
MO5: Know the basic ideas on Environmental lapse rate (Re)

MODULE 3: Meteorological parameters: pressure, temperature, variation of both with height, precipitation, humidity, mixing ratio, saturation mixing ratio, radiation and wind velocity, Temperature inversion - types; adiabatic lapse rate, environmental lapse rate; Wind Roses.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Will be able to compare pressure and temperature variation with altitude (An)
MO2: Generate knowledge on precipitation and humidity (Cr)
MO3: Compare mixing ratio and saturation mixing ratio (An)
MO4. Outline about radiation and wind velocity (An)
MO5: Compare and generate knowledge on temperature inversion type and wind rose (An, Cr)

MODULE 4: Air temperature: warming and cooling of air near ground, measurement of temperature; Urban heat islands; Humidity - expressions of humidity, measurement of humidity; Clouds-classification and types; Aerosols-condensation nuclei-precipitation mechanism-cloud seeding.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Evaluate the warming and cooling of air temperature and its measurement (Ev)
MO2: Generate knowledge on urban heat islands (Cr)
MO3: Explain humidity expressions and its measurements (Un)
MO4: Distinguish the types of clouds (Un)
MO5: Relate the mechanism of aerosol condensation, nuclei precipitation and cloud seeding (Ap)

MODULE 5: Precipitation: process, types of precipitation, measurement of precipitation-recording, non-recording, radar, satellite, estimation of precipitation, averaging techniques - thiessen polygon and isohyets; Wind- forces affecting wind, types of wind and measurement of wind.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Understand the process of precipitation and mechanism of its measurement (Un)
MO2: Create knowledge on the applications of advanced meteorological devices (Cr)
MO3: Create knowledge on averaging techniques (Cr)
MO4: Definition and types of winds (Re)
MO5: Understand the wind measurement mechanisms (Un)

MODULE 6: General circulation of atmosphere: Ferrel's law and Corioli's effect- Global air circulation system and heat transport from equator to poles. Boundary layer climates: effects of topography, energy and mass exchange, climates of vegetated surface, urban climatology; Seasons in India, Monsoons of India. Southwest Monsoon- Normal dates of onset and withdrawal of monsoon - Rainfall distribution and coefficient of variation of monsoon rain- Impact of climate change on Indian Monsoon.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Create knowledge on air circulation and heat transport (Cr)
MO2: Understanding on boundary layer climates (Un)
MO3: Create knowledge on vegetated surfaces and urban climatology (Cr)
MO4: Outline about the seasons of India and its differentiation (An)
MO5: Understand about monsoons of India

References

1. Barry, R.G. and Chorley, R.J. (2009). Atmosphere, Weather and Climate. 9th Edition, Routledge
2. Hess,S.L. (1959). Introduction to Theoritical Meteorology, Holt Renehart and Winston, New York.
3. Houghton J (2002) Physics of Atmospheres (Third Edition), Cambridge University Press.
4. Iribarne J V & W L Godson (1981) Atmospheric Thermodynamics (Second Edition), Springer.
5. John C Johnson (1996) Physical Meteorology, , MIT Press, Cambridge.
6. John Wallace and Peter Hobbs (2006) Atmospheric Science - an Introductory Survey, second edition Elsevier, 504 pages
7. Mason B J (2010) Clouds, Rain and Rain Making (second Edition), Cambridge University Press.
8. McIlveen,R. (2010). Fundamentals of Weather and Climate, 2nd Edition. Oxford University Press.
9. Neuberger H. (1966) Introduction to Physical Meteorology, The Pennsylvania State University Press.
10. Seymour L. Hess (2006) Introduction to Theoretical Meteorology, , Krieger, New York.

On-line Sources

http://unfccc.int/2860.php

http://www.imd.gov.in/Welcome%20To%20IMD/Welcome.php
http://www.ipcc.ch/
http://www.isro.gov.in/applications/meteorology
https://climate.nasa.gov/
https://www.nationalgeographic.org/encyclopedia/meteorology/

SEMESTER I **COURSE CODE: CDM-CC-512** **CREDIT: 4**

NAME OF THE COURSE: ENVIRONMENTAL GEOSCIENCES

COURSE OUTCOMES:

Sl. No	Course outcome (CO) *At the end of the course, the student will be able to:*	Taxonomic level (TL)
1.	**CO1:** Understand the fundamentals of physical earth and related different earth processes.	Understand (Un)
2.	CO2: Develop knowledge on the physical properties of minerals and rocks.	Understand (Un)
3.	CO3: Develop knowledge on the soil forming processes and properties of soil.	Evaluate (E)
4.	CO4: Understand the global distribution of water	Understand (Un)
5.	CO5: Develop knowledge on various earth processes	Analyse (An)
6.	CO6: Develop knowledge on ocean and their surface processes.	Evaluate (E) Apply (Ap)

MODULE 1: Earth system: Origin and evolution of the earth, shape of earth; geological time scale, anthropocene; concept of plate tectonics - sea floor spreading and continental drift; Forces acting on the surface of the earth- tectonic and diastrophic forces.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:
MO1 Acquire knowledge about the origin and evolution of earth (Un)

MO2: Articulate and interpret geologic time scale (Re)
MO3: Understand the concept of plate tectonics (Re)
MO4 : Know about the forces acting on earth (Un)

MO5: Gain an overall understanding of the dynamism of earth (Un)

MODULE 2: Rock forming minerals – chemical composition and physical properties. Brief overview of formation, characteristics, structures of igneous, sedimentary and metamorphic rocks. Study of interior of earth (crust, mantle, core). Fossil fuels – classification, composition; energy content of coal, petroleum and natural gas; Overview of fossil fuels of India; Geothermal energy.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Articulate and distinguish minerals and rocks (Un)
MO2: Understand physical properties of minerals (Un)
MO3: Articulate and evaluate basic rock types (An)
MO4: Articulate and exemplify basic knowledge in fossil fuels (Un)
MO5: Compare and contrast about the layers of interior structure of earth   (Ev)

MODULE 3: Soil Genesis: Weathering processes– physical, chemical and biological weathering and soil formation; Soil profile development; soil properties-physical and chemical composition of soil; Soil types and classification.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Understand the weathering processes (Un)
MO2: Articulate soil formation (Un)
MO3. Able to distinguish soil profile (Ap)
MO4: Understand soil chemistry (Un)
MO5: Critically evaluate soil classification (Ap)

MODULE 4: Inventory of the earth's water: global distribution of water; Hydrological cycle: Evapo-transpiration- Precipitation-Runoff–Seepage; Groundwater: Source, occurrence and movement of groundwater; Definition of water table, water table fluctuations- environmental influences, fluctuations due to evapo-transpiration, meteorological phenomena, urbanization; Geologic formations as aquifer, aquitard, aquiclude; Brief note on confined and unconfined aquifer.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Outline the hydrological cycle (Re)

MO2: Describe various aspects of groundwater (Re)
MO3: Identify factors influencing water table (Ap)
MO4: Identify various groundwater bearing formations (An)
MO5: Define aquifer (Re)

MODULE 5: Earth's surface processes: erosion, transportation and deposition of earth's materials by streams, wind and glaciers. Drainage basin: definition, characteristics, drainage pattern, stream classification and ordering. Brief overview of integrated watershed management. Glaciers - physical and chemical aspects, recession of Himalayan glaciers, glaciers as an index of climate change. Use of topographic maps and environmental geologic maps in environmental studies.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Understand basic difference between geological process (Ap)
MO2: Evaluate the geological functions of streams (Un, Ev)
MO3. Understand and evaluate geological functions of wind (Un)
MO4: Understand geological functions of glaciers (Un)
MO5: Explain and critically discuss Himalayan glaciers (An)

MODULE 6: Ocean: Structures - Relief and Continental shelf- temperature-salinity-distribution-surface currents -sediment transport-tides-factors influencing ocean processes. Coastal erosion-causes, processes and management measures.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Understanding ocean structure (Un)
MO2: Identify various ocean water parameters (An)
MO3. Critically discuss surface currents (Ev)
MO4: Understanding tides (Un)
MO5. Understand sediment trasport (Un)

References

1. Burbank, D.W. & Anderson, R.S (2012). Tectonic Geomorphology. Wiley and Blackwell Publications, a John Wiley and Sons, Ltd.
2. Carla Montgomery (2020). Environmental Geology (11th Edition). Mc Graw Hill. ISBN13: 9780078022951
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4. Duggal, K.N. and Soni, J.P. (1996) Elements of water resource engineering New Age International Publisher.
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17. Tom Garrison, "Essentials of Oceanography" 9th Ed, Cengage Learning, Brooks/Cole,USA, 2012. ISBN: 978-0-8400-6155-3

On-line Sources

- http://all-about-water-filters.com/causes-effects-groundwater-contamination/
- http://eschooltoday.com/pollution/water-pollution/types-of-water-pollution.html
- http://esminfo.prenhall.com/takealook2007/keller/pdf/ch05.pdf
- http://www.groundwater.org/get-informed/groundwater/contamination.html
- https://www.environmentalpollutioncenters.org/soil/causes/
- ww.slideshare.net/saurabhmaheshwari944/surface-water-pollution-45275427

| SEMESTER I | COURSE CODE: CDM-CC-513 | CREDIT: 4 |

NAME OF THE COURSE: INTRODUCTION TO CLIMATE CHANGE

Sl. No.	Course outcome (CO) *At the end of the course, the student will be able to:*	Taxonomic Level (TL)
1.	**CO1**: Differentiate weather and climate	Un
2.	**CO2:** State the evolution of climate on earth	Un
3.	**CO3:** Articulate the global ocean circulation resulting in ENSO	Un
4.	**CO4:** Reflect climate change with respect to energy use	An
5.	**CO5**: Calculate Carbon and ecological footprint of human actions	Ap

6.	**CO6:** Brief on Sustainability in the context of Climate Change	An

MODULE 1: Elements of weather and climate: Difference between weather and climate. Global, regional and local climates- Classification of climates-genetic and empirical classifications, Koppen and Thronthwaite's schemes - climatic types and climatic zones. Climate variability and climate change – millennial and longer variation, inter-annual and inter-decadal variation, intra-seasonal variation.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Describe the variation between weather and climate (Re)
MO2: Discuss climate classification (An)
MO3: Sketch the longer variability of climate over millennia (Un)
MO4: Discuss inter-annual and inter-decadal variation (Un)
MO5: Write notes on intra-seasonal variation (Un)

MODULE 2: Global Wind Systems: Cloud Formation and Monsoon Rains – Storms and Hurricanes – Global Ocean Circulation –Trade winds and El Nino and La Nina phenomena – ENSO- Indian Ocean Dipole, regional wind patterns, weather-climate interface.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Identify and describe cloud formation and monsoon rains (An, Ap)
MO2: Discuss storms and hurricanes (Re)
MO3: Brief Global Ocean Circulation (Un)
MO4: Summarise El Nino and La Nina (Re)
MO5: Describe regional wind patterns (Un)

MODULE 3: Earth's Natural Green House Effect: Evolution of climate, Green House Gases and Global Warming; Observed changes in climate system – temperature, precipitation, CO_2 concentration, Sea level rise.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Comment on evolution of climate (Re)
MO2: Related Green House Gases with Global Warming (An)
MO3: Sketch changes in climate system (Re)
MO4: Discuss the effect of temperature, precipitation and CO_2 concentrations on climate system (Un)
MO5: Brief the causes and effects of sea level rise and relate it to climate change (Re, Un, Ap)

