Syllabus for

Master of Science in Environmental Science and Disaster Management

Under Choice Based Credit System

Academic Session:

w.e.f 2020-2022

For

All Constituent/ Affiliated Colleges Under

Binod Bihari MahtoKoyalanchal University, Dhanbad

Members of Board of Studies of CBCS Post Graduate Syllabus as per Guidelines of Binod Bihari MahatoKoyalanchal University, Dhanbad.

1. Chairman -(i) Dr. S. K. Sinha
   Head, University Dept.ofEnv. Sc. & DM
   BBMKU, Dhanbad.

2. External Expert Members –(i) Prof. (Dr.) Biswarup Mukherjee
   University Professor, Univ. Dept. of Zoology
   Ranchi University, Ranchi
   (ii) Dr. Anjani Kumar
   Principle Scientist, CIMFR, Dhanbad

3. Members (i) Dr. B Kumar, Associate Professor
   Dean, Faculty of Science, BBMKU, Dhanbad
   (ii) Dr. L B Singh
   DSW, BBMKU, Dhanbad

4. Invited Members - (i) Dr. Navita Gupta, Associate Professor
   Univ. Dept. of Zoology, BBMKU, Dhanbad
   (ii) Dr. Rupam Mallik, Assistant Professor
   Univ. Dept. of Zoology, BBMKU, Dhanbad
   (iii) Dr. SaritaMurmu, Assistant Professor
   Univ. Dept. of Zoology, BBMKU,Dhanbad

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COURSE STRUCTURE

Semester wise Course/ Examination structure for Science faculty

Semester	Paper Code (Credit/ Lecture)	Paper Name	Full Marks	End Semester Marks	Mid Semester (Internal) Marks (Written 20 marks)+ Day to Day assignment includes extracurricular activities (5 marks)+ Attendance (5 marks)
I	EDMF-101 (5 Credits, 60 lectures+ 15 Tutorials)	Foundation	100	70	30
	EDMC-102 (5 Credits, 60 lectures+ 15 Tutorials)	Core	100	70	30
	EDMC-103 (5 Credits, 60 lectures+ 15 Tutorials)	Core	100	70	30
	EDMC/P-104 (5 Credits,75 Lectures)	Practical	100	70	30

II	EDMS-205 (5 Credits, 60 lectures+ 15 Tutorials)	Skill Development Course	100	70	30
	EDMC-206 (5 Credits, 60 lectures+ 15 Tutorials)	Core	100	70	30
	EDMC-207 (5 Credits, 60 lectures+ 15 Tutorials)	Core	100	70	30
	EDMC/P-208 (5 Credits,75 Lectures)	Practical	100	70	30
III	EDMA09/ EDMC-309 (5 Credits, 60 lectures+ 15 Tutorials)	Open Elective/ Core	100	70	30
	EDMC-310 (5 Credits, 60 lectures+ 15 Tutorials)	Core	100	70	30

	EDMC-311 (5 Credits, 60 lectures+ 15 Tutorials)	Core	100	70	30

	EDMC/P-312 (5 Credits,75 Lectures)	Core / Practical	100	70	30
IV	EDME-413A/ EDME-413B/ EDME-413C (5 Credits, 60 Lectures+ 15 Tutorials)	Discipline Centric Elective Theory EDME-413A: EDME-413B: EDME-413C:	100	70	30
	EDME-414A/ EDME-414B/ EDME-414C (5 Credits, 60 Lectures+ 15 Tutorials)	Discipline Centric Elective Theory EDME-414A: EDME-414B: EDME-414C:	100	70	30
	EDME/P-415A/ EDME/P-415B/ EDME/P-415C (5 Credits, 75 Lectures)	Discipline Centric Elective Practical EDME-413A: EDME-413B: EDME-413C:	100	70	30
	EDMD-416 (5 Credits, 75 Lectures)	Dissertation /Project	100	70	30

Semester I

Compulsory Foundation Course

(Credits: Theory-04, Tutorial :01)

EDMF-101	**Fundamentals In Ecology**	**Theory:60 Hours** **Tutorial : 15 Hours**

Unit I

1.1 Organisms and Environment: Holocoenotic nature of environment;
1.2 Abiotic and biotic environment.
1.3 Ecological adaptations: Morphological and physiological responses of organisms to
1.4 Edaphic factors- Temperature, water, Light.

Unit II

2.1 Population ecology: Population characteristics,
2.2 Population growth, carrying capacity,
2.3 population regulation, life history strategies (*r* and K selection),
2.4 Population interactions including Lotka – Volterra model, population differentiation, Liebig's &Shelford's Law.

Unit III

3.1 Community ecology: Concepts of community and continuum; community attributes; Different Indices for measurement of Species Diversity
3.2 Community development: Models and mechanisms of ecological succession; changes in ecosystem
3.3 Ecosystem properties during succession; Concept of climax.
3.4 Ecosystem changes during succession.

