

**Ramakrishna Mission Vivekananda Educational and
Research Institute
(RKMVERI)**

(Deemed-to-be-university)

(Declared by Government of India under section 3 of UGC Act, 1956)

School of Environment and Disaster Management

SYLLABUS

Two Years M.Sc. in Environment and Disaster Management

**Faculty Centre for Integrated Rural Development and Management
Ramakrishna Mission Ashrama, Narendrapur
April, 2023**

SUMMARY OF THE COURSE

SEMESTER-1		
CODE	TITLE	CREDIT
Unit-1: EDM-107	Fundamentals of Environmental Science	2+1
Unit-2 : EDM-108	Environmental Chemistry	2+2
Unit-3 : EDM-109	Disaster Risk Management: Concepts and Frameworks	2+1
Unit-4 : EDM-110	Environmental Biology	2+2
Unit-5 : EDM-111	Disaster Management in India	2+1
Unit-6 : EDM-112	Ecology, Forestry and Bio-diversity	2+1
Unit-7 : SCH-101	Spiritual and Cultural Heritage of India-1	1+0
		13+8

SEMESTER-II		
CODE	TITLE	CREDIT
Unit-8: EDM-208	Environmental Policy, Legislations and Standards	2+1
Unit-9: EDM-209	Environmental Toxicology	2+2
Unit-10: EDM-210	Disaster Risk Reduction	2+1
Unit-11: EDM-211	Environmental Pollution and Management	2+2
Unit-12: EDM-212	Energy and Environment	2+1
Unit-13: EDM-213	Basics of Geo-informatics	2+2
Unit-14: EDM-214	Research Methodology and Statistics	2+2
Unit-15 : SCH-201	Spiritual and Cultural Heritage of India-2	1+0
		15+11

SEMESTER-III		
CODE	TITLE	CREDIT
Unit-16: EDM-309	Climate Change: Issues and Challenges	2+1
Unit-17: EDM-310	Disaster Response, Relief and Recovery	2+1
Unit-18: EDM-311	Waste Water Treatment and Solid and Hazardous Waste Management	2+2
Unit-19: EDM-312	Environmental Health and Safety Management	2+1
Unit-20: EDM-313	Environmental Impact Assessment	1+2
Unit-21: EDM-314	Environmental Biotechnology and	2+2

	Bio-remediation	
Unit-22: EDM-315	RS/GIS for Environment and Disaster Management	2+2
Unit-23 : EDM-316	Research Methodology for Environment and Disaster Management	2+1
		15+12

SEMESTER-IV		
CODE	TITLE	CREDIT
Unit-24: EDM-404	Dissertation Work Selection of theme – Identification of issues Literature survey - Hypothesis of the study Research methodology Data collection and analysis	0+24
Unit-25: EDM-405	Presentation of Dissertation and Viva Voce	0+02
		0+26

SEMESTER-1

EDM-107

FUNDAMENTALS OF ENVIRONMENTAL SCIENCES

2+1 credit (36+18 hours)

Module-1: Introduction to Environmental Science **8 hrs**

- Environmental science – definition, scope and importance
- Components of environment and their interrelationships
- Multidisciplinary nature of environmental science
- Environmental movements
- Environmental movements in India

Module-2: Atmosphere **4 hrs**

- Chemical composition of atmosphere
- Structure of atmosphere: troposphere, stratosphere, mesosphere, thermosphere
- Ozone layer and its depletion
- Temperature, humidity and precipitation
- Wind: direction, speed, pressure and circulation

Module-3: Lithosphere **4 hrs**

- Chemical and physical composition of lithosphere
- Crust, mantle, outer and inner core of earth
- Rocks, minerals and their classifications
- Soils and their classifications and properties, soil pH, water holding capacity, soil salinity, fertility and productivity
- Oceanic and continental lithosphere

Module-4: Hydrosphere **4 hrs**

- Hydrological cycle and processes, precipitation, evaporation and transpiration, runoff, base flow, infiltration
- Ground water hydrology – origin, classification and profile of groundwater, water bearing characteristics of different types of rocks, water table and piezometric surface
- Hydrologic characteristics of aquifer (unconfined, confined and semi-confined), porosity, permeability etc.
- Laws of ground water movement: Darcy's law, Bernoulli's equation, recharge and discharge areas, safe yield and overdraft

- Rainwater harvesting and artificial recharge, Consumptive and conjunctive use of water, watershed management.

Module-5: Biosphere

4 hrs

- Origin of life on planet – plants, animals, microorganisms and humans
- Evolution of life forms through geological time scale
- Biomes and their classifications - deserts, forests, grasslands, aquatic, tundra, and chaparral
- Interdependence of living things – food chain cycles
- Biodiversity and extinction of species

Module-6: Anthroposphere

4 hrs

- Human settlement and its evolution
- Gradual social change in relation to environment
- Nature vs. Nurture – human interventions in nature
- Dynamics of demography.
- Demography and environment

Module-7: Environment and Sustainable Development

8 hrs

- Global environmental issues and their impacts on development
- Origin and development of the concept of sustainable development
- Definition and meaning of sustainable development
- UN Sustainable Development Goals and their classification
- Status of implementation of Sustainable Development Goals
- LiFE: Life style for sustainable environment

Practical

- Measurement of dry and wet bulb temperature, pressure, wind speed
- Calculation and conversion of the basic meteorological parameters
- Soil and water pH measurement
- Water holding capacity of soil measurement
- Soil and water salinity measurement

Reading materials

1. R Carson, *Silent Spring*
2. World Commission on Environment and Development, *Our Common Future*.
3. Michael Allaby, *Basics of Environmental Science*
4. Eldon Enger and Bradely Smith, *Environmental Science: A Study of Interrelationships*
5. P H Raven, D M Hassenzahl, M C Hager, N Y Gift, and L R Berg, *Environment*
6. Erach Bharucha, *Text Book For Environmental Science*

EDM-108

ENVIRONMENTAL CHEMISTRY

2+2 credit (36+36 hours)

Module-1: Basic Concepts of Environmental Chemistry **8 hrs**

- Classification of elements with emphasis on potentially toxic elements
- Biogeochemical cycles of elements, saturated and unsaturated hydrocarbons in environment
- Stoichiometry, Gibb's energy, chemical potential, chemical kinetics, chemical equilibrium, mass and energy transfer across various interfaces
- Material balance, laws of thermodynamics, heat transfer process, acid-base reactions, solubility products, solubility of gases in water
- Chemistry of hydrocarbons and its decay.

Module-2: Environmental aspects of air-chemistry **6 hrs**

- Chemical composition of air, particles, ions and radicals in atmosphere
- Chemical processes for formulation of inorganic and organic particulate matter
- Thermochemical and photochemical reactions in atmosphere
- Photochemical smog, oxygen and ozone chemistry.

Module-3: Environmental aspects of water chemistry **4 hrs**

- Fundamentals of water chemistry
- Concepts of DO, BOD, COD, total hardness, redox potential.

Module-4: Environmental aspects of soil chemistry **8 hrs**

- Soil formation, composition and classification
- Soil profile, soil erosion, soil reaction
- Inorganic and organic components of soil
- Nitrogen pathways in soil, NPK in soils.