MODULE 4: Science of Climate Change: Drivers of climate change - Greenhouse gases, aerosols - reflective and black carbon, land use changes; Predicted changes in climate system. Energy balance, feed-back processes in climate system, concepts of global warming potential (GWP), radiative forcing, Aridity index, drought, Holdridge life zones system: global bioclimatic scheme for the classification of land areas.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Explain the various drivers of climate change (Re, Un)
MO2: Discuss about relfective and black carbon (Un)
MO3: Describe the feed-back process in climate system (Re, Un, An)
MO4: Articulate the concept of GWP (Re, Un)
MO5: Describe the land area classification on bioclimatic scheme (Un, Ap)

MODULE 5: Sustainable Development and Climate change: concept, models, sustainable development goals (SDGs); Indicators of sustainability. SDG and climate change, Restoration Ecology.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Define Sustainable Development (Re)
MO2: Explain the various models of SD (Re, Un)
MO3: List out SDGs (Re)
MO4: Relate SDG and Climate Change
MO5: Comment on Restoration Ecology

MODULE 6: Economics of climate change – Kyoto Protocol – Flexibility mechanisms - CDM concept. CDM scenario in India. CDM projects in India; National Action Plan on Climate Change, sustainable habitat, Concept of Green architecture, Carbon sequestration methods, Carbon Foot-print, Ecological foot-print.
Economic impactsof disasters; direct and indirect costs, output and welfare losses;
use of econometric tools to measure losses.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Explain Kyoto Protocol and its features (Re)
MO2: Discuss the concept of CDM (Re, Un)
MO3: Describe the CDM scenario in India (Un, Ap)
MO4: Write short notes on National Action Plan on Climate Change (Re, Un)
MO5: Comment on economic impacts of disasters (Un, Ap)

References

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2. Houghton J (2002) Physics of Atmospheres (Third Edition), Cambridge University Press,.
3. Iribarne J V & W L (1981) Godson Atmospheric Thermodynamics (Second Edition), Springer.
4. John C Johnson (1996) Physical Meteorology, MIT Press, Cambridge,
5. John Wallace and Peter Hobbs (2006) Atmospheric Science - an Introductory Survey -, second edition Elsevier, 504 pages.
6. Mason B J (2010) Clouds, Rain and Rain Making (second Edition), Cambridge University Press.
7. McIlveen,R. (2010). Fundamentals of Weather and Climate, 2nd Edition. Oxford University Press.
8. Neuberger H (1966) Introduction to Physical Meteorology, The Pennsylvania State University Press.
9. Seymour L. Hess, Krieger (2006) Introduction to Theoretical Meteorology, New York.

SEMESTER I	COURSE CODE: CDM-CC-514	CREDIT: 4

NAME OF THE COURSE: INTRODUCTION TO DISASTERS AND DISASTER MANAGEMENT

COURSE OUTCOMES:

Sl. No.	Course outcome (CO) *At the end of the course, the student will be able to:*	Taxonomic Level (TL)
1.	**CO1**: Understand the basic concepts of disaster and characteristics of Disasters	Un
2.	**CO2:** Articulate idea about hazard and vulnerability of health-related/biological disasters	Un
3.	**CO3:** Understand the impacts of Disasters and Hazards	Un
4.	**CO4:** Recognise the components of disaster management cycle- crisis management and risk management	Un
5.	**CO5**: Critically analyse General design of Risk management and National and International disaster recovery policies	An
6.	**CO6:** Identify important sectors in disaster management	Un

MODULE 1: Basic concept of disaster: definitions of hazard, vulnerability, risk, disaster; Difference between Hazard and Disaster; General characteristics of disasters; Causative factors of disasters; Classification of disasters – natural vs. man-made disasters, slow vs. sudden disasters,

classification based on processes of disasters. Brief outline of prominent disasters - earthquakes, volcanisms, landslides, cyclones, tsunamis, floods.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Define disaster (Re)
MO2: Differentiate hazard and disaster and understand the general characteristics of disasters (Un)
MO3: Define the concepts of vulnerability, risk (Re)
MO4. Classify the types of disaster based on processes of disasters (Un)
MO5: Brief outline of prominent disasters (Un)

MODULE 2: Health/Biological disasters: History of health-related disasters; Types, causes and impacts of health-related disasters– outbreaks of disease and epidemics, death, disabilities, psycho-social, economic; health systems; hazard and vulnerability of health-related disasters; preparedness, risk reduction and mitigation; health response and recovery measures.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Articulate knowledge of history of health related disasters (Re)
MO2: Describe types, causes and impacts of health-related disasters (Un)
MO3: Explain the hazard and vulnerability of health-related disasters (Re)
MO4. Understand preparedness, risk reduction and mitigation of health/biological disasters (Un)
MO5: Realize the health response and recovery measures of biological disasters (Un)

MODULE 3: Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Four Levels of disasters in India.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Investigate the impacts caused by disasters and hazards (An)
MO2: Understand the Economic Damage caused by disasters (Un)
MO3: Analyse the Loss of Human and animal life by means of disasters (An)
MO4: Apply knowledge on the ecosystem destruction caused by the occurrence of disaster (Ap)
MO5: Understand Four Levels of disasters in India (Un)

MODULE 4: Basic aspects of disaster management: definition of disaster management; components of disaster management cycle- crisis management and risk management. Crisis management-quick response, relief, recovery and development; Risk management- risk identification, risk reduction- preparedness, prevention and mitigation (structural and non-structural mitigation); and risk transfer.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Remember the definition of disaster management (Re)
MO2: Understand the basic concepts and components of disaster management cycle (Un)
MO3: Differentiate crisis management and risk management (Un)
MO4: Understand different stages of crisis management and risk management (Un)
MO5: Recognise the risk transfer mechanism (Un)

MODULE 5: General design of Risk management: different type of risks and solutions, concept of vulnerability, analysis, and preparedness; Prevention and response mechanism, emergency management teams, National and International disaster recovery policies Prediction of disasters; disaster warning systems.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Explain different types of risks and solutions (Un)
MO2: Articulate knowledge on concept of vulnerability, analysis, and preparedness (Un)
MO3: Communicate the idea of prevention and response mechanism of risk management (Re)
MO4: Understand the duties of emergency management teams (Un)
MO5: Comment on National and International disaster recovery policies and disaster warning systems (Un)

MODULE 6: Important sectors in disaster management: health and medical care- basics of first aid and practical training (breathing & CPR), communications, insurance, social work, NGO's, media, fire services, police and paramilitary services, armed forces etc.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Realize important sectors of disaster management (Un)
MO2: Explain and practice the basics of first aid and practical training (Un/Ap)
MO3: Understand the role of communications, insurance, social work in disaster management (Un)
MO4: Understand the duties of NGO's, media, fire services, police during a disaster (Un)
MO5: Recognise the responsibilities of paramilitary services, armed forces during a disaster (Un)

References

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18. Sahni, Pardeep Et.Al. (Eds.) (2002) Disaster Mitigation Experiences and Reflections. Prentice Hall of India, New Delhi.

| SEMESTER I | COURSE CODE: CDM-CC-515 | CREDIT: 3 |

NAME OF THE COURSE: FUNDAMENTALS OF OCEANOGRAPHY

COURSE OUTCOMES:

Sl. No.	Course outcome (CO) *At the end of the course, the student will be able to:*	Taxonomic Level (TL)
1.	**CO1**: Understand the history of oceanography	Un
2.	**CO2:** Understand Heat budget - components of energy budget of oceans and Define the Earth's heat budget.	Un, Re
3.	**CO3:** To Compare and generate knowledge on Tsunami,Coastal protection and wave breakers.	An, Cr
4.	**CO4:** Understand Physical characteristics of the ocean and the observed ocean circulation	Un
5.	**CO5**: Understand the Dynamics of ocean atmosphere coupling, Illustrate Tropical and subtropical jet streams and its influence on climate and Design the ocean modelling(Cr)	Un, An

6.	**CO6:** Create knowledge on Role of oceans in climate,Explain El Nino, La Nina, and El Nino-Southern Oscillation and Understand climate change and sea level rise.	Cr, Un

MODULE 1: Introduction - history of oceanography - great voyages. Physical properties of' sea water and their spatial distribution: temperature, salinity, density, light penetration. sound propagation. Chemical composition of sea water - major and minor constituents of sea water – constancy of composition - factors affecting constancy.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Understand the history of oceanography (Un)
MO2: Create knowledge on Physical properties of' sea water and their spatial distribution: (Cr)
MO3: Understand temperature, salinity, density, light penetration and sound propagation. (Un)
M04: Understanding on Chemical composition of sea water - major and minor constituents of sea water (Un)
M05: Understanding on constancy of composition and factors affecting constancy (Un)

MODULE 2: Heat budget - components of energy budget of' oceans,short wave and long wave heat fluxes, sensible and latent heat fluxes - mixed layer, thermocline.Bowen's ratio- annual cycle of heat fluxes-spatial and time variation of heat. Concept of water mass and water types. The Earth's heat budget.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Understand Heat budget - components of energy budget of' oceans (Un)
MO2: Distinguish short wave and long wave heat fluxes (Un)
MO3: Understand Bowen's ratio-annual cycle of heat fluxes-spatial and time variation of heat. (Un)
MO4: Generalise the Concept of water mass and water types (Un)
MO5: Define the Earth's heat budget. (Re)

MODULE 3: Waves: Wave generation and wave characteristics, wave refraction, generation growth and decay of waves. Onshore-offshore waves and long shore currents, rip currents and

undertow in the coast. Types of tides and their effect on the coast. Storm surges, Tsunami,Coastal protection ,wave breakers.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Outline Wave generation and wave characteristics (An)
MO2: Generate knowledge on wave refraction, generation growth and decay of waves (Cr)
MO3: Compare Onshore-offshore waves and long shore currents, rip currents and undertow in the coast. (An)
MO4. Illustrate types of tides and their effect on the coast (An)
MO5: Compare and generate knowledge on Tsunami,Coastal protection and wave breakers.
 (An, Cr)

MODULE 4: Physical characteristics of the ocean, the observed ocean circulation, global ocean circulation - major ocean currents - Indian Ocean circulation, thermohalinecirculation- Ekman spiral and Ekman transport - coastal and open ocean upwelling. Ekman layers in the laboratory, Taylor-Proudman on the sphere. Wind driven ocean circulation, the abyssal ocean circulation, Turbulent mixing.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Understand Physical characteristics of the ocean and the observed ocean circulation (Un)
MO2: Generate knowledge on Indian Ocean circulation and thermohaline circulation (Cr)
MO3: Explain coastal and open ocean upwelling (Un)
MO4: Generalise Ekman layers in the laboratory (Un)
MO5: Understand the Wind driven ocean circulation, the abyssal ocean circulation, Turbulent mixing. (Un)

MODULE 5: Dynamics of ocean atmosphere coupling: Meridional heat and water transfers- Atmospheric circulation- Hadley and Walker circulation and high latitude intrusion of westerlies- Tropical and subtropical jet streams and its influence on climate- Ocean conveyer belt- Introduction to ocean modelling

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Understand the Dynamics of ocean atmosphere coupling (Un)
MO2: Explain Meridional heat and water transfers (Un)
MO3: Summarize Atmospheric circulation (Un)
MO4: Illustrate Tropical and subtropical jet streams and its influence on climate (An)
MO5: Design the ocean modelling(Cr)