Unit IV

4.1 Ecosystem organization: Ecosystem structure and functions,
4.2 Primary production (methods of measurement, global pattern, controlling factors);
4.3 Energy dynamics (trophic organization, Lindeman's trophic Dynamic models, energy flow pathways, ecological efficiencies,);
4.4 Litter fall and decomposition; Biogeochemical cycles in terrestrial and aquatic ecosystems: Carbon, Nitrogen, Sulphur & Phosphorus

4.5 Ecosystem management: Concepts; sustainable development; sustainability indicators.

Unit V

4.1 Concept of Biodiversity.
4.2 Uses of Biodiversity- Productive, Consumptive, and non- productive
4.3 Threats to biodiversity
4.4 BiodiversityConservation and Management.

Suggested Readings:

1. E.P. Odum and G.W. Barrett. 2005. Fundamentals of Ecology. Cengage Learning India Pvt. Ltd.
2. J.S. Singh, S.P. Singh and S.R. Gupta. 2008. Ecology, Environment & Resource Conservation.Anamaya Publications.

3. Dash M C & Das S P, Fundamental IN Ecology, Mcgraw Hill Education (India) Pvt Ltd

4. Living In the Environment: An Introduction to environmental Science, Miller GP, International Function publication

Core Course

(Credits: Theory-04, Tutorial :01)

EDMC-102	Earth & Atmospheric Sciences	Theory:60 Hours Tutorial : 15 Hours

Unit I

1.1 Origin of Earth, Evolution of earth's atmosphere & Biosphere,
1.2 Stratification & Composition of Biosphere,
1.3 Gaia Hypothesis

Unit II

2.1Weathering and erosion processes;
2.2Types and formation of soils and soil profile.
2.3Major rock and ore forming minerals: Properties of minerals;
2.4Igneous, sedimentary and metamorphic rocks.
2.5Earthquakes, Volcanoes, Landslides and Floods: Their impact on environment.

Unit III

3.1 Hydrosphere: Types of aquatic ecosystems
3.2 Groundwater: Occurrence.
3.3 Estuaries, Mangroves.

Unit IV

4.1 Stratification of atmosphere, Atmosphere and the earth's radiation balance, circulation of atmosphere, atmospheric stability, lapse rates and mixing heights, plume behavior; Gaussian plume model; Wind Rose Diagram.
4.2 Photochemistry of nitrogen oxides, oxygen, ozone and chlorides in the atmosphere.
4.3 General relationship between landscape, biomes and climate.

Unit V

5.1 Stratospheric ozone layer- evolution, cause of depletion and effects of living world
5.2 Atmospheric deposition- cause and consequences of deposition.
5.3 Eutrophication- cause and effects on biological spectra
5.4 Acid Rain – Cause and effect on biological world
5.5 Global Warming

Suggested Readings:

1. T. R. Oke. 2006. Boundary layer climates. Methuen & Co. Ltd.
2. S. Pal Arya. 2001. Introduction to Micrometeorology. Academic Press.
3. H. R. Byers. 2006. General Meteorology. McGraw-Hill.
4. K. S. Valdiya. 1987. Environmental Geology. Tata McGraw-Hill.
5. J. M. Wallace and P. V. Hobbs. 2006. Atmospheric Science – An introductory survey Academic Press.

7. Hamblin. (8th Ed). 2000. Earths Dynamic Systems. Prentice Hall.
8. David Huddart and TimStott. 2010. Earth Environments- Past, Present and Future. Wiley-Blackwell.
9. Environmental Geology, Coates 1981. Coates, John Wielly& Sons Publications

10. Environmental Geology, Keller, Ce maririe Publication, Toranto Tata macgrowhill Publication, New delhi.

Core Course

(Credits: Theory-04, Tutorial :01)

EDMC-103	Natural Resources & Sustainable Development	Theory:60 Hours Tutorial : 15 Hours

Unit I

1.1 Natural Resources: Depletion and regeneration of natural resources, Renewable and non-renewable resources.

1.2 Biotic Resources- Forests, agriculture, fisheries, and livestock.

1.3 Abiotic Resources- Surface and ground water, Energy, mineral resources, land resources, soil erosion, ecosystem services.

Unit II

2.1 Energy Resources: Energy and people; Energy sources – Resource and reserves - an overview of the current global and National Energy Scenario.

2.2 Fossil Fuels: Oil, coal, natural gas – Sources, exploration, exploitation;environmental consequences.

Unit III

3.1Nuclear Energy: Nuclear fission and Fusion;
3.2Nuclear fuel cycle,
3.3Nuclear reactors (PWR,BWR, Gas Cooled Breeder)
3.4Nuclear power and its consequences.

Unit IV

4.1 Renewable and Alternative Energy Sources: Solar energy, solar power, photovoltaic cells; Wind power; Geothermal energy; Ocean energy; Fuel cells.