Module-5: Analytical methods in environmental sample analysis **10 hrs**

- Preparation of solutions for standard curves, analytical reagents, standard solution and indicators.
- Titrimetry, Gravimetry, Colorimetry, Spectrophotometry,
- Flame photometry, Atomic absorption spectrophotometry
- Basic chromatography
- GC, HPLC, X-Ray diffraction
- X-Ray fluorescence

- ICP-AES, ICP-MS, NMR, GC-MS, SEM, TEM

Practical

- Sampling techniques and sample preparation of soil and water.
- Physico-chemical characterization of water, soil and sediment.
- Air quality assessment
- Acid-base titration .

Reading materials

1. S. E. Manahan, Environmental Chemistry
2. A.K.De, Environmental Chemistry
3. V.Subramaniam, A text book of environmental chemistry
4. G.S. Sodhi, Fundamental concept of environmental chemistry
5. S. C. Santra, Environmental Science
6. Botkin & Keller, Environmental Science
7. P.R. Sreemahadevan Pillai, A comprehensive laboratory manual for environmental science & engineering
8. Frank Settle, Hand book of instrumental techniques for analytical chemistry
9. Robert G. Mortimer, Physical Chemistry

EDM-109

DISASTER MANAGEMENT: CONCEPTS AND FRAMEWORKS

2+1 credit (36+18 hours)

Module-1: Understanding disasters

2 hrs

- Etymology and history of disasters
- Anger of God
- Wrath of Nature
- Perception and Practice
- Science of disaster

Module-2: Understanding risks of disasters

4 hrs

- Hazards – classification of hazards
- Vulnerabilities – types of vulnerabilities
- Exposures – exposure of population and economy
- Risks of disasters – natural hazards and unnatural disasters
- Measuring risks of disasters

- Module-3: Patterns and Trends of Disasters** **6 hrs**
- Trends of various types of disasters
 - Patterns of losses due to disasters
 - Global and regional trends of disasters and losses
 - Global and local database on disasters
- Module-4: Natural and manmade hazards** **6 hrs**
- Geological disasters
 - Hydro-meteorological disasters
 - Biological disasters
 - Technological disasters
 - Complex and systemic disasters
- Module-5: Disaster Management Cycle** **6 hrs**
- Pre disaster - risk assessment, risk prevention, risk mitigation, risk transfer, disaster preparedness
 - During disaster – disaster response and relief
 - Post disaster – disaster rehabilitation, reconstruction and recovery
 - Disaster Management, Disaster Risk Management, Disaster Risk Reduction
 - Disaster Risk Resilience
- Module-6: Framework of Disaster Management** **8 hrs**
- International Decade for Natural Disaster Reduction (1990-1999)
 - Yokohama Strategy for Safer World (1995-2005)
 - Hyogo Framework of Action: Building Resilience of Countries and Communities to Disasters (2005-2015)
 - Sendai Framework for Disaster Risk Reduction (2015-2030)
 - Targets and indicators of SFDRR
- Module-7: Community Based Disaster Management** **2 hrs**
- Traditional role of communities in disaster management
 - Strength and weakness of communities
 - Empowering communities for effective management of disasters
- Module-8: Participatory Disaster Risk Assessment** **2 hrs**
- Concept and theoretical framework
 - Methods and techniques
 - Tool kit

Practical

- Field visit for community based disaster risk assessment
- Analysis of Patterns and Trends of Disasters

Reading materials

1. UNISDR, Living With Risks
2. The World Bank, Natural Hazards, Unnatural Disasters
3. United Nations, Hyogo Framework of Action: Building Resilience of countries and Communities to Disasters
4. United Nations, Sendai Framework for Disaster Risk Reduction 2015-2030
5. Rajib Shaw and R R Krishnamurthy, Disaster Management: Global Challenges and Local Solutions
6. P G Dhar Chakrabarti, Nothing Called Natural Disasters
7. Oxfam, A Practitioner's Guide to Participatory Capacity and Vulnerability Analysis
8. EM-DAT, International Database of Disasters

EDM-110

ENVIRONMENTAL BIOLOGY

2+2 credit (36+36 hours)

Module-1: Environment, flora fauna: interrelation and interactions 4 hrs

- The origin of life, the biosphere, evolution of organisms.
- Participation in elementary cycles of nutrients.

Module-2: Concept of three kingdom classification 2 hrs

- Animal, Plants and Protista, Prokaryotes and eukaryotes.

Module-3: Fundamental of Microbiology 4 hrs

- Classification of microorganisms
- Factor controlling growth of microbes
- Measurement, kinetics and characteristics of bacterial growth in natural and artificial system.

Module-4: Microbiology of Air 6 hrs

- Factors affecting the survival of microorganisms in air
- Sources of microorganisms
- Air-borne pathogens and its role on public health
- Sampling techniques for microbial air quality

Module-5: Microbiology of Water

6 hrs

- Common microorganisms encountered in fresh water sources
- Self-purification of water
- Common sources of microbial pollution in water
- Assessment of microbiological quality of water
- Characteristics of pollution indicator microorganisms,

Module-6: Microbiology of Soil

8 hrs

- Beneficial and pathogenic microbes in agriculture
- Soil as a microbial growth medium
- Characteristics of soil microenvironment for microbes
- Interaction of microorganisms and plant in soil
- Role of microorganism in maintaining the soil fertility.

Module-7: Elements of Food Microbiology

6 hrs

- Different fermented food (cheese, curd, wine)
- Harmful food born microorganism
- Detection of food-borne pathogens in raw and canned foods
- Bacteriology of milk, outline of the processes of food preservation (pasteurization, sterilization, canning and blanching)

Practical

- Laboratory safety
- Basic microbial techniques
- Isolation of microorganisms from air, water and soil
- Microbial staining, observation and micrometry
- Isolation of microorganisms of environmental interest

Reading materials

1. P.D. Sharma, Environment and Ecology
2. Mahua Basu and S.Xavier, Fundamentals of Environmental Studies by
3. Pelczar, General Microbiology
4. Maier, Pepper, Gerba, Environmental microbiology
5. Singh, Singh, Gupta, Ecology Environmental Science and conservation by
6. S. C. Santra, Environmental Science
7. Botkin& Keller, Environmental Science
8. N.S. Subba Rao, Soil Microbiology
9. P.R. Sreemahadevan Pillai, A comprehensive laboratory manual for environmental science & engineering
10. R.C.Dubey and Maheshwari, Practical Microbiology
11. J.G. Cappuccino and N Sherman, Microbiology A laboratory manual
12. K.R.Aneja, Experiments in microbiology plant pathology and biotechnology

EDM-111

DISASTER MANAGEMENT IN INDIA

2+1 credit (36+18 hours)

- | | |
|--|--------------|
| Module-1: Disasters in India | 4 hrs |
| <ul style="list-style-type: none">• Hazards• Vulnerabilities• Exposures• Risks• Pattern and trends of disasters in India | |
| Module-2: Evolution of disaster management in India | 2 hrs |
| <ul style="list-style-type: none">• Disaster management in ancient and medieval India• Disaster management in colonial India• Disaster management in post-colonial India• Four mega disasters that made difference• Report of High Powered Committee (HPC) | |
| Module-3: Legal and institutional framework | 6 hrs |
| <ul style="list-style-type: none">• Disaster Management Act 2005• Disaster Management Authorities at National, State and District levels• National and State Executive Committees• National Institute of Disaster Management• National Disaster Response Force | |
| Module-4: Role of other institutions | 4 hrs |
| <ul style="list-style-type: none">• National Crisis Management Committee• Nodal Ministries and Departments• Armed Forces• Civil Defence• SDRF, State Police, Fire Services | |
| Module-5: Other Stakeholders in disaster management | 4 hrs |
| <ul style="list-style-type: none">• Urban and Local bodies• Scientific and technical organisations• Academic and research institutions• Civil Society and NGOs• Private and Corporate sector• International and regional organisations | |