MODULE 6: Role of oceans in climate: Large scale air-sea interaction processes- ElNino, La Nina, El Nino-Southern Oscillation, El Nino-Modoky and Pacific Multi decadal Oscillation and their relation with Indian summer monsoon-In Dipole (IOD)- ocean warming, climate change and sea level rise.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Create knowledge on Role of oceans in climate (Cr)
MO2: Explain ElNino, La Nina, and El Nino-Southern Oscillation (Un)
MO3: Outline El Nino-Modoky and Pacific Multi decadal Oscillation and their relation with Indian summer monsoon (Cr)
MO4: Generalize In Dipole (IOD)- ocean warming, (Un)
MO5: Understand climate change and sea level rise. (Un)

Refernces

1. Encyclopedia of Beaches and Coastal Environments (Schwartz) 1982
2. Encyclopedia of Earth System Science (Nierenberg) 1992 (4 vols.)
3. Encyclopedia of Environmental Biology (Nierenberg) 1995 (3 vols.)
4. Encyclopedia of Geology (Selley, Cocks and Plimer) 2005 (5 vols.)
5. Encyclopedia of Oceanography (Fairbridge) 1966

SEMESTER I   COURSE CODE: CDM-DE-516   CREDIT: 2

NAME OF THE COURSE: CLIMATE RELATED SERVICES

COURSE OUTCOMES:

Sl. No.	Course outcome (CO) *At the end of the course, the student will be able to:*	Taxonomic Level (TL)

1.	**CO1:** Understand the fundamentals of climate services and to describe the importance and use of climate information for planning and decision making in socio-economic development and management	**Un**
2.	**CO2:** Critically analyse the functioning of Climate Services Information System	**An**
3.	**CO3:** To understand the elementary concepts on Methods for routine dissemination of climate information to user groups and sectors	**Un**
4.	**CO4:** Familiarize with the applications such as Climate information for construction industry	**Un/Ap**
5.	**CO5:** Articulate knowledge on methods of measurements and generation of necessary climate information for the sites in the absence of historical data	**Ap**
6.	**CO6:** Understand and apply knowledge on enhancing the quality and relevance of climate services	**Ap, Un**

MODULE 1
Introduction to Climate Services – Definition, Global Framework for Climate Services, European Commission's Roadmap for Climate Services, Importance and use of climate information for planning and decision making in socio-economic development and management. Agriculture and food security, Disaster risk reduction, Energy, Health and Water resources. Private and public institutions in climate services: World Meteorological Organization (World Weather Watch and WMO Information System), National weather services, India Weather Forecasting Bulletin, Agromet Advisory Bulletins, IBM Weather channel, Skymet, AccuWeather and so on.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Understand the basics of Climate services (Un)
MO2: Create knowledge on importance and use of climate information for planning and decision making (Cr)
MO3: Articulate idea on Agriculture and food security, Disaster risk reduction (Un)
M04: Describe the role of Health and Water resources services (Un)
M05: Critically analyse the functioning of Private and public institutions in climate services (Un)

MODULE 2

Climate Services Information System – Climate observations, Standardized management and exchange of climate and climate-related datasets; Data retrieval and management; Monitoring and analysing climate variability on different temporal scales, attributions to observed climate anomalies; Predicting and projecting future climate states, including forecasting seasonal climatic anomalies and projecting long-term trends that could affect climate-sensitive sectors.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:
MO1: Understand the components of Climate Services Information System (Un)
MO2: Generate knowledge on importance and use of climate information for planning and decision making (Cr)
MO3: Explain the Data retrieval and management (Un)
M04: Monitoring and analysing climate variability on different temporal scales (Ap)
M05: Understand Predicting and projecting future climate states (Un)

MODULE 3

Deriving products (datasets, text, maps, charts, statistics, etc.) that describe the past, present and future climate of a location, region, country and global; Tailored products and information within a range of social, economic and environmental contexts, Methods for routine dissemination of climate information to user groups and sectors; Framework for active partnerships with the user community as well as feedback mechanisms that provide guidance for designing climate watches. User Interface Platforms.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:
MO1: Articulate knowledge on Deriving products that describe the past, present and future climate of a location (Un)
MO2: Generate knowledge on importance and use of climate information for planning and decision making (Cr)
MO3: Describe Tailored products and information (Un)
M04: Understand and use Methods for routine dissemination of climate information to user groups and sectors (Un, Ap)
M05: Develop Framework for active partnerships with the user community as well as feedback mechanisms (Cr)

MODULE 4

Familiarization with the following applications: climate in regional and town planning, density, orientation, heights, area and distance between residential buildings; micro and local climate - Climate information for construction industry; Radiation of the locality; methods of determining radiation received by buildings, duration and of radiation on walls; wind regime, wind velocity and directions; slanting rain and rain fall characteristics, extreme rainfall; artificial heating, ventilation and air-conditioning; green building code.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Familiarize the importance of climate in regional and town planning (Un)
MO2: Generate knowledge on micro and local climate (Un)
MO3: Explain Climate information for construction industry (Un)
M04: Communicate on methods of determining radiation received by buildings (Un)
M05: Understand slanting rain and rain fall characteristics (Un)

MODULE 5

Climate information for location and operation of hydroelectricity, thermal, nuclear, solar and wind energy plants; methods of measurements and generation of necessary climate information for the sites in the absence of historical data - Climate information for road, rail, inland and coastal water transport and for locating airports - Information on Bio-climatology for health, climate pathology, climate therapy, medical climatology, acclimatisation of humans and animals, pests and weeds; tourism, sports; Climate information for agriculture (including aspects of storage and transport).

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Acquire knowledge on Climate information for location (Un)
MO2: Familiarize with methods of measurements and generation of necessary climate information (Un)
MO3: Understand the Climate information for transportation facility construction (Un)
M04: Communicate the idea of Information on Bio-climatology for health (Un)
M05: Express the idea of Climate information for agriculture (Un)

MODULE 6

Enabling market growth, building the market framework, and enhancing the quality and relevance of climate services - nature and scope of the demand and supply sides of the climate services market, appropriate business models for developing and delivering relevant and credible climate services. Investments needed to engage the climate service community (users, providers and researchers), Infrastructure investments for building climate services market. Engaging users, providers, purveyors and researchers to co-design, co-development and co-evaluation of climate services. Making innovations in service products.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Apply knowledge on enhancing the quality and relevance of climate services (Ap)
MO2: Discuss about nature and scope of the demand and supply sides of the climate services (Un)
MO3: Develop appropriate business models for developing climate services (Cr)
M04: Analyse Investments needed to engage the climate service community (An)
M05: Generate idea of making innovations in service products (Ap,Cr)

SEMESTER – II

SEMESTER II	COURSE CODE: CDM-CC-521	CREDIT: 3

NAME OF THE COURSE: RESEARCH METHODOLOGY

COURSE OUTCOMES:

Sl. No.	Course outcome (CO)	Taxonomic Level (TL)
	At the end of the course, the student will be able to:	
1.	**CO1**: Formulate a good research design	Ap
2.	**CO2:** Brief on ethics in research	Un
3.	**CO3:** Write the basic statistical procedures in research	Re
4.	**CO4:** Describe the sample distribution pattern	Un
5.	**CO5**: Perform basic programming using Python	Un
6.	**CO6:** Explain the building blocks in Python	An

MODULE 1: Research Problem: Identification, selection, objectives of research; review of literature, research questions; hypothesis, research design, data collection procedures, data analysis, systematic interpretation of results, conclusion and 'take home' message.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Describe the selection criteria for a good research (Un, Ap)
MO2: Write notes on the features of Review of Literature (Re, Un)
MO3: Comment on Research design (Un)
MO4: Discuss the various data collection procedures (Re, Un)
MO5: Articulate how to interpret results (Re, Un)

MODULE 2: Research ethics: authorship, citation and copyright – Plagiarism identification – Patents – Intellectual property Rights (IPR)– Process of Patenting –Patent laws; Publication of scientific results – Journals, impact factor –Bibliographical preparation – Style of bibliography - Citation index, H index. Preparing CVs, Writing emails.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Describe the aspects of authorship, citation and copyright (Re, Un)
MO2: Discuss plagiarism and its identification (Un)
MO3: Elaborate on patents and IPR (Re)
MO4: Brief on impact factor of journals (un)
MO5: Describe citation index and H-index (Un)

MODULE 3: Statistical Methods – R and SPSS: Introduction – scope, statistical enquiry, primary and secondary data, census vs. samples, methods of sampling – random, stratified, and systematic; bar diagram, pie diagram and scatter plots; measures of central tendency – means, median and mode; measures of dispersion – range, standard deviation, variance and standard error; skewness and kurtosis.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Comment on the scope of statistics in Research (Re, Un)
MO2: Brief on various methods of data collection (Un)
MO3: Discuss the various sampling techniques (Re)
MO4: Prepare various types of charts using data (Ap)
MO5: Do problems based on basic statistics (Re, Un, Ap)

MODULE 4: Basic concept of probability theory: Distributions - Normal, log-normal, Binomial, Poisson, t, and F-distribution. Correlation, Regression, tests of hypothesis (t-test, chi-square test, ANOVA: one-way and two-way); significance and confidence limits; Approaches to development of environmental models; linear, simple and multiple regression models.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Describe the different types of population distribution (Un)
MO2: Solve problems on Correlation and regression (Re, Ap)
MO3: Test significance of results (Re, Un, Ap)
MO4: Perform one way an two way ANOVA (Re, Un, Ap)
MO5: Discuss the approaches to develop environmental models (Un, Ap)

MODULE 5: Advanced Data Analysis and Visualization: Python - Overview of Python as a programming language, Python for scientific computing, Python syntax and formatting, Setting up of python your environment, Python script and a Jupyter Notebook, familiarise python documentation.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Give an overview of Python (Re)
MO2: Brief Python as a programming Language (Un)
MO3: Describe Python syntax and formatting (Re, Un)
MO4: Comment on Python script and Jupyter Notebook (Re)
MO5: Discuss Python documentation (Re, Un)

MODULE 6: Basic building blocks and programming in python: Exploration of statistical learning using the scikit-learn library; Understand the packages - Biopython, Cubes, graph-tool and matplotlib.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Comment on statistical learning (Re)
MO2: Discuss scikit-learn library (Re, Un)
MO3: Describe packages in Python (Re, Un)
MO4: Comment on Biopython, Cubes(Re, Un)
MO5: Use graph-tool and matplotlib (Ap)

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7. Gupta S.P.., 1995. Statistical Methods, Sultan Chand and Sons Publishers, New Delhi.
8. Gurumani N. 2006. Research Methodology for Biological Sciences. MJP Publishers, Chennai.
9. Hanumanth Rao. K and Srinivasa Subbarao Pasumarti. 2012. Research Methodology-Techniques and Applications, Discovery Publishing House (P) Ltd, New Delhi.
10. Kent D. (2014). Python Programming Fundamentals. Springer, London. 978-1-4471-6641-2
11. Kothari C. R. 2012. Research Methodology- Methods and Techniques, Second revised edition, new age International Publishers.
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SEMESTER II   **COURSE CODE: CDM-CC-522   CREDIT: 4**

NAME OF THE COURSE: REMOTE SENSING AND GIS IN DISASTER MANAGEMENT

COURSE OUTCOMES:

Sl. No	Course outcome (CO) *At the end of the course, the student will be able to:*	Taxonomic level (TL)
1.	**CO1:** Knowledge of the principles and concepts of Remote Sensing Technology	Un
2.	**CO2:** Develop knowledge on the various platforms and sensors used on board	Un
3.	**CO3:** Develop knowledge on various land observation satellites	Un
4.	**CO4:** Develop knowledge on the principles and concepts of digital image processing	Un
5.	**CO5:** Develop knowledge of the principles and concepts of GIS and GPS technology.	An
6.	**CO6:** Acquired knowledge regarding application of remote sensing in disaster mangement	Ev