4.2 Bio Energy: Biomass conversion processes; Biodiesel; Environmental consequences of biomass resource harnessing.

4.3 Energy Conservation: National energy policy, energy efficiency improvement, audit and energy saving.

Unit V

5.1 Conservation of Biodiversity principles- In-situ & Ex Situ Conservation, Protected Area Networks, Animal Corridors.
5.2 Conservation of Biodiversity- IUCN, Threatened species, Red data book, MAB.
5.3 Invasion: Causes and Effects
5.4Biodiversity Hotspots- Concepts, distribution and Importance; Indian efforts for conservation of Biodiversity.
5.5 Hotspot-with special reference to India.

Suggested Readings:

1. M. Dayal. (6th Ed). 1997. Renewable Energy: Environment and Development. Konark Pub.Pvt. Ltd.
2. S. Vandana. 2002. Alternative Energy. APH Publishing Corporation.
3. S. K. Agarwal. 2003. Nuclear Energy: Principles Practice and Prospects. APH Publishing Corporation.
4. P. Chaturvedi. 1995. Bio-Energy Resources. Concept Publications.
5. V S. Mahajan. 1991. National Energy: policy, crisis and growth. Ashish Publishing House.
6. Ramade F Ecology of Natural Resources, John wiely& Sons, New York.
7. Desai A V ed 2001, Non Conventional Energy new Age International (P) Ltd UN University , Tokyo

Core Practical

(Credits: Theory-04, Tutorial :01)

EDMC/P-104	Practical Based on Core Course EDMC-101,EDMC-102 & EDMC-103	Theory:60 Hours

Sl no	Practical	Distribution of Marks
1	Calculations of Biodiversity	20
2	Introduction Species diversity methods	10
3	Biodiversity Calculations : Shannon Index	10
4	Statistical Analysis/ Productivity Calculations/ Project Report	10
5	Practical Record	10
6	Viva Voce	10
	Total	**70**

1) Introduction Species Diversity Calculations: a) Belt method, b) Transect method, c) Quadrat Method
2) Calculations of Density, Frequency, Abundance, Relative Density, relative Frequency & Relative abundance, Important Value Index

3) Biodiversity Calculations: (a) Shannon Indices. (b) α, β and γ diversity.

4) Measurement of Primary Productivity in Aquatic system-
   (a) Light and Dark Bottle method.
   (b) Diagonal Oxygen Curve method.

5) Statistical analysis of collected samples (Mean, Standard deviation , Correlation Regression Coefficient & t-test)

6) Project Report on visit to near biodiversity &Eco restoration sites.

7) Practical Record

8) Viva Voce

Semester II

Skill Development Course

(Credits: Theory-04, Tutorial :01)

EDMS-205	Environmental Pollution & Global Environment Change	Theory:60 Hours Tutorial : 15 Hours

Unit I

1.1 Air pollution: Types and sources, Effects of various gaseous pollutants

1.2 Classical & Photochemical smog, Acid Rain

1.3 Ozone layer depletion: Causes and consequences.

Unit II

2.1 Water Pollution: Types and sources; Effects of water pollution on plants, animals and human health; Thermal pollution.
2.2 Noise pollution: Types, sources and effects on human health

Unit III

3.1 Soil pollution: Types and sources,
3.2 Effects of pesticides, fertilizers and heavy metals on ecosystems,
3.3 Mechanisms of metal toxicity, metallophytes. ,
3.4 Radioactive pollution: Sources and hazards.

UNIT IV

4.1 Toxicology: Principles of toxicology, factors affecting toxicity, Chronic and acute toxicity;
4.2 Measurement of Toxicity: Effective concentration, LD50, LC 50, Probit Scale.
4.3 Uptake, bioaccumulation, bio-transformation, bio magnification, bioremediation.

Unit V

5.1 Climate Change- green house effects, their sources, implications on climate , oceans, agriculture, wildlife, and natural vegetation
5.2 Effects of increased CO_2 on plants
5.3 International efforts on climate change issues.
5.4 Carbon Sequestration and Carbon Foot Print.

Suggested Readings:

1. A. K. De. (3rd Ed).2008 Environmental Chemistry. New Age Publications India Ltd.
2. I. C. Shaw and J. Chadwick. 1997. Principles of Environmental Toxicology. Taylor&

Francis Ltd.
3. S.C. Santra. 2011. Environmental Science. New Central Book Agency.
4. Ira. S. Richards. 2008. Principles and Practices of Toxicology in Public Health. Jones andBarlett Publications.
5. Gupta P Toxicology Vol II & III, MeteropolitianBooK Co.
6. Bood A Toxicology, Swarup& sons, New Delhi.

Core Course

(Credits: Theory-04, Tutorial :01)

EDMC-206	Environmental Monitoring and Remote Sensing Technology	Theory:60 Hours Tutorial : 15 Hours

Unit I

1.1 Instrumental Techniques & Its applications: pH Meter, Conductivity meter, Spectrophotometry, Chromatography, Spectroscopy.
1.2 Methods of Collection & Analysis of Environmental Samples.