- Religious and faith based organisations
- Community based organisations
- Volunteers

Module-6: Disaster Management Policy, Guidelines, Plans **8 hrs**

- National Policy on Disaster Management
- National Guidelines on Disaster Management
- National Plan on Disaster Management
- State Disaster Management Plan
- District Disaster Management Plan
- Relief Manuals and SOPs

Module-7: Disaster Communication System **2 hrs**

- Early Warning of Disasters in India
- Disaster communication network
- Emergency Operation Centres at national, state and district levels
- India Disaster Resource Network

Module-8: Financing Disaster Management in India **6 hrs**

- National Disaster Response Fund
- National Disaster Mitigation Fund
- State Disaster Response Fund
- State Disaster Mitigation Fund
- Finance Commission Awards

Practical

- Critical review of Disaster Management Plan of a State, District and City

Reading materials

1. Report of the High Powered Committee on Disaster Management 2001
2. Disaster Management Act, 2005
3. National Policy on Disaster Management 2009
4. National Plan on Disaster Management 2016
5. Ministry of Home Affairs, Disaster Management in India
6. P G Dhar Chakrabarti, Financing Disaster Management in India
7. Chapter-8 of the Report of Fifteenth Finance Commission titled Disaster Risk Management

EDM-112

ECOLOGY, FORESTRY, WILD LIFE AND BIO-DIVERSITY

2+1 credit (36+18 hours)

Module-1: Ecology

6hrs

- Scope of ecology; origin of life and theories of organic evolution
- Ecosystem concept; structure and function; ecosystem dynamics, energy flow, ecosystems of India
- Food chain and food web complexity, guild analysis, keystone species,
- Structure and function of forest, lake and agricultural ecosystem.
- Concept of niche, niche overlapping, niche breadth and width, resource partitioning, niche and habitat concept
- Ecological succession and Biome.

Module-2: Population ecology

6 hrs

- Population growth models, R and K selection, carrying capacity
- Human population size, age structure, adaptation and resilience, Population viability analysis
- Metapopulation, Levin's model, metapopulation persistence time, correlated extinction
- Community structure and dynamics, theory of island bio geography
- Concept of diversity and stability, intermediate disturbance hypothesis, predator-prey-population oscillation,
- Community development, Connell and Slatyer's facilitation, inhibition and tolerance model, Trillman's resource ratio hypothesis.

Module-3: Forestry

6 hrs

- Forest types of India and their distribution
- Analysis of forest communities, values of forests
- National and International efforts for forest conservation - people's biodiversity register
- Forest Management Practices
- Scope and Future of National Green Mission

Module-4: Wild Life

4 hrs

- Tools for wildlife research, use of radio telemetry and remote sensing in wildlife research, legal binding of biological materials, concept of bio-patents and PBR
- Threats to wildlife conservation and wildlife trade
- Principles of conservation and management of animal communities,

- Wildlife habitat and behavior studies
- Wildlife census; captive wildlife

Module-5: Bio Diversity

6hrs

- Diversities of life forms (Plants, animals and microbes)- importance of biodiversity, type of biodiversity, alpha, beta and gamma diversity, global patterns of biodiversity,
- Causes and consequences of biodiversity loss
- Biodiversity conservation approaches, in situ and ex-situ conservation, concept of protected area network, sanctuary, national Park and biosphere reserves, Design and management of protected areas,
- Biodiversity management policies, national and International efforts, bio-prospecting and bio-piracy issues.
- Biogeographic zones in India, national action plan for protection of biodiversity - role of Botanical Survey and Zoological Survey in biodiversity documentation and conservation.

Module-6: Threats to bio-diversity

4 hrs

- Threats of biodiversity, overexploitation, fragmentation, habitat loss, poaching of wildlife,
- Extinction vortex, Cause of extinction, Population viability analysis, Red Data Book.
- Man-wildlife conflicts, natural calamities
- Effect of degeneration of biodiversity on future of evolution

Module-7: Biodiversity hotspots

4 hrs

- Hotspots and Mega diversity Countries
- India as a mega-diversity nation; flora & fauna of other megadiversity countries; hot-spots of biodiversity; wealth of Indian hot-spots.
- Endangered and endemic species of India

Practical

- Biodiversity measurement techniques- Biodiversity richness and diversity indexes:
- IUCN red list categorization- Guideline criteria.
- Eco restoration – site visit
- Field Study (under normal and usual condition)
- Audio video Demonstrations
- Case studies related to man animal conflict, habitat development and biodiversity conservation

Reading materials

1. E. Odum, Fundamentals of Ecology
2. S. C. Santra, Fundamentals of Ecology and Environmental Biology
3. P.D. Sharma, Ecology and Environment
4. M. J. Jeffries, Biodiversity and Conservation
5. P K Maity and P. Maity, Biodiversity –Perception, Peril and Preservation
6. Graeme Caughley, John M. Fryxell, and Tony Sinclair, Wildlife Ecology, Conservation and Management
7. O. P. Chaubey, Forest Ecology In India

SCH-101

SPIRITUAL AND CULTURAL HERITAGE OF INDIA -PART I

1+0credit (18 hours)

Module-1: Personality Development: Western View

- Freud (Id, Ego, the Super ego - Instinctual energy (Libido) Alfred Adler (some ethical value), Carl Jung (Ego-conscious mind- personal unconsciousness, collective unconscious etc.)

Module-2: Personality Development: Oriental View

- Necessity to know our mind - four fold functions of mind; Personality-- An introduction; 'it is personality that matters'; Laws of personality development; Different layers of personality; Man is divine; 'Pleasure is not the goal'; How to change our character; control of our negative emotions, subjective changes.

Module-3: Service

- What is service? Concept of service in Religions (Hinduism, Buddhism, Jainism, Christianity and Islam).

Module-4: Approach to Rural Development

- Three tier of organization for conducting rural development - what upper class should do? Ramakrishna Mission's approach to rural development.

Note: Students in groups will prepare a summary of the whole module and give a presentation just before the study leave for end of Semester Exams.

SEMESTER-II

EDM-208

ENVIRONMENTAL POLICY, LEGISLATIONS AND STANDARDS

2+1 credit (36+18hours)

Module-1: Environmental Policy **6 hrs**

- Environmental Policy – rationale and objectives – factors that influence environmental policy - process of formulation of environmental policy
- Environmental Policy of India – Policies on issues related to environment

Module-2: Environmental Laws **2 hrs**

- Environmental laws – evolution of environmental laws – Constitutional provisions on environmental issues – Powers of the Central, State and Local governments on environmental issues

Module-3: Environmental Laws of India **12 hrs**

- Central legislations on environment - Environment (Protection) Act - Water (Prevention and Control of Pollution) Act - Air (Prevention and Control of Pollution) Act- Factories Act - National Environmental Tribunal Act - National Green Tribunal Act - Wildlife Protection Act - Indian Forest Act - Forest Conservation Act - Forest Dwellers (Recognition of Forest Rights) Act

Module-4: International Environmental Laws **4 hrs**

- Overview of international environmental laws – application and enforcement -International environmental laws adopted by India

Module-5: Environmental Regulations **2 hrs**

- Regulations framed under various Central legislations on environment

Module-6: Environmental Standards: Global **2 hrs**

- Global environmental standards –ISO 14000 Family of Standards - USEPA, OSHA, ACGIH, ASHRAE, ENISO

Module-7: Environmental Standards: National **6 hrs**

- National environmental standards on air, water, noise etc
- Application of environmental standards in different contexts

Module-8: Environmental Information System **2 hrs**

- ENVIS (Environmental Information System)- Objective of the scheme, framework, Overview of ENVIS Centres - role of the centres, monitoring mechanism.