MODULE 1: Introduction to Remote Sensing: EMR Spectrum – EMR interaction with Atmosphere – Atmospheric Windows – EMR interaction with Earth surface features; reflection, absorption, emission and transmission – Spectral response pattern –Vegetation, Soil, Water bodies – Spectral properties and characteristics.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Understand the basic concept of Remote sensing (Re)
MO2: Articulate and interpret electromagnetic spectrum (Re)
MO3. Acquire knowledge about energy interaction in atmosphere (Un)
MO4: Acquire knowledge about energy interaction with earth surface features (Un)
MO5: Analyse the spectral response pattern (An)

MODULE 2: Active, Passive Remote sensing; Visible, Infrared, thermal, and microwave remote sensing Platforms and sensors – Resolutions – spatial, spectral, temporal, and radiometric; Path, row and swath width.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Understand basic difference between passive and active remote sensing (Un)
MO2: Understand the concept of thermal remote sensing (Un)
MO3: Acquire knowledge about microwave remote sensing (Ap)
MO4: Understand the platforms in remote sensing (Un)
MO5: Analyse different resolutions (An)

MODULE 3: Land observation satellites: characters and applications of IRS series; LANDSAT series, SPOT series; High resolution satellites - character and applications of CARTOSAT series, IKONOS Series, QUICKBIRD series. Weather/Meteorological satellites: INSAT series, NOAA, GOES, NIMBUS. Marine observation satellites – OCEANSAT.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Understand the general aspects of land satellites (Un)

MO2: Articulate and understand IRS satellites (Un)

MO3: Acquire knowledge about high resolution satellites (Un)

MO4: Explain and critically discuss INSAT (An)

MO5: Compare land and marine observation satellites (An)

MODULE 4: Digital image processing: geometric correction, radiometric corrections – topographic and atmospheric, true and false colour composite, understanding the image statistics, image enhancement, filtering, classification of image into thematic classes – visual, unsupervised, supervised and other advanced methods. Change analysis, accuracy assessment.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Define the basic term DIP (Re)

MO2: Recognise various processing stages (Un)

MO3: Outline various image rectification process (Re)

MO4: Analyze image enhancement processes (An)

MO5: Distinguish supervised and unsupervised classification (Un)

MO6: Critically analyse the data merging process (An)

MODULE 5: Introduction to Geographical Information Systems: definitions, components and functions of GIS, data types and data models, data format, data analysis – clip, overlay, union, buffering etc, data integration and modelling, digital elevation models, GNSS and GPS – Concept and working principles, Basics of Geodesy – coordinates, projections, and datum.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Recognise various components of GIS (Un)

MO2. Identify various data types in GIS (Un)

MO3: Articulate and understand various analysis in GIS (An)

MO4. Analyse the principles and functions of GPS (Un)

MO5: Critically analyse the applications of GIS and GPS (An)

MODULE 6: Applications of remote sensing in climate change and disaster management: Satellite meteorology - Tsunami, Cyclone, storms and Hurricanes tracking and monitoring through Doppler radar, Tide gauges, wave and current recorders, pressure sensor, sediment accumulation sensor, optical backscattered sensor (OBS), sediment traps, data buoys, navigation lights and signals, positioning systems (radio positioning & satellite), Multiband bathymetry, gravity and magnetic anomalies in sea and surveillance system. Network of Satellite linked automatic weather

stations, weather and climate data supply and management. IMD Network. National Data Centre and Database of related sectors.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Articulate and understand tracking of cyclone using remote sensing (An)

MO2: Recognise and compare various tracking devices (An)

MO3. Understand IMD network (Un)

MO4: Understand automatic weather stations (Un)

MO5. Compare data base of different sectors (Ap)

References

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SEMESTER II **COURSE CODE: CDM-CC-523** **CREDIT: 3**

NAME OF THE COURSE: GOVERNANCE AND POLICES OF CLIMATE CHANGE AND DISASTER MANAGEMENT

COURSE OUTCOMES:

Sl. No.	Course outcome (CO) *At the end of the course, the student will be able to:*	Taxonomic Level (TL)
1.	**CO1**:Understand Climate change institutions and governance	Un
2.	**CO2:** Explain the Funding streams	Un
3.	**CO3:** Define Disaster Law and Policy related to disaster prevention	Re
4.	**CO4:** Analyze the legal issues	An
5.	**CO5**: Outline the Legal Framework for Disaster Management in India	Re
6.	**CO6:** Comprehend the Acts and policies of India	Un

MODULE 1: Climate change institutions and governance: UNFCCC - Conference of Parties (COP); International Climate Agreement; Policy approaches for adaptation and mitigation, technology and finance; IPCC, CIIMP model outputs, NAPCC and SAPCC; Kyoto Protocol; decarbonizing energy production; carbon markets: Emission trading, Carbon accounting, Carbon Offsets, Tradable Permits and Leakage; National Communications; Biennial Update Report; Intended Nationally Determined Contributions.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Define UNFCCC, COP; International Climate Agreement; Policy approaches for adaptation andmitigation, technology and finance (Re)

MO2: Differentiate between IPCC, NAPCC and SAPCC (Un)

MO3: State Kyoto Protocol and decarbonizing energy production (Re)

MO4. Outline carbon markets (Re)

MO5: Describe Tradable Permits and Leakage and Intended Nationally Determined Contributions (Re)

MODULE 2: Funding streams – Green Climate Fund, Forest Carbon Partnership Facility, Global Environment Facility, Adaptation fund, Bilateral and multilateral funds, and official development assistance fund, voluntary and compliance markets; global think tanks in climate change; Climate Services, Business Incubations and Entrepreneurships.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Describe Green Climate Fund, Forest Carbon Partnership Facility and Global Environment Facility (Re)

MO2: Define Adaptation fund, Bilateral and multilateral funds, and official development assistance fund (Re)

MO3: Explain voluntary and compliance markets (Un)

MO4. Describe global think tanks in climate change (Re)

MO5: Outline Business Incubations and Entrepreneurships. (Re)

MODULE 3: Disaster Law and Policy related to disaster prevention: emergency response, compensation & insurance, human rights, and community recovery, relief policy and procedure.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Define emergency response, compensation & insurance (Re)

MO2: Outline human rights, and community recovery (Re)

MO3: Describe relief policy and procedure (Re)

MODULE 4: Exploring the legal issues: Disaster Law and Policy, features, legal analysis of issues emerging from disastrous events the causes of disasters and their relationship to laws, designed to protect health, safety, and the environment.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Define Disaster Law and Policy and features (Re)

MO2: Analyse legal issues emerging from disastrous events (Un)

MO3: Describe the causes of disasters and their relationship to laws (Re)

MODULE 5: Legal Framework for Disaster Management in India: Role and law and public institutions including government in Disaster Management Constitutional Perspectives to Disaster Management, Disaster Management Act (NDMA) 2005, Institutional roles and responsibilities for disaster management in India, civil liberties, liability and indemnification under the constitution and legislation.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Define Role and law and public institutions including government in Disaster Management (Re)
MO2: Outline Disaster Management Act (NDMA) 2005 (Re)
MO3: Describe Constitutional Perspectives to Disaster Management (Re)
MO4. State Institutional roles and responsibilities for disaster management in India (Re)
MO5: Describe civil liberties liability and indemnification under the constitution and legislation.

MODULE 6: Acts and policies of India: Map policy of India, Remote Sensing Policy, RTI Act, Privacy Act, Groundwater Act, Mines & Mineral Act, Atomic Mineral Act, Oil & Natural Gas Act (including coal), Environmental Pollution and Prevention Act, Wildlife Act, Forest Act, Western Ghats Ecosystem act, National Biodiversity Act, National Marine Biodiversity act, Marine Environmental Act, Integrated Coastal Zone Regulation, Offshore Mining Regulation, Law of the Sea, Maritime Law; National Data sharing & accessibility policy.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Define Map policy of India and Remote Sensing Policy (Re)
MO2: Outline RTI Act, Privacy Act, Groundwater Act, Mines & Mineral Act, Atomic Mineral Act, Oil & Natural Gas Act (including coal), Environmental Pollution and Prevention Act, Wildlife Act, Forest Act, Western Ghats Ecosystem act, National Biodiversity Act, National Marine Biodiversity act and Marine Environmental Act .(Re)
MO3: State Integrated Coastal Zone Regulation and Offshore Mining Regulation, (Re)
MO4. Outline Law of the Sea, Maritime Law; National Data sharing & accessibility policy. (Re)

References

1. Anil K. Gupta, Sreeja S. Nair & Swati Singh (2013) Environmental Legislation for Disaster Risk Management: Training Module (Indian)
2. Daniel A. Farber, Jim Chen (2006) Disasters and the law. Aspen Pub
3. Dhar P.G. Chakrabarti, Chandrani Bandyopadhyay & Karuna Raina (2009) Disaster Risk Reduction for Safe Development : A study of Corporate Practices in India
4. Disaster Management Act 2005 (India)
5. National Policy on Disaster Management 2009
6. The Disaster Management Act (2005) National Act, Rules and Notifications) along with State DM Rules and Notifications
7. Wolters Kluwer (2010) Disaster Law and Policy, Law & Business/Aspen Publishers

NAME OF THE COURSE: NATURAL AND MAN-MADE DISASTERS - I

Sl. No.	Course outcome (CO) *At the end of the course, the student will be able to:*	Taxonomic Level (TL)
1.	**CO1**: Describe various aspects of chemical disasters including initiation factors and impacts of chemical accidents and list out the various chemical accidents in India	Un, Re
2.	**CO2:** Brief on various transport accidents as well as the Major Accident Hazard areas in India and to predict potential Accident Hazard Zones	Un, Re, An
3.	**CO3:** Comment on the kinds and nature of chemical hazards and the regulations and legislations to handle them	Un, Re
4.	**CO4:** State the nuclear and radiological accidents and hazards and explain the factors leading to such hazards	Re, An
5.	**CO5**: Mention the disasters caused by biological agents, and its impacts with the regulatory and institutional framework for its containment	Un, Re, Ap
6.	**CO6:** Explain the causes and management of technological disasters. Analyze the failure factors of Space Shuttle Columbia disaster, Challenger disaster, Mir disaster	Un, Re, Ap

MODULE 1

Chemical Disasters: Causative Factors Leading to Chemical Disasters, Initiators of Chemical Accidents, Process and Safety System Failures, Natural Calamities, Terrorist Attacks/Sabotage, Impact of Chemical Disasters, Major Chemical Accidents in India, Aims and Objectives of the Guidelines, Industrial (Chemical) Installations and Storages, Industrial (Chemical) Installations.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:

MO1: Define chemical disasters
MO2: List out the initiating factors of chemical accidents
MO3: Make short notes on terrorist attack and sabotage
MO4: Identify and explain the impacts of chemical disasters
MO5: Describe the objectives and guidelines for controlling chemical accidents

MODULE 2

Good Engineering for Safety: Accident Reporting, Investigation and Analysis, Safety Promotional, Guidelines for Transport Accidents, Air Transportation, Maritime Transportation, Major Accident Hazards (MAH) areas in India.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Explain process of accident reporting
MO2: List out the methods of investigation and analysis of transport accidents
MO3: Comment on the guidelines for transport accidents
MO4: Explain the various types of transportation such air, maritime transport
MO5: Describe the Major Accident Hazards (MAH) areas in India