Unit II

2.1 Ambient Air Quality Standards(NAAQS)
2.2 Water quality analysis.
2.3Methods of collection of water samples and analyses of physico-chemical characteristics.

Unit III

3.1 Methods of collection of soil samples and analyses of physico-chemical characteristics.
3.2 Methods of extraction of soil meso fauna.
3.3 .Methods of measurement of soil organic matter.

Unit IV

4.1 Fundamentals of Remote sensing**:** Principles of remote sensing (Optical/Microwave),History of remote sensing.
4.2 Principles of Aerial photography.
4.3 Satellites, sensors, data generation.
4.4 Hyper spectral remote sensing.
4.5 Basics of GIS & GPS, Basics of cartography.
4.6 Applications of GIS surveying and mapping.

Unit V

5.1 Applications of remote sensing: Remote sensing based land use/land cover mapping, urban landscape mapping, industrial land use,
5.2 Remote sensing of vegetation-spectral characters of vegetation, landscape ecology, remote sensing of vegetation change, remote sensing for biodiversity applications,
5.3 Remote sensing for climate change studies, remote sensing of desert vegetation, remote sensing of surface water, biophysical characteristics,
5.4 Remote sensing for soil studies, remote sensing for flood mapping, flood damage assessment, drought assessment, desertification and water shed management.

Suggested Readings:

1. C. N. Sawyer, P. L. McCarty and G. F. Parkin. 2002. Chemistry for Environmental Engineering and Science. John Henry Press.
2. H. H. Rump. 2000. Laboratory Manual for the Examination of Water, Waste water and soil. Wiley-VCH.
3. R. K. Sapru. 1987. Environmental Management in India (Vol. I & II). Ashish Publishing House.
4. George Joseph, *Fundamentals of remote sensing*, Universities press (India) Pvt Ltd., Hyderabad, 2003
5.Jenson, J.R. *Introductory Digital Image Processing*: Prentice Hall Series, 1996.
6.Jensen, J.R., *Remote Sensing of the Environment – An Earth Resources Perspectiv*, Pearson Education, Inc. (Singapore) Pvt. Ltd., Indian edition, Delhi, 2000.
7.Lillesand, Thomas M. and Kiefer, Ralph, W., *Remote Sensing and Image Interpretation,* John Wiley and Sons, New York, 2000.
8.Michael N. Demers. *Fundamentals of Geographical Information Systems.*John Wiley & Sons, Inc. 2008. 20

Core Course

(Credits: Theory-04, Tutorial :01)

EDMC-207	Introduction to Disaster Management	Theory:60 Hours Tutorial : 15 Hours

Unit I

1.1 Disaster- Types of Disaster- Natural & anthropogenic.
1.2 Causes and phases of disaster, Rapid onset and slow onset disasters. Nature and responses to geo-hazards.
1.3 Thunderstorms, Cloud bursting; meteorology and hydrology; Lightening.
1.4 Changes in Coastal zone, coastal erosion, beach protection; Coastal erosion due to natural and man-made structures.

Unit II

2.1 Floods and Cyclones: causes of flooding, Hazards associated with flooding.
2.2 Flood forecasting. Flood management, Integrated Flood Management and Information System (IFMIS), Flood control.
2.3 Water related hazards- Structure and nature of tropical cyclone,
2.4 Tsunamis – causes and physical characteristics.

Unit III

3.1 Earthquakes**:** Causes and characteristics of ground-motion, earthquake scales, magnitude and intensity, earthquake hazards and risks,
3.2 Volcanic land forms, eruptions, Landslides, rock-falls, avalanches,
3.3 Anthropogenic disaster & Its Management: Industrial disaster, Mining disasters, High rise buildings.

Unit IV

4.1 Epidemic diseases- Cholera, Diarrehoea, Jaundice, Dengue; Pandemic diseases- SARS, Ebola Virus, COVID-19 virus
4.2 Circumstances in Developing, Developed and Under Developed countries.
4.3 Importance of Health Infrastructure related to – age, sex, geographical locations etc.
4.4 Steps taken by Indian Government to mitigate the epidemics.

Unit V

5.1 Mitigation efforts: UN draft resolution on Strengthening of Coordination of Humanitarian Emergency Assistance,
5.2 International Decade for Natural Disaster Reduction (IDNDR).
5.3 Policy for disaster reduction- Including COVID -19 pandemic.
5.4 Problems of financing and insurance.
5.5 Training for emergency. Regulation/guidelines for disaster tolerance building structures.