Practical

- Case studies on application and compliance of environmental laws

Reading materials

1. Bare Acts
2. Kohli and Menon, Development of Environmental Laws in India
3. Ved Nanda and George Pring, International Environmental Law and Policy for the 21st Century
4. P G Dhar Chakrabarti, Green Federalism

EDM-209

ENVIRONMENTAL TOXICOLOGY

2+2 credit (36+36 hours)

Module-1: General Principles of Toxicology **8 hrs**

- Basic definition and terminology
- Importance of dose and dose response relationship, Dose-response assessment, No-Observed-Adverse-Effect Level(NOAEL), lowest-observed-adverse-effect level (LOAEL), reference dose (RfD), reference concentration (RfC), Slope Factor.
- Dose response curve and factor affecting dose response curve
- Testing adverse effects of chemicals and generating dose response data
- Risk and risk assessment: carcinogenic and non-carcinogenic risks, principles and evaluation (use of software for area-specific prediction analysis)

Module-2: Major class of contaminants **6 hrs**

- Inorganic: Metal and metalloids, organo-metalic compounds, inorganic gases.
- Organic contaminants: CFC, organo-chlorine compounds, polycyclic aromatic hydrocarbons, pesticides, herbicides etc.
- Radiation: Source, nature and different types of radiation, protection and

control from radiation.

Module-3: Adsorption, distribution, metabolism and elimination (EDME) of toxic agents **8 hrs**

- Passive diffusion, Filtration
- Carrier-mediated transport
- Engulfing by cell
- Gastro-intestinal tract, Respiratory tract, skin, Barriers, Binding and storage organs, Urinary and biliary excretion, Lungs and other routes of excretions.

Module-4: Bio-transformation of toxicants **6 hrs**

- Phase I (Degradation) reactions: Oxidation, Reduction and hydrolysis
- Phase II (Conjugation) reaction: Glucuronide formation, Sulfate conjugation, methylation, acetylation, amino acid conjugation, glutathione conjugation.

Module-5: Bio-activation and bioaccumulation **6 hrs**

- Epoxide formation, N-Hydroxylation, free radicals and superoxide formation, Activation in gastrointestinal tract.
- Factor affecting bio-accumulations

Module-6: Risk assessment **6 hrs**

- Chronic daily intake (CDI), Evaluation of Cancer risks, Non-cancer risks, hazard quotient (HQ) for a single substance, hazard index (HI) for multiple substances, sensitivity analysis
- Monte Carlo simulation, Mathematical problems on the determination of risk accompanying carcinogenic and non-carcinogenic contaminants,
- Computation of acceptable concentration

Module-7: Ecological risk assessment: an overview. **4 hrs**

- Biomarkers; Bioaccumulation; Biomagnification; Bioconcentration factor;
- Risk assessment; Effects on population and ecosystems; Damage process and action of toxicants; Toxicity of heavy metal (Pb, Cd, Hg and As).

Practical

1. Instrumentation for quantification of toxicological exposure.
2. Dose response curve plotting and significance

Reading materials

1. P. D. Sharma, Environmental Biology and Toxicology
2. S. C. Santra, Environmental Science
3. Williams, James, Roberts, Principles of Toxicology
4. Michael C. Newman, Fundamentals of Ecotoxicology
5. Flanagan, Braithwaite, Brown, Widdop and Wolff, Basic Analytical Toxicology
6. Central Pollution Control Board, Guideline for Recognition of Environmental Laboratories under the environmental (Protection)Act, 1986

EDM-210

DISASER RISK REDUCTION

2+1 credit (36+18 hours)

Module-1: Disaster Prevention and Mitigation **4 hrs**

- Disaster Risk Reduction: Conceptual Issues
- Risk Prevention: Concept, Strategies and Limits of Prevention
- Risk Mitigation: Concept and Strategies
- Structural and non-structural mitigation
- Economics of Disaster Prevention and Mitigation

Module-2: Earthquake Risk Mitigation **4 hrs**

- Understanding Risks of Earthquake
- Earthquake Resilient Housing and Infrastructure
- Retrofitting of Lifeline Structures
- Training of engineers, architects, planners and masons
- Enforcement of Building Regulations

Module-3: Cyclone Risk Mitigation **4 hrs**

- Understanding Risks of Cyclone
- National Cyclone Risk Mitigation Project
- Structural Measures for Cyclone Risk Mitigation
- Non-Structural Measures for Cyclone Risk Mitigation
- Cyclone Resilient Agriculture and Livelihood

Module-4: Flood Risk Mitigation **4 hrs**

- Understanding Risks of Flood
- Structural Measures for Flood Risk Mitigation
- Non-Structural Measures for Flood Risk Mitigation
- Management of Urban Flood

- Trans-border Management of Flood

Module-5: Drought Risk Mitigation **4 hrs**

- Understanding Risks of Drought
- Evolution of Drought Risk Management in India
- Institutional Framework for Drought Risk Management
- Programmes and Schemes for Mitigating Risks of Drought
- National Drought Manual

Module-6: Mitigation of other Risks of Disasters **6 hrs**

- Other geological disasters
- Other hydro-meteorological disasters
- Industrial disasters
- Biological disasters

Module-7: Capacity Building for Disaster Risk Reduction **2 hrs**

- Capacity: Concept and Issues
- Capacity Development Strategies
- Training and Sensitisation
- Education and Research
- Awareness Generation

Module-8: Eco-system based Disaster Risk Reduction **2 hrs**

- Eco-system, Human Well-being and Disasters
- How can Eco-system contribute to DRR
- Strategies and Tools of Eco-DRR
- Eco-DRR for Flood, Cyclone and Drought

Module-9: Mainstreaming DRR in Development **4 hrs**

- Concepts, Principles and Strategic Approach
- Mainstreaming DRR in Development Sectors
- Mainstreaming DRR in Project Cycle Management
- Tools for Mainstreaming DRR in Development

Module-10: Future of Disaster Risk Reduction **2 hrs**

- Patterns and Trends of DRR since 1990
- Global Goals and Targets of DRR: Prospects and Challenges
- Future of DRR.

Practical

- Visit to India Meteorological Department

- Visit to an ongoing Disaster Risk Mitigation Project
- Case study on Disaster Risk Mitigation Project

Reading materials

1. Julio Kuroiwa, Disaster Reduction –Living in Harmony with Nature
2. Jochen Zschau and Andreas Kuppens, Early Warning Systems for Natural Disaster Reduction
3. UNISDR, Towards a Culture of Prevention –Disaster Risk reduction Begins at School: Good Practices and Lessons Learnt
4. NDMA, National Guidelines on Earthquake, Cyclone, Flood, Urban Flood, Drought
5. Planning Commission, Disaster Management – the Development Perspectives
6. P G Dhar Chakrabarti, Mainstreaming Disaster Risk Reduction for Sustainable Development: A Guidebook for the Asia-Pacific

EDM-211

POLLUTION AND WASTE MANAGEMENT

2+2 credit (36+36 hours)

Module-1: Air Pollution

10 hrs

- Chemical composition of atmosphere (Classification of elements, chemical speciation, Particles, ions and radicals in the atmosphere)
- Sources of air pollution (Natural and anthropogenic sources of air pollution)
- Types of air pollutants (Primary and Secondary pollutants)
- SO_x, NO_x, PAN, photochemical smog, acid rain
- Organic and inorganic pollutants, their behaviour and fate on local, regional and global scale
- Monitoring of criteria and non-criteria pollutants (Stack sampling with special emphasis on isokinetic sampling)
- Air Quality standards. Effects of air pollutants on human health, plants, animals and materials
- Different aspects of air pollution control - Principle and application of mechanical collectors, Fabric Filters, Gas & Venturi Scrubbers, Electrostatic precipitators.