MODULE 3

Chemical Hazards, types of Chemical hazards, Acquisition and Delivery of Chemical Agents, Effects of Chemical Agents, Aims and Objectives of the Guidelines, Present Status and Context, Institutional Framework, Legislative and Regulatory Framework.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Comment on chemical hazards
MO2: Write essay on the process of acquisition and delivery of chemical agents
MO3: Explain the effects of chemical agents
MO4: Brief on the aims and objectives of guidelines pertaining chemical hazards
MO5: Describe the Major Institutional Framework, Legislative and Regulatory Framework related to chemical agents

MODULE 4

Nuclear and Radiological Emergency/Disaster Scenarios-Accidents in Nuclear Power Plants and other Facilities, 'Criticality' of Accidents, case study from the world. Accidents during transportation of Radioactive Materials-Issues in nuclear fuel cycle

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Comment on Nuclear and radiological emergencies
MO2: Explain the accidents in Nuclear Power Plants
MO3: Comment on the criticality of accidents
MO4: Explain the various cases of nuclear accidents in the world

MO5: Describe the accidents during transportation of radioactive materials

MODULE 5

Biological Agents as Causes of Mass Destruction, Sources of Biological Agents, Biosafety and Biosecurity, Epidemics, Biological Disasters (Bioterrorism), Impact of Biological Disasters, Regulatory Institutional and Framework.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Describe the biological agents as causes of destruction
MO2: Explain biosafety and biosecurity
MO3: Write brief notes on epidemics and bioterrorism
MO4: Explain the various impacts of biological disasters
MO5: Describe the regulatory and institutional framework to address biological hazards

MODULE 6

Technological disasters: causes, perception and management of space technology disasters. Case study of Space Shuttle Columbia disaster, Challenger disaster, Mir disaster Dam failure (dam burst)- Case study. Dam break analysis.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Define technological disasters
MO2: List out the causes, perception and management of space technology disasters
MO3: Explain after proper understanding the causes of Columbia, Challenger and Mir disaster
MO4: Comment on the various causes of dam failures
MO5: Explain dam break analysis

References

1. National Disaster Management Guideline – Chemical Disaster (Industrial) – NDMA, Govt. of India
2. National Disaster Management Guideline – Chemical Disaster (Terrorism) – NDMA, Govt. of India
3. National Disaster Management Guideline – Biological Disasters – NDMA, Govt. of India
4. National Disaster Management Guideline – Nuclear & Radiological emergencies – NDMA, Govt. of India

SEMESTER – III

NAME OF THE COURSE: NATURAL AND MAN-MADE DISASTERS - II

COURSE OUTCOMES:

Sl. No.	Course outcome (CO) *At the end of the course, the student will be able to:*	Taxonomic Level (TL)
1.	**CO1**:Understand the natural and man-made disasters	Un
2.	**CO2:** Demonstrate numerical modelling, prediction and management strategies of cyclones	Ap
3.	**CO3:** Define monitoring and management of drought	Re
4.	**CO4:** Demonstrate earthquake probability and forecasting, earthquake preparedness, earthquake resilient designs, safety, and early warning	Ap
5.	**CO5**: Construct landslide modelling with remote sensing & GIS applications	Ap
6.	**CO6:** Outline coastal hazards, causes, effects and management methods	Re

MODULE 1: Types of disasters: Meteorological/climatological (tropical cyclones, drought, lightning, forest/wildland fire, heat and cold wave/thermal extremes), geological (earthquake, volcanic eruptions, tsunamis, landslide/mass movement, land subsidence), hydrological (flood/flash flood, wave surge/coastal erosion, avalanche), biological (epidemic/pandemic, pest attacks/locusts/insect infestations), technological/man-made (industrial, nuclear, transportation, dam failure, stampede, terrorism, pollution) and extra-terrestrial (asteroids/meteoroids/comets impact).

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Define types of disasters (Re)
MO2: Differentiate between natural and man-made disaster (Un)
MO3: State biological disasters (Re)
MO4. Classify the types of hydrological disasters (Un)
MO5: Describe extra-terrestrial disaster impacts (Re)

MODULE 2: Tropical cyclones: overview, cyclone genesis, theories of tropical cyclogenesis, maximum potential intensity, potential vorticity dynamics, numerical modeling and prediction, mitigation and management strategies, cyclones in the Indian context.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Describe cyclone genesis, theories of tropical cyclogenesis, (Re)
MO2: Explain maximum potential intensity and potential vorticity dynamics (Un)
MO3: Demonstrate numerical modeling and prediction of cyclones (Ap)
MO4. Prepare mitigation and management strategies (Ap)
MO5: Outline cyclones in the Indian context (Re)

MODULE 3: Drought: overview, water scarcity and drivers, definition of drought, drought monitoring, impacts of drought on environment, drought affected regions, drought management. **Lightning** - basics of lightning and thunder, different types, flashes and strikes, management strategies (lightning arrestor, earthlings etc). **Forest/wildland fire** - introduction to wildfire, causes, impacts on ecosystems, fire ecology, dendrochronology, forest fire management. **Heat and cold wave/thermal extremes** - basics, factor affecting heat/cold wave spells in India.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Define monitoring and management of drought (Re)
MO2: Outline drought affected regions and impacts of drought on environment (Re)
MO3: Describe basics of lightning and thunder and management strategies(Re)
MO4. Summarise fire ecology, dendrochronology and forest fire management (Un)
MO5: Outline Heat and cold wave/thermal extremes (Re)

MODULE 4: Earthquakes: Causes, perception, spatial distribution, ground motion and their effects, earthquake probability and forecasting, earthquake preparedness, earthquake resilient designs, safety, and early warning. The San Andreas Fault, induced seismicity, seismic hazard analysis. **Tsunamis** - causes, generation and propagation, impacts, spatial distribution, management strategies, tsunamis in India.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Define Earthquakes (Re)
MO2: Explain The San Andreas Fault, induced seismicity and seismic hazard analysis (Un)
MO3: Demonstrate earthquake probability and forecasting, earthquake preparedness, earthquake resilient designs, safety, and early warning (Ap)
MO4. Describe tsunamis (Re) and prepare management strategies (Ap)
MO5: State tsunamis in India (Re)

MODULE 5: Volcanic eruptions: causes, types of volcanoes and associated structures, global pattern of volcanism, volcanic activity, volcanic hazards and hazard assessment, volcano monitoring, preparedness and management. **Landslides:** fundamentals and types of mass movement. Slope stability - factors influencing slope stability, slope stability analysis, management options. Landslide instrumentation & early warning system, landslide modelling, remote sensing & GIS applications, case studies in India. **Avalanche** - introduction, causes, impacts. **Land subsidence** - overview, causes, geological controls, early warning.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Define volcanic eruptions (Re)
MO2: Prepare volcanic hazards assessment, volcano monitoring, preparedness and management (Ap)
MO3: Describe landslides and Slope stability (Re)
MO4. Demonstrate landslide instrumentation and early warning system(Ap)

MO5: Construct landslide modelling with remote sensing & GIS applications (Ap)

MO6: Describe Avalanche and Land subsidence

MODULE 6: Flood: types of flood, causes, effects, perception and management. Flood and climate change, hydrograph analysis, hydrological analysis and design. Floods in India. **Coastal erosion** - overview on coastal hazards, causes, effects, management methods. Case studies in India.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Define types of flood, causes, effects, perception and management (Re)

MO2: Demonstrate hydrograph analysis, hydrological analysis and design (Ap)

MO3: State Floods in India. (Re)

MO4. Outline coastal hazards, causes, effects and management methods (Re)

MO5: Describe Case studies in India (Re)

References

1. Amita Sinvhal 2013, Understanding Earthquake Disasters Jain Publishers,New Delhi
2. Anblagan,R, Bhoop Singh, D Chakraborty, Atul Kohli, "A Field Manual for Landslide Investigations", a guide for the beginners working on landslide Investigations
3. Barbara W. and Murck et. al., Environmental Geology, John Wiley and Sons, New York, 1996. PP 535
4. Vogelbacher A. (2013) Flood Disaster Risk Management - Hydrological Forecasts Requirements and Best Practices : Publ.NDMA ,Govt.India,New Delhi Training Module

SEMESTER III	COURSE CODE CDM-CC-532	CREDIT: 4

NAME OF THE COURSE: CLIMATE CHANGE- IMPACTS, ADAPTATION AND MITIGATION

COURSE OUTCOMES:

Sl. No.	Course outcome (CO) *At the end of the course, the student will be able to:*	Taxonomic Level (TL)
1.	**CO1**: Understand the basic aspects of Climate Change	Un
2.	**CO2:** Identify the various impacts of climate change	Un
3.	**CO3:** Understand the importance of adaptation in climate change scenario	Un

4.	**CO4:** Identify and describe the various components of integrated natural resources management	Un
5.	**CO5**: Critically analyse the techniques of carbon sequestration	An
6.	**CO6:** Identify the components of disaster management	Un

MODULE 1: General Impacts of climate change on physical and biological systems:
(Glaciers, snow, ice and/or permafrost; Rivers, lakes, floods and/or drought; Coastal erosion and/or sea level effects); biological systems (Terrestrial ecosystems; aquatic ecosystems), redistribution of biota; Human and managed systems (Food production; Livelihoods, health and/or economics).

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Understand the impacts of climate change (Un)
MO2: Understand the effects of climate change on physical systems (Un)
MO3: List the impacts of climate change on biological systems (Re)
MO4. Understand the effects of climate change on terrestrial ecosystems (Un)
MO5: Understand the effects of climate change on aquatic systems (Un)

MODULE 2: Climate change scenarios of India: impact of climate change on various sectors - agriculture, forest, biodiversity, water resources, animal husbandry and fisheries, ecosystem – human health – industry, settlement and society, monsoon system of India.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Understand the effects of climate change on agriculture (Un)
MO2: Understand the effects of climate change on agriculture and forestry (Un)
MO3: Understand the effects of climate change on water resources and fisheries (Un)
MO4. Understand the effects of climate change on human settlement and society (Un)
MO5: Define and illustrate the monsoon systems of India (Re)

MODULE 3: Climate change adaptation: the climate record, Determinants of adaptive capacity: Economic resources, Technology, Information and skills, Infrastructure, Equity and Institution. Methods of enhancing adaptive capacity in sectors: Agriculture, Forestry Social, Rural, Urban, Coastal; social, ecological asset and infrastructure development; technological process optimization.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: List the determinants of adaptive capacity (Un)
MO2: Understand the role of technology in climate change adaptation (Un)
MO3: Define the methods of enhancing adaptive capacity (Re)
MO4. Understand the methods of enhancing adaptive capacity in agriculture (Un)
MO5: Understand the methods of enhancing adaptive capacity in urban and rural sectors (Un)

MODULE 4: Integrated natural resources management; institutional, educational and behavioural change or reinforcement; financial services including risk transfer; information systems to support early warning and proactive planning. Use of clean energy and enhancing the energy efficiency in industries, transport, and buildings.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Define Integrated natural resources management (Re)

MO2: Understand the institutional and behavioural change in resource management (Un)

MO3: Understand the need for information systems in early warning (Re)

MO4. Define clean energy and energy efficiency (Re)

MO5: List the methods for enhancing energy efficiency (Un)