Reference Books:

Bolt, B.A. *Earthquakes* , W. H. Freeman and Company, New York. 1988
Carter, N,W. *Disaster Management: A Disaster Manager's Hand Book*, Asian Development Bank, Manila. 1992
GautamAshutosh.*Earthquake: A Natural Disaster*, Ashok Publishing House, New Delhi. 1994
Sahni, P.andMalagola M. (Eds.).*Disaster Risk Reduction in South Asia*, Prentice-Hall of India, New Delhi. 2003.
Sharma, V.K. (Ed.). *Disaster Management*, IIPA, New Delhi. 1995.
Singh T. *Disaster management Approaches and Strategies*, Akansha Publishing House, New Delhi. 2006
Sinha, D. K. *Towards Basics of Natural Disaster Reduction*, Research Book Centre, New Delhi. 2006
Smith, K. *Environmental Health, Assessing Risk and Reduction Disaster*, 3rd Edition, Routledge, London. 2001 21

Core Practical

(Credits: Theory-04, Tutorial :01)

EDMC/P-208	Practical Based on Core Course EDMC-205,EDMC-206 & EDMC-207	Theory:60 Hours

Sl no	Practical	Distribution of Marks
1	Water Quality Monitoring	20
2	Introduction to environmental Instruments	10
3	Air Quality monitoring demonstration/ working principles	10
4	Noise Pollution Analysis/ Soil Quality Analysis	10
5	Practical Record	10
6	Viva Voce	10
	Total	**70**

1. Working Principles of different environmental monitoring Instruments-pH meter, Conductivity meter, Spectrophotometer, Bod Incubator, High Volume Sampler, Respirable Dust Sampler, Centrifuge, Noise Level meter

2. Water Quality monitoring: Determination of water parameters: pH, Dissolved Oxygen, Total Solids, Total Suspended Solids, Total Dissolved Solids, BOD & COD, TOC,Chloride Content.

3. Air Quality Monitoring as per NAAQS: Determination of PM 2.5 & PM 10, estimation of SO_x, NO_x, & CO, Ozone estimation

4. Noise Pollution: noise level in Residential, Silent, Commercial, Industrial Areas

5. Soil Quality analysis- Determination of pH, Electrical Conductivity, Moisture content, Water holding capacity

6. Project Work

7. Viva Voce

Semester III

Open Elective/ Core Course

(Credits: Theory-04, Tutorial :01)

EDMA09/ EDMC-309	**Risk Assessment & Vulnerability Analysis, Disaster preparedness Response**	**Theory:60 Hours Tutorial : 15 Hours**

Unit I

1.1 Meaning, observation, perception, and identification of risk and vulnerability factors associated with disasters.
1.2 Various preventive strategies, Hazard, Risk and Vulnerability.
1.3 Understanding Risk: Concept and Elements, Risk Reduction, Risk Analysis Techniques, and Risk Assessment.
1.4 Vulnerability analysis :Observation and Perception of Vulnerability, Vulnerability Identification, Vulnerability to Shanty Settlements, The Experience of Vulnerability-I, The Experience of Vulnerability-II, Strategies for Survival.
1.5 Vulnerability and Development: The Role of Development, Resource Analyses and Mobilization, Strategic Developments for Vulnerability Reduction.

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Unit II

2.1 Disaster preparedness plan, use and application of emerging technologies.
2.2 Role and responsibilities of various agencies and mitigation strategies.
2.3 Disaster Management: Prevention, Preparedness, and Mitigation.
2.4 Risk assessment and preparedness during pandemic and epidemic diseases like COVID-19.

Unit III

3.1 Disaster Preparedness for People with Special Needs/Vulnerable Groups.
3.2 Disaster Preparedness with Relevance to Housing, Infrastructure and Livestock.
3.3 Community Based Disaster Preparedness Plan.
3.4 Role of Information, Education, Communication, and Training.

Unit IV

4.1 Disaster Preparedness: Role and Responsibilities of Central, State, District, and Local Administration.
4.2 Disaster Preparedness: Role and Responsibilities of Armed Forces, Police, Para-military Forces, National Service Scheme and Scouts.
4.3 Disaster Preparedness: Role and Responsibilities of International Agencies, Non-governmental Organisations.

Unit V

5.1 Community Based Organisations, Community, and Media, Information Technology
5.2 Role in Disaster Preparedness with Special Reference to Geographical Information System.
5.3 Use and Application of Emerging Technologies in Disaster Preparedness Mitigation I & Mitigation II.

Suggested Books

Bolt, B.A. *Earthquakes* , W. H. Freeman and Company, New York. 1988
Carter, N,W. *Disaster Management: A Disaster Manager's Hand Book*, Asian Development Bank, Manila. 1992

GautamAshutosh.*Earthquake: A Natural Disaster*, Ashok Publishing House, New Delhi. 1994

Sahni, P.andMalagola M. (Eds.).*Disaster Risk Reduction in South Asia*, Prentice-Hall of India, New Delhi. 2003.
Sharma, V.K. (Ed.). *Disaster Management*, IIPA, New Delhi. 1995.