Module-2: Water Pollution

10 hrs

- Type, sources and consequences of fresh water and ground water pollution
- Case study of Arsenic contamination of ground water with special references to Bengal basin

- Physico-chemical and bacteriological sampling and characterization of water
- Water standards, Sewage and effluent treatment
- Marine and coastal pollution: Types, natural and anthropogenic sources, consequences, effect on human and marine biota
- Control and management-significances of CRZ and integrated coastal zone management.

Module-3: Soil pollution

8 hrs

- Sources of soil pollutants
- Physico-chemical and biological sampling and analysis of soil quality, Effect and consequences of soil pollution, Interaction of soil pollutants with soil components
- Soil reclamation strategies

Module-4: Noise pollution

4 hrs

- Concept of Noise, Sources of noise pollution
- Effect of meteorological parameters on noise pollution
- Management of noise and noise-indices
- Noise exposure levels and standard, Impact of noise on human health, noise abatement strategies.

Module-5: Other pollution

4 hrs

- Marine pollution, types, causes and consequences, effect on human and marine biota, management and control of marine pollution
- Radioactive pollution, causes, consequences and management
- Pollution from industries and thermal power stations, types, causes, consequences and management
- Odour pollution, sources, consequences and management

Practical

- Application of advanced instruments for monitoring, measurement of pollutants and related studies
- Visit to different laboratories.

Reading materials

1. S. C. Santra, Environmental Science
2. MahuaBasu and S.Xavier, Fundamentals of Environmental Studies
3. P.D. Sharma, Environment and Ecology
4. S M Khopkar, Environmental pollution analysis
5. P. Narayanan, Environmental Pollution - Principles, Analysis and Control
6. Botkin & Keller, Environmental Science

7. Central Pollution Control Board, Guideline for recognition of environmental laboratories under the environmental (Protection)Act,
8. C V Chalapati Rao, Urban Air Pollution India – Status and Challenges

EDM-212

ENERGY AND ENVIRONMENT

2+1 credit (36+18 hours)

Module-1: Solar energy and environment **4 hrs**

- Sun as source of all energy
- Solar radiation and its spectral characteristics

Module-2: Fossil fuels **6 hrs**

- Fossil fuels: classification, composition
- Physico-chemical characteristics and energy content of coal, petroleum and natural gas
- Shale oil, Coal bed Methane
- Gas hydrates
- Gross-calorific value and net-calorific value.

Module-3: Renewable energy **6 hrs**

- Hydro-energy, tidal energy, geo-thermal energy, ocean thermal energy, wind power, solar energy (solar collectors, photo-voltaic modules, solar ponds).

Module- 4: Nuclear energy **4 hrs**

- Nuclear energy - fission and fusion
- Nuclear fuels
- Nuclear reactor – principles and types.

Module-5: Energy efficiency **6 hrs**

- Energy codes, energy audit, energy efficiency and energy rating
- Energy efficient production and consumption development
- Energy efficient building codes and design
- Bureau of Energy Efficiency, BEE energy performance star rating of commercial buildings
- Building envelope, performance cost index, co-efficient of performance, energy efficiency ratio

Module-6: Lighting system **4 hrs**

- Selecting lighting sources - FL, CFL, LED etc.
- Lighting control, emergency lighting, standards - LDS, LES, LENI

Module-7: Energy standards **6 hrs**

- ANSI/ASHRAE/IES Standard energy standard 90.1-2016
- EN 15193- Energy requirements for Lighting; ISO EN 13790:2008 - Energy performance of buildings (industry and residential)
- ISO EN 13790:2008 calculation procedures
- ISO 50001:2011, Energy management systems; Energy code Compliance evaluation (objective methods) 2

Practical

1. LENI calculation
2. Energy transfer in building envelop

Reading materials

- Richard Wolfson, Energy, Environment and Climate
- Sandeep Kundu and Mohd Nawaz, Sustainable Energy and Environment: An Earth System Approach
- Foster, Ghassemi and Cota, Solar Energy: Renewable Energy and Environment

EDM-213

BASICS OF GEO-INFORMATICS

2+2 credit(36+36 hours)

Module-1: Data Base Management System **4 hrs**

- DBMS – concept, formation and management procedure;

Module-2: Remote Sensing **8 hrs**

- Remote sensing: Introduction and process, agencies and satellite system
- Electro Magnetic Radiation – associated wavelength and frequency, other atmospheric phenomena
- Types of Remote Sensing, Image characteristics, orbits, swath, nadir, orbital calendar

Module-3: Remote Sensing Imageries **10 hrs**

- Sensor resolutions and its types

- Digital image and classification, visual image interpretation
- Concepts on co-ordinate system - map, scale, sphere/spheroid, diatums, projection, projection parameters

Module-4: Geographic Information System (GIS)

14 hrs

- Overview of GIS: introduction, components, functions and advantages, application
- Raster and vector data concept - data sources and format, data capture (raster/vector/attribute)
- Image processing
- Practical orientation and demonstration

Practical

1. DBMS –MSAccess
2. Introduction to ERDAS Imagine; Geo-referencing
3. AOI tool, Mosaicking and Subsetting, Digital image processing
4. Visual interpretation of digital images
5. Map composition; import/export
6. Introduction with ArcGIS; Raster and vector data recognition, Georeferencing, Reprojection; digitization, creating Geodatabase, feature class and shape file
7. Thematic Map, graphs and Layout; Import and export
8. Preparation and submission of assignment

Reading materials

1. Basudev Bhatta, Remote Sensing and GIS
2. K Elangovan, GIS: Fundamentals, Applications and Implementation
3. Ray, Dwvedi, and Vijayan, Remote Sensing Applications

EDM-214

RESEARCH METHODOLOGY AND STATISTICS

2+2 credit (36+36 hours)

Module-1: Fundamentals of Research

4 hrs

- Concepts related to Science and Research – Definitions, Aims, Characteristics, Types
- Scientific research vs. Commonplace explanation
- Methods, Methodology, Techniques

Module-2: Research Problem and Design

6 hrs

- Research Process: Concept, Major Steps of Research
- Selection and Identification of Research Problem; Research Issue, Problem, Questions, Objectives
- Hypothesis and variables – concept and types
- Research Design – Definitions and Concepts; Types of research design – experimental, quasi-experimental, ex-post facto

Module-3: Measurements and Data Collection procedure

10 hrs

- **Tools of Data Collection** - Secondary information, Observation – Participant and Non-participant, Interview, Administering written questionnaire, Focus Group Discussion
- **Interview** - Group interview, Panel interview, Focused interview, Repetitive interview
- **Questionnaire** – Typology; Procedure of questionnaire development; Pre-testing
- **Scaling techniques** - Ranking and rating scale, Thurstone's Equal Appearing Interval Scale, Likert's Summated rating Scale;
- **Measurement** – Concepts, Types, Examples, Levels of measurement, Problems of measurement, Reliability and Validity of Measurement

Module-4: Data presentation and interpretation

16 hrs

- **Basic Probability:** definitions, event and sample space, random variable, joint and conditional probabilities, expectations.
- Measures of Central Tendency, dispersion, skewness and kurtosis: mean, median, mode, range, mean deviation, quartile deviation, standard deviation - definition, properties, advantage and disadvantages, uses; interpretation and conclusion
- **Tests of hypothesis** – z-test, t-test, X^2 -test, One-way/two-way ANOVA; test significance and confidence limits
- **Presentation of data: meaning and importance, characteristics.** Data definition, types (qualitative vs. quantitative, primary vs secondary, experimental vs. survey), analysis and interpretation, presenting quantitative data - graphical presentation (bar diagram, histogram, frequency polygon, ogive, pie chart etc.); tabular presentation (univariate,

bivariate, multivariate).