MODULE 5: Climate Change Mitigation Technologies and Practices: General and technology specific barriers and the rebound effect; Energy Supply – Transport – Emission standards: Vehicle emission performance standard - CARB, EURO and Bharat Stage ; Buildings – Industry – Forestry; Carbon footprint and carbon sequestration – different methods of Carbon Capture and Storage (CCS); Sector-wise measures and instruments to mitigate climate change : Short term and Long term Mitigation action bioeconomy or low carbon economy; enhancing the carbon sequestration capacity of forests and land use

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Define Green technology (Re)

MO2: Differentiate the types of vehicle emission performance standards (Un)

MO3: Define the emission standards (Re)

MO4. Define low carbon economy (Re)

MO5: Understanding carbon sequestration capacity of forests (Un)

MODULE 6: Climate smart agriculture; reducing emission from deforestation and degradation (REDD+), long term mitigation pathways; Concepts, methodology and structure of mitigation assessment; costs and benefits of mitigation, Technology transfer, Current Transfer of Climate Change Mitigation Technology, Methodological and Technological Issues in Technology Transfer. LULUCF activities.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Define climate smart agriculture (Re)

MO2: List the methods of mitigation assessments (Un)

MO3: Define the costs and benefits of mitigation (Re)

MO4. Define REDD+ (Re)

MO5: List the technological issues in mitigation technology transfer (Un)

References

1. Anil Kumar Thakur, Gangadhar V Kayande Patil, (2012) Disaster Management and Climate Change,Pupl .NDMA,Govt India,New Delhi.
2. Dash Sushil Kumar (2007) "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd,
3. Global Warming- the complete briefing (second edition): John Houghton, Cambridge University Press (2009)
4. IPCC Fourth and Fifth Assessment Reports.
5. Jan C. van Dam, (2003) Impacts of "Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press,
6. John Houghton (2009) Global Warming- the complete briefing (second edition):, Cambridge University Press

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SEMESTER III	COURSE CODE: CDM-CC-533	CREDIT: 3

NAME OF THE COURSE: COMMUNITY BASED DISASTER MANAGEMENT

COURSE OUTCOMES:

Sl. No.	Course outcome (CO) *At the end of the course, the student will be able to:*	Taxonomic Level (TL)
1.	**CO1**: To understand the concept, community organisation, mobilisation, participation in outreach activities and recognise community welfare services along with the interpretation in the principles and process of community organisation	Un
2.	**CO2:** Illustrate strategies on capacity building among different communities, compare the concepts and principles of participatory rural appraisal, design and generate tools for community level analysis	An, Ev, Cr
3.	**CO3:** Outline the basics on disaster management through risk reduction strategies, construct models for disaster preparedness and vulnerability assessment, compare structural and non-structural measures in DRR	An, Cr, Ev
4.	**CO4:** Policy designing for disaster preparedness programme, to know the role and responsibilities on disaster management through generating vulnerability analysis organise survey activities and master plans for future, construct and design for rehabilitation measures and preparedness for psychological care.	Re, Cr, Ap
5.	**CO5**: Awareness creation, task force formation through construct mapping networking and linkaging. Can demonstrate techniques on participatory learning and risk assessment analysis. Recognise various schemes of government and civil organisation for linkage and coordination	Ap, Re

6.	**CO6:** Understanding the general structure, working principle of NGO and outline the funding and legal status. Identify developmental projects of national and international NGO's and their role on disaster management	Re, Un

MODULE 1: Community Participation: concept, importance and methods to achieve, Community organization in rural and urban communities, Concepts:- Definitions of community organization: a critique, community mobilization, community participation, outreach, working with groups; community welfare, community development, community centers and services; Principles of community organization, Processes in community organization- steps and processes

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Understand the concept and definition of community organisation (Un)
MO2: Compare the community organisation in rural and urban sectors (An)
MO3: To know about community mobilisation, participation and outreach activities (Re)
MO4: Recognize and state community welfare, services and development (Re)
MO5: Generate principles and processes in community organisation (Cr)

MODULE 2: Strategies and Techniques in Community Organization: formation and capacity building of CBOs, capacity building of community level institutions (e.g- PRI), strategies for capacity building of marginalized groups, committee formations, leadership and cadre building and networking Participatory rural appraisal (PRA): Understanding Participatory Rural Appraisal, Comparison of PRA and RRA; the concept and principles of Participatory Rural Appraisal; Different PRA methods and Tools – participatory mapping, participatory modeling, transects, mobility map, Venn diagrams, Flow diagrams, Timeline, Trend analysis, seasonal calendar, ranking, SWOT analysis, interviews, daily schedule, Force field analysis.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Generate strategies on capacity building activities at community level institutions and marginalised groups (Cr)
MO2: Construct leadership, cader building and networking (Ap)
MO3: Compare the concepts and principles of participatory rural appraisal and RRA (Ev)
MO4: Organize and design on different PRA methods and tools (Cr)
MO5: Generate methods for community level analysis (Cr)

MODULE 3: Community Based Disaster management: Meaning and Definition; Disaster Risk Reduction Strategies, Preparedness Plans, Action Plans and Procedures, Early warning Systems Models in disaster preparedness, Community based DRR, Structural non-structural measures in DRR, Factors affecting Vulnerabilities, Mainstreaming disaster risk reduction in development, Undertaking risk and vulnerability assessments.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Define the meaning and definition of community based disaster management (Re)
MO2: Identify and outline the disaster risk reduction strategies, action plans and procedures (Re, An)
MO3: Construct early warning model systems for disaster preparedness (Ap)
MO4. Compare structural and non-structural measures in DRR (An)
MO5: Distinguish the factors affecting vulnerability and outline the vulnerability assessment models (An, Un)

MODULE 4: Community Disaster Systems, Structures and Policies: Policies for Disaster Preparedness Programs, Preparedness Planning, Roles and Responsibilities, Public Awareness and Warnings, Conducting a participatory capacity and vulnerability analysis, Sustainable Management, Survey of Activities Before Disasters Strike, Survey of Activities During Disasters, DRR Master Planning for the Future, Capacity Building, Sphere Standards. Rehabilitation measures and long-term reconstruction; Psychosocial care provision during the different phases of disaster

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Design policies for disaster preparedness programmes, planning, public awareness and warnings (Cr)
MO2: Identify and know the role and responsibilities of disaster management (Re)
MO3: Generate plans for vulnerability analysis and sustainable management (Cr)
MO4: Organize survey activities and prepare master plan for future (Cr, Ap)
MO5: Construct rehabilitation measures, design long term reconstruction and prepare for psychological care at different phases of disasters (Ap,Cr)

MODULE 5: Preparedness Activities: Awareness creation, Task force formation, Mapping, Networking, Collaborations and Linkages, Sustainability, Vulnerable populations; Participatory Learning and Action (PLA), Participatory technique of Risk assessment and Analysis. Community Based Organizations and its management for DRR, Need assessment, prioritization, planning and monitoring techniques, Various Government Schemes in the locality, knowledge about other civil society organizations and their work, Coordination and Linkages with Government Department and Civil Society Organizations;

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Recognise preparedness on awareness creation and task force formation (Re)
MO2: Construct mapping, networking, collaboration and linkaging modalities for vulnerable populations (Ap)
MO3: Demonstrate participatory learning, techniques of risk assessment analysis (Ap)
MO4: Explain need assessment, planning and monitoring techniques (Un)

MO5: List the government schemes, civil organisations and recognise coordinations and linkage with government organisations (Re)

MODULE 6: NGOs and their Importance in Disaster Management: Non-governmental organizations, Type of NGOs, General structure and working principles - Public relations, Funding & Legal status, Developmental Projects through NGOs, Non-Governmental Organizations and their role in Disaster Management, NGOs working exclusively in Disaster Management: International and National NGOs.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: List the general structure and working principles of NGO (Re)
MO2: Outline funding and legal status (An)
MO3: Identify developmental projects of NGO and their role in disaster management (Re)
MO4: Name NGO's working exclusive for disaster management (Re)
MO5: Identify and list national and international NGO's (Re)

References

1. Brody, R. 1982. Problem Solving: Concepts and Methods for Community Organizing. New York: Human Sciences Press.
2. Cox et al. (Eds.). 1970. Strategies of Community Organization: A book of readings. Illinois: F.E. Peacock Publishers
3. Datar et al. 2010. Skill Training for Social Workers: A Manual. New Delhi: Sage Publications
4. Gamble, D. N., and Weil, M. 2010. Community Practice Skills: Local to Global Perspectives. New York: Columbia University Press.
5. Gangrade, K.D. 2001. Working with Community at the grass root level: Strategies and programmes. New Delhi: Radha Publications.
6. Hardcastle, D., Powers, P. and Wenocur, S. (2011). Community Practice: Theories and Skills for Social Workers. New York: Oxford University Press.
7. Kothari, Miloon. 2006. Development and Social Action. New Delhi: Rawat Publications
8. Krist-Ashman, K.K., and, Hull, G.H. 2001. Generalist Practice with Organizations and Communities. Belmont, USA: Brooks/Cole.
9. Netting, F.E., Kettner, P.M., and McMurtry, S.L. 1998. Social Work Macro Practice. New York: Longman
10. Rivera, F.G., and Erlich, J.L. 1998. Community Organizing in a Diverse Society (3rd Edition). Boston: Allyn & Bacon
11. Rothman, J. Erlich, J. and Tropman, J. (2001). Strategies of community interventions (6th Edition Illinois: F.E. Peacock Publishers.
12. Rubin, H.R. & Rubin, I. 1986. Community Organizing and Development. Ohio: Merrill Publishing Company.
13. Shah, G. 1990. Social Movements in India: A Review of Literature. New Delhi: Sage Publications.
14. Siddiqui, H.Y. 1984. Social Work and Social Action. New Delhi: Harnam Publications

COURSE NAME: FIELD STUDY

AIM: Climate change and disaster management (CC&DM) employs an interdisciplinary approach, teaching students how to meet the climate challenges for creating a safe and healthy environment, and how to recognize and control the effects environmental disasters on earth.

OBJECTIVES: Field study focuses on particular locations and/or institutions, covering the natural or man-made sites (e.g., climate sensitive sectors/ disaster affected / disaster prone areas etc), research and development institutions related to climate change and disaster management studies etc. It is compulsory that each student must visit at least 2 natural/man made sites, 2 research and development institutions and 2 industries/ factories anywhere in India.

By visiting various environmentally relevant areas, industries and institutions, students can learn how to integrate and apply knowledge from the appropriate areas of basics of climate change and disaster management. Students have to prepare a report on the field visit discussing about the importance of the visited area, and the knowledge they derived from the visit and submit the report with photographs. Marks will be awarded to the report after evaluation.