Core Course

(Credits: Theory-04, Tutorial :01)

EDMC310	**EDMC-310- Environmental Biotechnology and Water Resource Conservation & Management**	**Theory:60 Hours Tutorial : 15 Hours**

EDMC 310: Environmental Biotechnology and water resource Conservation and Management

Unit I

1.1 Concept of Bio Remediation.
1.2 Types of Bioremediation; applications.
1.3 Role of plants and microbes in In-situand Ex-situbioremediation of contaminated ecosystems;
1.4 Some case Studies.

Unit II

2.1 Use of GEMs in bioremediation, Release of GEMs in environment.
2.2 Airborne microbes,
2.3 Suicide genes.,Geno sensor technology.
2.4 Micro-electromechanical systems (MEMS); Gene probes; Nah Operon.

Unit III

3.1Biotechnology for Management of Resources**:** Bio-transformation of heavy metals; Oil field microbiology; improved oil recovery;
3.2Role of environmental biotechnology in management of resources.
3.3Reclamation of wasteland and wetlands; Biomass production; Biogas and biofuel production, Microorganisms in mineral and energy recovery.
3.4 Biomass production.
3.5Nanotechnology for control of pollution.

Unit IV

4.1 Diversity of aquatic habitats; hydrological cycle, Aquatic food webs including microbial loop; trophic cascade.
4.2 Lakes - Origin and classification, ecological zonation, thermal stratification, water circulation, physical and chemical characteristics
4.3 Plankton – diversity and models of nutrient-limited growth, paradox of plankton; a general account of zooplankton and phytoplankton.
4.3 A general account of benthic and periphytic communities.
4.4 Characteristics of running water habitats; River Continuum Concept.
4.6 Oceans: Chemistry of seawater, circulation and ecological zonation in sea, marine biota, coral reefs, General account of estuaries and wetlands.

Unit V

5.1 Concept of Eutrophication: Causes, consequences and control measures.
5.2 Natural Eutrophication.
5.3 Cultural Eutrophication.
5.4 Eutrophication; A case study.

Reference Books

Evano, G.H. and Furlong, J.C. *Environmental Biotechnology – Theory and Application.*John Wiley and Sons, USA. 2004.

Jjemba, P.K. *Environmental Microbiology – Theory and Application.* Science Pub. Inc., USA. 2004.

Olguin, C. J., Sanchez, G., Hernandez. E. *Environmental Biotechnology and Cleaner Bioprocesses.*Taylor & Francis.2000.

Pepper, I.L. and Gerba, C.P. *Environmental Microbiology - Laboratory Manaul*. Elsevier, USA. 2005.

Ratledge, C. and Kristiansen, B. *Basic Biotechnology*. 2nd ed. Cambridge University Press, Cambridge, UK. 2002.

Rittman, B. and McCarty, P. L. *Environmental Biotechnology*: *Principles and Applications*.2nd edition. Tata McGraw-Hill, USA. 2000.

Rittmann, B.E. and McCarty, P.L. *Environmental Biotechnology – Theory and Application.*McGraw Hill, USA. 2001.

Silver C. S. and DeFries, R. S. *One Earth one Future: - Our Changing Global Environment*.East-West Press Edition, 1991.

Singh, J.S., Singh, S.P. and Gupta, S.R. *Ecology, Environment and Resource Conservation*.Anamaya Publishers, New Delhi, India. 2006.

Speth, J. C. *Global Environmental Challenges – Transitions to a Sustainable World*.

Dobson, M. and Frid, C. 1998.Ecology of Aquatic Systems.Longman.

Adams, S.M. (Ed). 2002. Biological Indicators of Aquatic Ecosystem Stress. American Fisheries Society, Bethesda.

. Talling, J.F. and Lemoalle, J. 1998. Ecological Dynamics of Topical Inland Waters. Cambridge University Press.

Wetzel, R.G. and Likens, G.E. 2000. Limnological Analysis.Springer-Verlag.

Wetzel, R.G. 2000. Limnology: Lake and River Ecosystems. Academic Press
.
.Dodson, S. 2005. Introduction to Limnology. McGraw-Hill, New York.

A.J. Schleiss and R.M. Boes. 2011. Dams and Reservoirs under Changing Challenges.CRC Press.

J.N. Parkinson, J.A. Goldenfum and C.E.M. Tucci. 2010. Integrated Urban Water Management.CRC Press.

A.N. Findikakis and K Saro. 2011. Groundwater Management Practices. CRC Press.

Core Course

(Credits: Theory-04, Tutorial :01)

EDMC-311	EDMC-311 : Waste & Its management	Theory:60 Hours Tutorial : 15 Hours

Unit I

1.1 Solid Wastes **:**Introduction & resources
1.2 Types of wastes – Municipal and industrial wastes, Domestic waste, Hazardous waste and Radioactive wastes, e-wastes, Agricultural waste.

Unit II
2.1 Solid waste characterization: ultimate and proximate analysis;
2.2 Integrated Solid waste Management; Waste reduction at source, volume reduction,
2.3 Collection techniques/Methods and Transport of solid waste.