- **Writing technical/scientific reports:** Aims, Types, Format, Language, use of Style Manual

Practical

- Collection of data –Questionnaire development and collection of field data through Personal Interviews/Group interview
- Using computer software for data analysis
- Graphical presentation (Bar diagram, histogram, frequency polygon, ogive, pie chart, etc.); tabular presentation (univariate, bivariate, multivariate).
- Measures of Central Tendency, Dispersion, Skewness and Kurtosis
- Tests of Hypothesis – Z, t, Chi-square, F (ANOVA)
- Scientific report writing

Reading materials

1. Anol Bhattacharjee, Social Science Research: Principles, Methods, and Practices
2. C. R Kothari and G Garg, Research Methodology: Methods and Techniques
3. A. M Gun and A K Gupta, Fundamentals of Statistics. Vol. 1 and Vol-3
Problems of measurement, Reliability and Validity of Measurement

SCH-201

SPIRITUAL AND CULTURAL HERITAGE OF INDIA-2

1+0credit (18 + 0 hours)

Module-1: Service

- Difference between Service and Charity, Types of Service, Gradation of Service, Why should we serve others? A. Practical Reasons, B. Scientific Reasons, Biology, Physics, C. Ethical Reasons, D. Religious Reasons - Islam, Christianity, Hinduism, E. Philosophical Reasons.
- Philosophy of Service- Service of God in Man and Karma Yoga.

Module-2: Regeneration of India

- India - Her Eternal Glory, Her Life Center, Causes for the decay of India, Regeneration of India and Her Future.

Module-3: Swami Vivekananda on Social Reforms

- Swamiji's view on Social Reforms, Condition of the masses and ways

for their uplift, Condition of the Women and ways for their uplift,
Social evils and their eradication, All round development of the society,
Swami Vivekananda on Organization, Qualities of a successful
reformer.

Note: Students in groups will prepare a summary of the whole course and give
a presentation of their respective portions just before the study leave

SEMESTER-III

EDM-309

CLIMATE CHANGE: ISSUES AND CHALLENGES

2+1 credit (36+18 hours)

Module-1: Climate Change – Concepts and Issues **4 hrs**

- Concepts of climate change – Climate, weather and climate change – natural and anthropogenic climate change – Climate variation and climate change –Definition of climate change
- Dynamics of climate change – Global Carbon Cycle – Green House Emission –Effects of GHGs
- Issues of climate change - Impacts of climate change – climate change mitigation and adaptation – climate change and sustainable development
- Science of climate change–development of science of climate change – multi-disciplinary character of climate change science

Module-2: Parameters and Projections of Climate Change **4 hrs**

- Rising temperature
- Changing pattern of precipitation
- Melting glaciers
- Sea Level Rise

Module-3: Extreme Climatic Events **4 hrs**

- IPCC Special Report on Extreme Climatic Events
- Increasing frequencies and intensities of cyclonic storms
- Changing pattern of floods
- Growing risks of droughts
- Emerging extreme climatic events
- Slow onset climatic events

Module-4: Models for Climate Change Projections **2 hrs**

- Climate change scenarios, climate models- components of climate models
- AR-1- 1990- Simple emission trend
- AR-2-1995-IS92 Model
- AR-3 and 4 -2001 and 2007- SRES Model
- AR-5-2015-RCP Model

- AR-6-2021-SSP Model
- Net Zero Emission

Module-5: Impacts of Climate Change **4 hrs**

- Impact of climate change on agriculture and food security
- Impact of climate change on water resources
- Impact of climate change on eco-system
- Impact of climate change on human health

Module-6: Climate Change Mitigation **4 hrs**

- Concept of climate change mitigation – how does it differ from disaster risk mitigation
- Strategies for reducing Anthropogenic Green House Gas Emission
- Strategies for enhancing carbon sinks
- Differential responsibilities for climate change mitigation
- Clean Development Mechanism and Carbon Credit

Module-7: Climate Change Adaptation **4 hrs**

- Adaptation, adaptation cycle and adaptive capacity
- Adaptation options, approaches and policy needs
 - Agriculture
 - Water resources
 - Forestry
 - Human health
 - Disaster risk reduction
- Integration of Climate Change Adaptation with Disaster Risk Reduction

Module-8: Climate Convention, Protocol and Agreements **4 hrs**

- Intergovernmental Panel on Climate Change
- UN Framework Convention on Climate Change
- Conference of Parties
- Kyoto Protocol 1997
- Paris Agreement on Climate Change 2015
- Climate Change Pact 2021

Module-9: Climate Change in India **6 hrs**

- Climate risks of India
- National Action Plan on Climate Change and Climate Missions
- State Action Plans on Climate Change
- India's Nationally Determined Contributions to Climate Change

Practical

- Climate change related project works

Reading materials

1. Mark Maslin, Climate Change: A Very Short Introduction
2. Joseph Rom, What Everybody Needs to Know about Climate Change
3. IPCC, Fourth, Fifth and Sixth Assessment Reports- Summary for Policy Makers
4. IPCC, Special Report on Extreme Climatic Events, Summary for Policy Makers
5. Paris Agreement on Climate Change, 2015
6. National Action Plan on Climate Change
7. R Krishan and others, Assessment of Climate Change over the Indian Region
8. P G Dhar Chakrabarti, Climate Change and Sustainable Development

EDM-310

Disaster Response, Recovery and Reconstruction

2+1 credit (36+18 hours)

Module-1: Disaster Preparedness for Response **6 hrs**

- Scenario building and contingency planning
- Mock drills and table top exercises
- Emergency Support Functions and Coordination
- Logistics and supply chain management
- Emergency Operation Centres

Module-2: Disaster Response **6 hrs**

- Incident Response System
- Evacuation
- Search and Rescue
- Emergency Health Management
- Emergency Humanitarian Assistance

Module-3: Post Disaster Need Assessment **6 hrs**

- Rapid Assessment of Disaster Damage
- Damage and Loss Assessment (DALA)
- Post Disaster Need Assessment (PDNA)
- Case studies on PDNA

Module-4: Disaster Relief and Rehabilitation **6 hrs**

- Humanitarian Charter, Standard and Principles
- SPHERE Core Standards of Relief
- Minimum Standards of Relief
- SDRF Norms for Disaster Relief & Rehabilitation

Module-5: Disaster Reconstruction and Recovery **6 hrs**

- Early recovery and long term recovery
- Inclusive recovery
- Livelihood recovery
- Psycho-social recovery

Module-6: Building Back Better **6 hrs**

- Concept and principles of Build Back Better
- Build back houses and habitat
- Build back infrastructure
- Build back communities