NAME OF THE COURSE: MODELLING OF DISASTERS AND EARLY WARNING SYSTEMS

Sl. No.	Course outcome (CO) *At the end of the course, the student will be able to:*	Taxonomic Level (TL)
1.	**CO1**: Describe various aspects of modeling of disasters	Un, Re
2.	**CO2:** Explain and propose different earthquake modeling techniques.	Un, Re, Ap
3.	**CO3:** Comment on principles behind landslide modeling and describe various models	Un, Re, An
4.	**CO4:** Explain how modeling can address flooding and micro level planning and management	Re, An
5.	**CO5**: Mention the principles behind Atmospheric pollution modeling	Un, Re

| 6. | **CO6:** Explain the National and international status, Feasibility and mode of operation of early warning system | Un, Re, An |

MODULE 1

Modeling concepts: Causal and statistical models, Characteristics, Steps in model development, Importance of model building. Conservation of mass and mass balance –calibration and verification of models; Transport phenomena – Advection, diffusion, dispersion, simple transport models; chemical reaction kinetics – Law of mass action, Rate constants, reaction order, types of reactions, equilibrium principles.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:

MO1: Define the concept of modeling
MO2: Explain the ideal characteristics of models
MO3: Comment on the importance of model building
MO4: Explain how models can be applicable in pollution studies
MO5: Define principles like Law of mass action, Rate constants, reaction order, types of reactions, equilibrium principles

MODULE 2

Seismic Wave (P & S) propagation, forward modeling and inverse modeling, response to various structures, model testing for structural design, Back analysis with historical data, Tsunami propagation. Storm surge and cyclone modeling.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:

MO1: Explain the propagation of seismic waves
MO2: Describe forward and inverse modeling
MO3: Explain model testing for structural design
MO4: Describe the technique of back analysis
MO5: Explain models to predict tsunami, storm surge and cyclone

MODULE 3

Landslide modeling including deposition profile and distance travelled by the material, probability of landslide occurrence, statistical analysis, geospatial technology for scenario development, DEM generation, Artificial Neural Network (ANN), Genetic Algorithm (GA), Simulated Annealing (SA) for highly non-linear models.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:

MO1: Define and explain deposition profile
MO2: Explain the factors of landslide occurrence
MO3: Comment on geospatial technology for scenario development
MO4: Explain Artificial Neural Network (ANN) and Genetic Algorithm (GA)
MO5: Explain Simulated Annealing (SA) for highly non-linear models

MODULE 4

Flood and drought hydrodynamic modeling, spatial data modeling for micro level planning and management, hydraulics of open channels, hydrological models, soil moisture modeling.

MODULE OUTCOMES
After Completion of this module, the student should be able to:

MO1: Comment on flood and drought hydrodynamic modeling
MO2: Explain spatial data modeling for micro level planning and management
MO3: Comment on hydraulics of open channels
MO4: Describe various hydrological models
MO5: Describe soil moisture modeling

MODULE 5

Stratosphere-troposphere interaction, Monsoon meteorology, Boundary layer meteorology, Remote sensing, Ocean-land atmosphere biosphere interaction, air pollution meteorology, Atmospheric pollution modeling.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:

MO1: Describe stratosphere-troposphere interactions
MO2: Explain meteorological principles during monsoon and in boundary layer
MO3: Describe ocean-land atmosphere and biosphere interaction
MO4: Comment on air pollution meteorology
MO5: Describe atmospheric pollution modeling
MODULE 6

Early warning systems: National and international status, Feasibility and mode of operation of early warning system for earthquakes, volcanoes, cyclones, flood, landslides, tsunami etc.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:

MO1: Comment on the state of early warning systems available nationally and internationally
MO2: Explain the mode of operation of early warning systems
MO3: Describe the early warning system of earthquakes and volcanoes
MO4: Describe various warning systems of cyclones and floods
MO5: Describe warning systems for landslides and tsunamis

References

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2. John R. Jensen (2009) Remote Sensing of the Environment: An Earth Resource Perspective. 2nd Edition, Dorling Kindersley (India) Pvt. Ltd, NODIA, India, pp 585
3. J.L.Schnoor, Environmental Modeling Fate and Transport of Pollutants in Water, Air and Soil, John Wiley & Sons Inc., New York, 1996.
4. Sekhar Chandra Dutta , Parthasarathi Mukhopadhyay,2012. Improving Earthquake And Cyclone Resistance Of Structures.

SEMESTER – IV

NAME OF THE COURSE: WEATHER AND CLIMATE MODELLING

COURSE OUTCOMES:

Sl. No.	Course outcome (CO) *At the end of the course, the student will be able to:*	Taxonomic Level (TL)
1.	**CO1**: Articulate the basic dynamism of atmosphere	Ap
2.	**CO2:** Comment on the use of various scales in measuring upper air characteristics	Un
3.	**CO3:** Understand the components of the atmospheric system	Un
4.	**CO4:** Comment on various weather forecasting techniques	Un
5.	**CO5**: Articulate the climatic processes	Un
6.	**CO6:** Discuss weather forecasting models	Un

MODULE 1: Basic Thermodynamics and Dynamics of the Atmosphere: Thermodynamics-First law of Thermodynamics , Boyl's and Charl's law, perfect gas equation, genera l thermo dynamic principles of the dry and moist air, Concepts of atmospheric stability, introduction to thermodynamic diagrams. Dynamics- introduction, conservation of mass, momentum and energy, introduction to equations of motion, concepts of circulation and vorticity, balanced atmospheric flows, introduction to wave theory and instability.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Understand first law of thermodynamics (Un)
MO2: Learn concepts of atmospheric stability (Re, Un)
MO3: Understand basic concept of dynamics of atmosphere (Re, Un)
MO4: Articulate concepts of circulation and vorticity (Re)
MO5: Acquire basics of wave theory (Re, Un)

MODULE 2: Atmospheric variables and its synthesis: Surface and Upper air atmospheric measurements, Synoptic, conventional and non conventional atmospheric data, special observations from Weather Radars, satellite observations, concepts of data assimilation – objective analysis and initialization (Elementary ideas only).

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Explain the upper air characteristics (Re, Un)
MO2: Understand measurement of temperature and pressure of upper air (Re, Un)
MO3: Analyse different sources of atmospheric data (An)
MO4: Learn about weather Radar (Un)
MO5: Understand the concepts of data assimilation (Un)

MODULE 3: Different Components of the Climate System: Introduction, Interaction between different components, its importance in Weather and Climate Models , Difference between Weather and Climate Models, Spatial and temporal comparison, Teleconnections of different time

and space scales.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Differentiate between weather and climate models (An)
MO2: Components of weather model (Un)
MO3: Components of climate model (Un)
MO4: Comment on earth and space segments (Re)
MO5: Discuss the role of Teleconnections (An)

MODULE 4: Weather Forecasting: Types of forecasting-short, medium and long range; Approaches for weather forecast, methods of forecasts-synoptic, numerical prediction, statistical, analogue, persistence and climatological approach. Numerical Weather Prediction (NWP)-History of NWP, Filtered Forecast Models, Primitive Equation Models, Operational NWP applicant system: Global Forecast System, Regional and mesoscale forecast system (WRF), Nowcast model, multi-model ensemble technique, Storm Surge modelling.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Describe the methods of forecasts (Re)
MO2: Comment on the various types of forcasting (Re, Un)
MO3: Explain the numerical prediction of weather (Re, Un)
MO4: Discuss the Global Forecast System (Un, An)
MO5: Explain the various models of weather forcasting (Re, Un)

MODULE 5: Parameterisation of Weather and climatic processes: Scope of Physical Parameterization, Processes to be parametrised, Planetary radiation budget and Paremeterization, Radiation and convection, Parametrisation of climate models, Ocean processess to be parameterised.

MODULE OUTCOMES:
After Completion of this module, the student should be able to:
MO1: Brief on various parameters of climatic processes (Re)
MO2: Explain the Statistical forecast methods (Re)
MO3: Discuss the modes of natural internal variability (Re, Un, An)
MO4: Describe the EBM and its salient features (Re, Un, Ap)
MO5: Explain EBM and glacial cycling (Re, Un)

MODULE 6: Climate Models - Zonal box models: Simple Box model of the ocean-atmosphere Coupled system, land and ocean energy balance box model; deceptively simple EBMs; One dimensional radiative Convective (1-D RC) models. Radiation factors - Convective experiments; Sensitivity experiments with RC models - humidity - clouds - lapse rate; Development of RC Models - Cloud prediction - Model sensitivity; single Column models.

MODULE OUTCOMES:

After Completion of this module, the student should be able to:

MO1: Describe the importance of modelling in weather forecasting (An)

MO2: Simple Box model of the ocean-atmosphere Coupled sphere (Re, Un)

MO3: Explain the radiation factors in modelling (Re)

MO4: Discuss Sensitivity experiments with RC models (Re, Un)

MO5: Explain Model sensitivity; single Column models (Re, Un)

References

1. Alan Watts (2005) Instant Weather Forecasting. Water Craft Books
2. Chandrasekhar A (2010) Basics of Atmospheric Science PHI Learning Private Ltd New Delhi
3. Guffie. R. andHenderson-Sellers, A., (2005) A climate modeling primer. John Wiley and Sons (Paperback).
4. James R Holton and Gregory Hakkim(2012):An introduction to Dynamic Meteorology , International geophysics series Vol 88
5. John M Wallace and Peter V Hobbs (2006) : Atmospheric Science an introductory survey Academic press
6. Ram Sastry AA (1984) Weather and Weather Forecasting. Publication Division, New Delhi
7. Taner CB, (1973) Basic Instrumentation and Measurements Micrometeology. University 'of Wisconsin, Madison.
8. Trenberth, K.E., (2010): Climate system modeling. University of Cambridge Press (Paperback) - selected reading.
9. Washington, W.M. and Parkinson C.L., (2005): Introduction to three- dimensional climate modeling. University Science books. - selected reading

SEMESTER IV	COURSE CODE: CDM-CC-542	CREDIT: 2

COURSE NAME: INTERNSHIP

Duration: Three weeks.

It can be conducted in any organisation/s related to the stakeholders (government/semi-government/public/private) of climate change and disaster management.

Sl. No.	**Course outcome (CO)** *At the end of the course, the student will be able to:*	**Taxonomic Level (TL)**
1.	**CO1**: Apply the knowledge of climate change adaption methods to the real terrain application.	Ap, Un
2.	**CO2:** Understand the industrial operations and management strategies to reduce / avoid man-made disasters.	Un

3.	**CO3:** Observe the various fire and rescue strategies in the departments of an industry.	Un
4.	**CO4:** Apply the knowledge of various disaster management strategies applicable to a particular industry.	Ap
5.	**CO5**: Prepare detailed project reports based on their experiences management strategies, mock drills in the organisation.	Cr

ASSESSMENT

40% for attending the Internship

60% for Internship report

SEMESTER IV   COURSE CODE: CDM-CC-543   CREDIT: 2

NAME OF THE COURSE: GREEN SKILL PROGRAMME

Sl. No.	Course outcome (CO) *At the end of the course, the student will be able to:*	Taxonomic Level (TL)
1.	**CO1**: Share knowledge and develop suitable methods in management of waste	Un, Ap
2.	**CO2:** Articulate knowledge of wastewater treatment using constructed wetland	Un, Ap
3.	**CO3:** Analyse and interpret air quality in a place by comparing the air quality data with standards	An, Ap
4.	**CO4:** Conduct Environmental impact assessment by preparing Environmental impact statement of any developmental activity	Ap, Cr
5.	**CO5**: Evaluate the carbon foot print by means of analysing the greenhouse gas emission from an institution	Un, Ev
6	**CO6:** Create a biodiversity register and can analyse the threats to biodiversity	Cr, An
7	**CO7:** Evaluate the environmental impacts of a particular operation and develop an environmental audit report	Ev, Cr

1. **Solid Waste management technologies:**
   Hands on exercise will be given to categorise the solid waste generated in the department into biodegradable and non-biodegradable waste. Quantification of each category will be

done   and training will be given to convert biodegradable waste into biocompost using bioport and inoculum method. A visit to a nearby solid waste management site will be made to get a perception of large scale solid waste management. Further, training will be given to students to write project proposal of solid waste management for an organization.

2. **Waste water treatment using phytoremediation:**

    Using box type constructed wetland method. A model constructed wetland is available in the department to treat the waste water. Students will be given training to understand this technique, followed by treating of wastewater.