Unit III

3.1 Recycling, treatment and disposal techniques.
3.2 Landfill -landfilling methods and operation. Leachate and Landfill gas, Leachate management.
3.3 Composting, vermi-composting, biofertilizers.
3.4 Energy from Waste- Incineration, Pyrolysis, Gasification, Refuse derived fuels, Biogas.

Unit IV

4.1 Wastes from Industries- Petrochemical industries, Oil Refineries, textile, sugar, pulp and paper, cement, distilleries, dairy, food processing, mining.
4.2 Collection, segregation, transport, treatment and disposal of effluents.
4.3 Standards for disposal of treated effluents; Common Effluent Treatment Plants (CETP). Re-cycling and re-use of treated effluents-technologies; Concept of Zero discharge.
4.4 Properties of sewage and industrial effluents; effluent standards; treatment of industrial effluents, sewage treatment (primary, secondary and tertiary treatment).
4.5 Advanced treatments (nitrate and phosphate removal); Sludge treatment and disposal.
4.6 Waste water use.

Unit V

5.1 Biomedical Wastes and their Management**.**
5.2 Segregation and storage of biomedical wastes.
5.3 Transport of medical waste: Authorization and accidental spilling reporting.
5.4 Biomedical waste treatment and disposal methods: Incineration.

Reference Books
Acharya, D.B. and Singh, M. *Hospital Waste Management*. Minerva Press, Delhi. 2003.
Alleman, J. E. and Karanagh, J. T. *Industrial Waste*.Ann Arbor Science.1982.
Bhatia, S.C. *Solid and Hazardous Waste Management*.Atlantic Publishers.2007.

Blackman, W.C. *Basic Hazardous Waste Management*. CRC Press, USA. 2001.
Evans, G. *Biowaste and Biological Waste Treatment.*James and James (Science Publishers) Ltd, U.K. 2005.
Hasan Syed E. Geology and Hazardous Waste Managemet, Prentice Hall, USA, 1996.
Kreith, F. *Handbook of Solid Waste Management*. McGraw Hill Publishers, USA. 22,1999
LaGrega M.D., Buckingham, P.L. and Evans J.C., Hazardous Waste Management, McGraw Hill International Publications, Singapore, 1994 – Revised Edition Available – ISBN 0-07-113454-9.
Moore, J. W. *The changing Environment*.Springer-Verlag. 1986.
Pichtel, J. *Waste Management Practices: Municipal, Hazardous, and Industrial*. CRC Press, USA. 2005.
Shah, K. L. *Basics of Solid and Hazardous Waste Management Technology*. McGraw Hill, USA. 1999.
Sloan, William M., (Ed). Site Selection for New Hazardous Waste Management Facilities, WHO Regional Publications, European Series 46, 1993.
Tchobanogloas, G. *Integrated Solid Waste Management: Engineering, Principle and Management.*McGraw Hill, USA. 1993.
Vesilind, P. A., Worrell, W. and Reinhart, D. *Solid Waste Engineering***.**Brooks/Cole Thomson Learning Inc., USA. 2002.
Williams, P.T. *Waste Treatment and Disposal*. John Wiley and Sons, USA. 2005

Core Practical

(Credits: Theory-04, Tutorial :01)

EDMC/P-312	Practical Based on Core Course EDMC-309, EDMC-310 and EDMC-311	Theory:60 Hours

Sl no	Practical	Distribution of Marks
1	Preparation of media and culture of Microbes	20
2	Estimation of nitrates, phosphates, free chlorine / chloride demand	10
3	Isolation / Gram staining of microbes	10
4	Plankton analysis	10
5	Practical Record	10
6	Viva Voce	10
	Total	**70**

EDMC/P- 310: Environmental Biotechnology & Water resource Conservation and management

1) Preparation of media for microbial culture.

2) Microbiological culture from air, water and counting of bacterial colonies by standard plate count (SPC) method.

3) Gram staining of isolated microbes.

4) Estimation of coliform bacteria from MPN method.

5) Estimation of Salinity, Free CO_2, Phosphate, Nitrate, Sulphate, Free Chrlorine Demand

6) Qualitative & quantitative analysis of planktons.

7) Membrane Filter Techniques

.

8) Project Report

9) Viva Voce

Semester IV

Discipline Centric Elective Theory Course

(5 Credits, 60 Lectures, 15 Tutorials)

EDME-413A	**Rehabilitation, Reconstruction and Recovery of Disaster Management**	**Theory:60 Hours Tutorial : 15 Hours**

Unit I

1.1 Reconstruction and Rehabilitation as a Means of Development.
1.2 Damage Assessment.
1.3 Role of Various Agencies in Disaster Management and Development.
1.4 Information Management Structure.
1.5 Parameters of Vulnerability

Unit II

2.1 Economic Infrastructure.
2.2 Creation of Long-term Job Opportunities and Livelihood Options.
2.3 Funding Arrangements for Reconstruction.