Practical

- Visit to NDRF Battalion Headquarter in Kalyani
- Visit to State Emergency Operation Centre in Nabanna

Reading materials

5. National Plan on Disaster Management, 2016
6. NDMA, National Guidelines on Disaster Management
7. Ministry of Home Affairs, Standard Operating Procedure for Responding to Natural Disasters
8. Sphere Minimum Standards in Humanitarian Response
9. Ministry of Home Affairs, Handbook for Post Disaster Need Assessment
10. Ministry of Home Affairs, Disaster Management in India
11. UN Special Envoy on Tsunami recovery, Key Propositions for Building Back Better

EDM-311

**WASTE WATER TREATMENT AND
SOLID AND HAZARDOUS WASTE MANAGEMENT**

2+2 credit (36+36 hours)

Module-1: Type and sources of water pollution **4 hrs**

- Domestic, industrial and agricultural water pollutions

Module-2: Major water quality parameters and their applications 4 hrs

- BOD, COD, DO, TDS, Salinity, acidity, alkalinity,

Module-3: Waste Water Treatment 6 hrs

- Primary, Secondary and tertiary treatment of waste water,
- Principles of coagulation, flocculation, porous media, filtration, disinfection and ion exchange, absorption,
- Membrane process,
- Major contaminant groups and natural pathways for their removal from water

Module-4: Solid waste – composition and characteristics 2 hrs

- Waste and solid waste – Definition of solid waste - Types of solid waste – sources of solid waste – Municipal solid waste
- Physical composition of solid waste - Density of waste - Moisture content in waste- Size of waste - Distribution of waste
- Chemical composition of solid waste –Lipid – Proteins - Carbohydrates
- Proximate and ultimate analysis of solid waste –Kinetics of waste generation
- Process of waste degradation –Aerobic and anaerobic process of waste degradation

Module-5: Collection, segregation and transportation MSW 2 hrs

- Generation of municipal solid waste from different sources –Generation from different income groups
- Collection of municipal solid waste – House-to-house collection of solid waste –Community bin system of collection of waste
- Segregation of municipal solid waste –Segregation of waste at source – Secondary and final segregation
- Transportation of municipal solid waste –stages in transportation of solid waste – Choice of vehicles for transportation –Types of vehicles and other mechanical means for transportation of solid waste

Module-6: Treatment of municipal solid waste 4 hrs

- Solid waste processing technologies - Mechanical and thermal volume reduction - Biological and chemical techniques for energy and other resource recovery.
- Landfill –Sanitary landfill – Technology and processes of sanitary landfill - Controlled landfill - Open dump of solid waste
- Technology and processes of composting of municipal solid waste
- Incineration of solid waste –Waste-to-energy projects

- Four R's of Municipal Solid Waste Management

Module-7: Municipal solid waste management in India **6 hrs**

- Municipal Solid Waste Scenario in India – Estimates of waste generation in cities –Sources of waste – Composition of municipal solid waste
- Legal and Institutional Framework – Constitutional provisions – Municipal Acts of the States- Municipal Solid Wastes (Management and Handling) Rules, 2000-Solid Waste Management Rules 2016 – Responsibilities of different stakeholders
- Collection and segregation of solid waste in large, medium and small cities of India
- Disposal and treatment of solid waste in India – State of landfills, open dumps, composting and waste-to-energy plants in India
- Towards Sustainable Solid Waste Management in India – Challenges and opportunities

Module-8: Management of hazardous waste **4 hrs**

- Hazardous waste – Types of hazardous waste –Systems and processes for collection, treatment and disposal of hazardous waste - Hazardous and Other Waste Management Rules 2016
- Construction waste –Collection and disposal of construction waste - Construction and Demolition Waste Management Rules 2016
- Plastic waste - Plastic Waste Management Rules 2016
- Electronic and electrical waste - E-Waste Management Rules 2016
- Bio-medical waste - Biomedical Waste Management Rules 2016

Practical

- Field visit to municipal solid waste disposal and treatment facilities
- Project work on waste management

Reading materials

1. Sunil Kumar, Municipal Solid Waste Management in Developing Countries
2. Shyamala Mani, P U Asnani and others, Improving Municipal Solid Waste Management in India
3. Ministry of Urban Development, Municipal Solid Waste Management Manual, Part-1 and Part-2
4. Subhasis Chattopadhyaya and others, Municipal Solid Management in Kolkata- A Review

EDM-312

ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT

1+1 credit (18+18 hours)

Module-1: Environmental health

4 hrs

- Environmental diseases –types and classification of environmental diseases – growing incidence of environmental diseases
- Zoonotic and vector borne diseases –Toxic metals and elements – pesticides and other organic chemicals –Pesticide and other organic chemicals – Climate change related environmental diseases

Module-2: Environmental health regulations

4 hrs

- Water quality monitoring –air quality monitoring – food safety regulations – solid, liquid and hazardous waste management

Module-3: Occupational health

4 hrs

- Occupational health concepts –Significance of occupational environment for health – agents of occupational diseases –prevention of occupational disease

Module-4: Safety regulations

6 hrs

- Need for integration of Safety, Health and Environment (SHE), Hazard Identification - Assessment of risk; Risk management
- Principles of Accident Prevention: Accident recording, analysis, investigation and reporting; Onsite and off-site emergency preparedness and response plans; rules and regulations dealing with chemical accidents.
- Protection from Hazardous Materials: Personal protective equipment and clothing; Fire safety; Noise and vibrations; and Principles of noise control.
- Hazardous Material – Storage, Disposal and Safety: Notification of sites; Safety reports; and safety audits.
- Documentation requirements – policy formulation, targets and objectives, standard operating procedure (SOP), record keeping etc. Training requirements.

Practical

- Visit to a factory for exposure to application of safety regulations

Reading materials

1. Robert Friis, Essentials of Environmental Health
2. Charles Reese, Occupational Health and Safety Management – A Practical Approach
3. Government of India, National Occupational Health and safety in India

EDM- 313

ENVIRONMENTAL IMPACT ASSESSMENT

1+2 credit (18+36 hours)

Module-1: Concept of Environment Impact Assessment 4 hrs

- Definition of EIA –objectives - Types of EIA
- Grouping of environmental impacts – direct, indirect, cumulative and induced impacts
- EIA principles and processes –EIA benefits and flaws

Module-2: EIA study planning and management 4 hrs

- Documentation requirements – policy formulation, targets and objectives, standard operating procedure (SOP), record keeping etc. Training requirements
- Questionnaire design on on-site and off-site emergency plans
- Quantitative environmental risk analysis, safety audit and preparation of report and notification of sites

Module-3: EIA standards in India 6 hrs

- EIA regulations in India
- Standards of environmental management in different sectors
- Environmental impact on air, water, soil, noise
- Biological and socio-economic impacts

Module-4: EIA practice in India 4 hrs

- Application of EIA in different sectors
- Case studies on EIA

Practical

- Field study and project work on Environmental Impact Assessment

Reading materials

1. Anji Reddy Mareddy, Environmental Impact Assessment – Theory and Practice

EDM- 314

ENVIRONMENTAL BIOTECHNOLOGY AND BIOREMEDIATIONS

2+2 credit (36+36 hours)

Module-1: Macrophytes for Waste Water Treatment **4hrs**

- Sewage and waste water treatment, solid waste management, chemical control of water pollution, role of microphyte and macrophytes in water treatment; recent approaches to biological waste water treatment, treatment for waste water from dairy, distillery, tannery, sugar and antibiotic industries. Thin film techniques for waste water treatment using aquatic plants.
- Anaerobic digestion: anaerobic digestion of high-solid wastes.