3. **Air quality monitoring and assessment:**

    Students will be taken to the air PCB funded quality monitoring station of Kariavattom campus and will be asked to monitor the air quality displayed in the LED screen for a week time. They will analyse the data and present the results by comparing with ambient air quality standards. Further, Hands on training will be given to students to assess air quality of a particular place using High Volume Sampler available in the department.

4. **Environment Impact assessment:**

    Students will be taken to a developmental project site (proposed / ongoing project site) to understand the probable environmental impact due to the implementation of the project. Based on the field visit and the available literature related to the project, they will be asked to prepare the terms of reference (TOR), Environmental management Plan (EMP) and the draft Environmental Impact Report (EIS). This learning exercise will be useful to the students to work in the preparation of environmental impact of any developmental activity.

5. **Carbon Foot Print analysis:**

    Students are trained to evaluate Carbon foot print. Carbon footprint analysis, also known as a greenhouse gas (GHG) emissions assessment, evaluates the greenhouse gas emissions caused by the manufacture of a product or any given activity that contributes to global warming. This begins with the assessment of emission of carbon, sulfur hexafluoride, and methane. These emissions quantities are then converted into carbon dioxide equivalents (CO2e).

6. **Biodiversity Register Preparation**

    A biodiversity register can be used to maintain records of all living beings in their locality. The register may include minute details about plants and animals, both wild and domesticated in a particular area and knowledge regarding use of the various species. It allows us to analyze the reasons for depletion of biodiversity and plan conservation measures. Students will get training on the preparation of standard biodiversity register of a particular area.

7. **Environmental Auditing**

    Environmental auditing is essentially an environmental management tool for measuring the effects of certain activities on the environment against set criteria or standards. This is used to help improve existing human activities, with the aim of reducing the adverse effects of these activities on the environment. Students should study an organisation's environmental effects in a systematic and documented manner and will produce an environmental audit report.

8. **Economic Valuation and Cost Benefit Analysis (CBA)**

Students will be trained in various methods of economic valuation of environmental resources like contingent valuation, hedonic price method, choice experiments and travel-cost method. They will also be exposed to several case studies of CBA.

ASSESSMENT

40% Continuous / Formative Assessment (see PG Regulations).

60% End-semester/Summative Assessment: Skill evaluation

SEMESTER IV   **COURSE CODE: CDM-CC-544   CREDIT: 6**

COURSE NAME: DISSERTATION

AIM: The dissertation work is formulated to take the students deep in the field of research in various fields of climate change and disaster management. In order to critically evaluate and make a solution to various environmental problems, proper analysis, data collection evaluation and gathering the information is necessary.

OBJECTIVES: To carry out the dissertation work, students have to find a problem which is environmentally relevant to their M.Sc. programme. Based on that, students have to conduct independent research analysis under the supervision of a teacher, on various environmental problems. Various Laboratories (geomatic lab, computer lab, science lab) and/or field work is required for completing the project work. The student has to submit the dissertation after the completion of work and has to present the work using a power point presentation. Also they have to attend the viva-voce examination related to their project work. Marks will be awarded to each component in the assessment.

SKILL ENHANCEMENT ELECTIVE (SE)

Course Code: CDM-SE-501	Credits: 2

NAME OF THE COURSE: COMMUNICATION AND WRITING SKILLS

Sl. No	Course outcome (CO) *At the end of the course, the student will be able to:*	Taxonomic level (TL)
7.	CO1: Realize the purpose of communication and understand the barriers of communication	Remember (R)
8.	CO2: Develop skills on different types of communication and	Apply (Ap)
9.	CO3: Articulate and critically evaluate on the art and benefits of listening	Evaluate (E)
10.	CO4: Improve their writing skills and write good technical reports	Apply (Ap)
11.	CO5: Develop skill on oral communication and reading	Analyse (An)
12.	CO6: Develop knowledge on attending job interviews and develop good interview manners	Apply (Ap)

MODULE I: *Introduction to Communication:* Purpose of Communication; Process of Communication; Differences between Technical and General Communication; Barriers to Communication; Measures to Overcome the Barriers to Communication.
MODULE OUTCOME:

After Completion of this module, the student should be able to:
MO1: Articulate the purpose of communication and understand the barriers of communication (Re)
MO2: Identify the different types of communication (Re)
MO3: Analyze the communication methods (An)

MODULE II: *Types of Communication:* Types of Communication; Verbal Communication-Importance of verbal communication- Advantages of verbal communication- Advantages of written communication; Significance of Non-verbal Communication
MODULE OUTCOME:
After Completion of this module, the student should be able to:
MO1: Explain the importance of verbal communication (Un)
MO2: Articulate the advantages of written communication (Un)
MO3: Develop the art of written communication (Ap)

MODULE III: *Listening Skills:* Listening Process; Classification of Listening; Purpose of Listening; Common Barriers to the Listening Process; Measures to Improve Listening; Listening as an Important Skill in Work Place.

MODULE OUTCOME:
After Completion of this module, the student should be able to:
MO1: Articulate and critically evaluate on the art and benefits of listening (Un)
MO4: Outline the importance of listeninge(An)

MODULE IV: *Language for Communication:* Language and Communication; General Principles of Writing; Improving Writing Skills, Essentials of good style, Expressions and words to be avoided; Grammar and Usage; Features of Writing a Good Report; Guidelines for Report Writing; Steps in Report Writing; Structure of Report; Types of Reports and Different Formats.
MODULE OUTCOME:
After Completion of this module, the student should be able to:
MO1: Improve their writing skills and write good technical reports (Ap)
MO2: Articulate the usage of grammar (Un)
MO3: Outline the types and formats of reports (An)

MODULE V: *Oral Communication and reading Skills:* Oral Presentation- Purpose – Audience-Locale; Steps in Making a Presentation- planning-Structure and style-Preparation –Presentation; Delivering a Presentation. Reading Skill; Purpose of Reading; Types of Reading; Techniques for Effective Reading.
MODULE OUTCOME:

After Completion of this module, the student should be able to:
MO1: Develop skill on oral communication and reading (An)
MO3: Prepaer and deliver a presentation (Ap)

MODULE VI: *Employment Communication – Resume and job interviews*: Contents of Good Resume; Guidelines for Writing Resume; Different Types of Resumes; Different Types of Cover Letters; Importance and Factors Involving Job Interview; Characteristics of Job Interview; Job Interview Process; Job Interview Techniques- Manners and etiquettes to be maintained during an interview; Sample Questions Commonly asked During Interview
MODULE OUTCOME:

After Completion of this module, the student should be able to:

MO1: Develop knowledge on attending job interviews and develop good interview manners (Ap)
MO3: Identify the types of resumes and prepare a resume (Re, Ap)
MO4: Outline the manners and etiquettes to be maintained during an interview (An)

ACTIVITIES, LEARNING RESOURCES & ASSESSMENT
Suggested Class Room Activities:
- Assignments based on the theory
- Seminar Presentation on selected topics

- Debates on selected topics
- Newspaper reading and reporting
- Writing technical reports
- Preparing resumes
- Attempting mock interviews

LEARNING RESOURCES
References

- Adair, John. Effective Communication. London: Pan Macmillan Ltd., 2003.
- Ajmani, J. C. Good English: Getting it Right. New Delhi: Rupa Pubications, 2012.
- Amos, Julie-Ann. Handling Tough Job Interviews. Mumbai: Jaico Publishing, 2004.
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- Collins, Patrick. Speak with Power and Confidence. New York: Sterling, 2009.
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- Hasson, Gill. Brilliant Communication Skills. Great Britain: Pearson Education, 2012.
- Kalish, Karen. How to Give a Terrific Presentation. New York: AMACOM, 1996.
- Kratz, Abby Robinson. Effective Listening Skills. Toronto: ON: Irwin Professional Publishing, 1995.
- Prasad, H. M. How to Prepare for Group Discussion and Interview. New Delhi: Tata McGraw-Hill Publishing Company Limited, 2001.
- Raman, Meenakshi & Sangeeta Sharma. Technical Communication: Principles and Practice. Second Edition. New Delhi: Oxford University Press, 2011.
- Sharma, R. C. & Krishna Mohan. Business Correspondence and Report Writing: Third Edition. New Delhi: Tata McGraw-Hill Publishing company Limited, 2007.
- Thorpe, Edgar & Showick Thorpe. Winning at Interviews. 2nd Edition. Delhi: Dorling Kindersley, 2006.
- Turton, N. D. & J. B. Heaton. Longman Dictionary of Common Errors. Essex: Longman, 1987. First Indian Edn. 1998.

On-line sources

- https://public.wsu.edu/~brians/errors/
- http://users3.ev1.net/~pamthompson/body_language.htm
- http://www.albion.com/netiquette/corerules.html
- http://www.bbc.co.uk/worldservice/learningenglish/radio/specials/15
- http://www.colostate.edu/Depts/Speech/rccs/theory44.html
- http://www.dailywritingtips.com/
- http://www.englishdaily626.com/c-errors.php
- http://www.indiabix.com/group-discussion/topics-with-answers/
- http://www.thehumorsource.com

PRACTICALS

Semester   **: I**
Course code   **: CDM-P-511**
Course Title **: ATMOSPHERIC SCIENCE, GEOSCIENCE AND CLIMATE CHANGE**

1. Introduction to weather instruments (e.g., temperature, rain gauge, anemometer, psychrometer)– recording, tabulation and interpretation of weather data.

2. Megascopic identification of rocks – Igneous (at least 4 nos), Sedimentary (4 nos) and metamorphic (4 nos.) rocks.
3. Megascopic identification of minerals – quart, feldspar, calcite, biotite, Pyroxene, amphibole etc.
4. Soil: analysis of organic matter (OM & OC) and nutrients (N,P,K)
5. Soil: texture analysis – Pipette analysis for quantifying sand, silt and clay; textural data analysis using triangular plot.

Semester   : II
Course code   : CDM-P-521
Course Title   : STATISTICS, DISASTER MANAGEMENT AND REMOTE SENSING

1. Statistics (basic statistical work-mean median, mode; correlation; R-statistic) and programming (Python).

2. Study of topographic maps and interpretation (scale, Lat. & Long., ground control points, geomorphological study of selected grids etc.).

3. Interpretation of aerial photographs and satellite imageries – interpretation of natural and man-made features in imagery, geomorphological studies, preparation of land use/land cover maps etc.

Semester   : III
Course code   : CDM-P-531
Course Title   : WEATHER AND CLIMATE MODELING

1. Disaster preparedness: mock drills for floods, cyclones and earthquakes disasters in association with various disaster management agencies.

2. Exercise on weather forecasting using various tools for various application

3. Plan a detailed meticulous disaster management activity for meteorological/ geological/ hydrological/ biological and technological disaster.

4. Students can go for training in hospitals/ health departments for getting ten basic first aid training and procedures for any emergency. These include the following.

- Remember the "Three P's."
- Check the scene for danger before you provide help.
- To treat cuts and scrapes, apply gentle pressure, disinfectant, and bandages.
- To treat sprains, apply ice and compression at intervals and keep the limb elevated.

- To treat heat exhaustion, use cool fluids, cool cloths, and shade.

- To treat hypothermia; use warm fluids and warm covering.

- To treat burns, determine the burn type and severity. Cover the wound with loose cloth to prevent infection.

- Use an EpiPen to treat allergic reactions.

- To treat fractures, keep the fractured area stable and immobilized, and apply a cold pack.

- Perform CPR, if an injured person stops breathing.

The link for the training tips is : https://unchartedsupplyco.com/blogs/news/basic-first-aid

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