Module-2: Vermi-composting for Solid Waste Management **4hrs**

- Solid waste management with vermin composting:
- Concept of vermicomposting, Importance of earthworms, Classification of earthworms, Techno-economic aspect of vermicomposting.
- Detail of vermicomposting technology
- Organic waste processing.

Module-3: Biological nitrogen fixation **4 hrs**

- Biological nitrogen fixation: nitrogen fixing organisms, biochemistry of nitrogenase, genetics of nitrogen fixation, different types of biological nitrogen fixation.
- Estimation of nitrogen fixing ability of microbes.

Module-4: Biosensor and pollution management **6hrs**

- Biosensors: types and applications; Bio-molecules; membrane and transducer; Bio-augmentation: estimation of microbial load; Methods of Inorganic and Organic waste removal; treatment of Oil pollution at sea;
- Biodegradation of natural and synthetic waste materials; methods in determining bio-augmentation and bio-magnification; Separation, purification and bio removal of pollutants; fermented products and

Biogas from wastes; utilization of aquatic slurry for salt-resistant paddy cultivation.

Module-5: Biomass production technology **6 hrs**

- Biomass production technology: sources of biomass, crop residues (cereals, leguminous crops, sugarcane etc.), composition of plant biomass, wastes as a source of energy, (cellulose, hemicellulose and lignins), biomass conversion,

Module-6: Bioremediation **4 hrs**

- Fundamentals, methods and strategies of application (bio-stimulation, bio-augmentation): examples, bioremediation of metals (Cr, As, Se, Hg), radio nuclides (U, Te), organic pollutants (PAHs, PCBs, Pesticides, TNT etc.),
- technological aspects of bioremediation (*in situ*, *ex situ*); Application of bacteria and fungi in bioremediation;
- Phyto-remediation: Fundamentals and description of major methods of application (phyto-accumulation, phyto-volatilization, rhizo filtration, phyto-stabilization).

Module-7: Environmental biotechnology in agriculture **6hrs**

- Bioinsecticides: *Bacillus thuringiensis*, Baculoviruses, uses, genetic modifications and aspects of safety in their use;
- Bio-fungicides: Description of mode of actions and mechanisms (e.g. *Trichoderma*, *Pseudomonas fluorescens*);
- Biofertilizers: Symbiotic systems between plants-microorganisms (nitrogen fixing symbiosis, mycorrhiza fungi symbiosis),
- Plant growth promoting rhizobacteria (PGPR): uses, practical aspects and problems in

Module-8: Polymers and plastic degradation **2 hrs**

- Polymers and plastic degradation: polymer degradation, photo chemical degradation, disposable synthetic polymers, polymer recycling, role of micro organisms in degradation

Practical

- Aseptic techniques
- Microbial culture techniques
- Culture media preparation
- Isolation of environmentally beneficial bacteria and morphological characterization
- Mass production and Bio fertilizers
- Biofertilizers production technology

- MIC study of microorganisms

Reading materials

1. Maier, Pepper and Gerba, Environmental microbiology
2. Evans and Furlong, Environmental biotechnology-theory and application
3. P.D. Sharma, Environment and Ecology
4. S. C. Santra Environmental Science
5. Central Pollution Control Board Guideline for recognition of environmental laboratories under the environmental (Protection)Act, 1986
6. Flanagan, Braithwaite, Brown and Widdop, Wolff, Basic analytical toxicology
7. Singh, BKP..Biotechnological Applications in Environment and Agriculture.
8. R.C.Dubey and Maheshwari, Practical Microbiology
9. J.G. Cappuccino and N Sherman, Microbiology A laboratory manual
10. K.R.Aneja, Experiments in microbiology plant pathology and biotechnology

EDM- 315

RS/GIS FOR ENVIRONMENT AND DISASTER MANAGEMENT

2+2 credit (36+36 hours)

Module-1: RS/ GIS for environment and disaster management 6 hrs

- Applications of RS/ GIS for environment and disaster management – an overview
- Role of space faring nations and the UNOOSA
- Role of ISRO, NRSC and the Decision Support System for disaster management

Module-2: RS/GIS for Hazard, Vulnerability and Risk Assessment 10 hrs

- Remote sensing applications in agricultural drought monitoring and forecasting
- Landslide hazard mapping
- Flood hazard mapping
- Storm surge hazard mapping
- Tsunami vulnerability mapping and risk assessment
- Forest fire monitoring

Module-3: Other applications of RS/ GIS for disaster management 10 hrs

- Disaster management planning
- Emergency response
- Damage and loss assessment

Module-4: RS/GIS for environmental management

10 hrs

- Air quality monitoring
- Ground water monitoring
- Watershed management
- Monitoring of forests and grasslands
- Monitoring of river and sea erosion

Practical:

- Case studies
- Exercises

EDM- 316

**RESEARCH METHODOLOGY FOR
ENVIRONMENT AND DISASTER MANAGEMENT**

2+1 credit (36+18 hours)

Module-1: Environmental and disaster research – an overview

6 hrs

- Phenomenal growth on environmental and disaster research
- Relevance and limitations of social science research methodology in environmental and disaster research
- Special needs on environmental and disaster research
- Mix of methods from social and physical sciences needed for interdisciplinary research on environment and disaster studies
- Qualitative and quantitative research in environment and disaster studies
- Ethical issues in environmental and disaster studies

Module-2: Statistical approaches in environmental science

10 hrs

- Attributes and variables: types of variables
- Basic concept of probability theory, sampling theory
- Sampling: Population and sample, advantages of sampling, techniques of sampling in environmental and social sciences, sampling error, optimum sample size.
- Distributions - normal, log-normal, binomial, poisson, t, X² and F-distribution.
- Correlation and Regression: definition, simple correlation coefficients - properties, rank correlation coefficients, partial correlation coefficients, multiple correlation coefficients, simple and multiple regression analysis, regression line - utility, interpretation.

Module-3: Environmental modelling **6 hrs**

- Approaches to development of environmental models
- Linear, simple and multiple regression models, validation and forecasting
- Models of population growth and interactions
- Lotka-Volterra model
- Leslie's matrix model.

Module-4: Methodological and Ethical Issues in Disaster Research **10 hrs**

- Planning and ethical issues
- Issues in qualitative fieldwork
- Challenges for quantitative and statistical analyses
- Research design and causation
- Obtaining reliable and valid measures
- Computer simulation and optimisation

Module-5: New Directions in Research **4 hrs**

- Strengths of the interdisciplinary approach
- Challenges of the interdisciplinary approach
- Strengths and limitations of application of GIS for disaster management

Practical

- Practical on drawing samples
- Correlation and Regression
- Preparation of research design of an environmental and disaster study

Reading materials

1. Mark Kanazawa, Research Methods for Environmental Research: A Social Science Approach
2. Storch and Flosr, Models in Environmental Research
3. Landstorm, Transdisciplinary Research – A Practical Approach
4. Rodrigues, Donner and Tainor, Handbook of Disaster Research

SEMESTER-1V

EDM - 404: Dissertation work

(0+24 credit)

- Selection of theme of dissertation
- Identification of issues for research
- Literature survey
- Hypothesis of the study
- Research methodology
- Data collection plan and analysis

EDM - 405: Presentation of dissertation work

(0+2 credit)

- Presentation of Dissertation
- Viva Voce