Unit III

3.1 Education and Awareness, the Philosophy of Coping with Disasters.
3.2 Dealing with Victims' Psychology.
3.3 Role of Information Dissemination.

Unit IV

4.1 Nature of Damage to Houses and Infrastructure due to Disasters, DisasterResistant House Construction, Role of Housing/Building Authorities.
4.2 Participative Rehabilitation Process: Some Case Studies; Role of Various Agencies in Recovery Measures.

Unit V

5.1 Rehabilitation Work, Constraints in Monitoring and Evaluation, Long-term Recovery.

5.2 Long-term Counter Disaster Planning.

Suggested Books:

Bolt, B.A. *Earthquakes* , W. H. Freeman and Company, New York. 1988
Carter, N,W. *Disaster Management: A Disaster Manager's Hand Book*, Asian Development Bank, Manila. 1992
GautamAshutosh.*Earthquake: A Natural Disaster*, Ashok Publishing House, New Delhi. 1994

Sahni, P.andMalagola M. (Eds.).*Disaster Risk Reduction in South Asia*, Prentice-Hall of India, New Delhi. 2003.

Sharma, V.K. (Ed.). *Disaster Management*, IIPA, New Delhi. 1995.
Singh T. *Disaster management Approaches and Strategies*, Akansha Publishing House, New Delhi. 2006

Sinha, D. K. *Towards Basics of Natural Disaster Reduction*, Research Book Centre, New Delhi. 2006

Smith, K. *Environmental Health, Assessing Risk and Reduction Disaster*, 3rd Edition, Routledge, London. 2001 21

Discipline Centric Elective Theory Course

(5 Credits, 60 Lectures, 15 Tutorials)

EDME-413B	**Disaster Medicine**	**Theory:60 Hours** **Tutorial : 15 Hours**

Unit I

1.1 Understanding Disaster Medicine
1.2 Epidemiological Study of Disasters
1.3 Prevention of Risk

Unit II

2.1 Medical Preparedness Plan
2.2 Logistics Management
2.3 Remote Area Planning

Unit III

3.1 Education and Training in Health Management of Disasters
3.2 Disaster Site Management
3.3 Clinical Causality Management

Unit IV

4.1 Community Health Management
4.2 Medical and Health Response to different Disasters
4.3 Role of Information and Communication Technology in Health Response

Unit V

5.1 Psychological Rehabilitation
5.2 Case Studies of Medical and Health Interventions in Disaster Management

Suggested Books:

Bolt, B.A. *Earthquakes* , W. H. Freeman and Company, New York. 1988
Carter, N,W. *Disaster Management: A Disaster Manager's Hand Book*, Asian Development Bank, Manila. 1992
GautamAshutosh.*Earthquake: A Natural Disaster*, Ashok Publishing House, New Delhi. 1994

Sahni, P.andMalagola M. (Eds.).*Disaster Risk Reduction in South Asia*, Prentice-Hall of India, New Delhi. 2003.

Sharma, V.K. (Ed.). *Disaster Management*, IIPA, New Delhi. 1995.
Singh T. *Disaster management Approaches and Strategies*, Akansha Publishing House, New Delhi. 2006

Sinha, D. K. *Towards Basics of Natural Disaster Reduction*, Research Book Centre, New Delhi. 2006

Smith, K. *Environmental Health, Assessing Risk and Reduction Disaster*, 3rd Edition, Routledge, London. 2001 21

Discipline Centric Elective Theory Course

(5 Credits, 60 Lectures, 15 Tutorials)

EDME-413C	**Towards Participatory Management**	**Theory:60 Hours**

		Tutorial : 15 Hours

Unit I

1.1 Towards Participatory Management: A New paradigm
1.2 Participatory Development
1.3 Participatory Rural Appraisal or Participatory Reflection and Action
1.4 Different Models of Participatory Approach in South Asia

Unit II

2.1 Model for Urban Development " Orangi Pilot Project"
2.2 Rural Poverty Unperceived
2.3 Integrated Rural Poverty Alleviation

Unit III

3.1 Women's Participation in Community Decision Making
3.2 Practical Action
3.3 Youth Participation in Development

Unit IV

4.1 Organisational Change for Sustainable Development
4.2 Participatory Forest Resource Management
4.3 Participatory Management towards Mountain Ecosystems

Unit V

5.1 Participatory Coastal Management
5.2 Participatory Management of Solid waste
5.3 South Asian Cooperative Environment Programme

Suggested Books:

Bolt, B.A. *Earthquakes* , W. H. Freeman and Company, New York. 1988
Carter, N,W. *Disaster Management: A Disaster Manager's Hand Book*, Asian Development Bank, Manila. 1992

GautamAshutosh.*Earthquake: A Natural Disaster*, Ashok Publishing House, New Delhi. 1994

Sahni, P.andMalagola M. (Eds.).*Disaster Risk Reduction in South Asia*, Prentice-Hall of India, New Delhi. 2003.

Sharma, V.K. (Ed.). *Disaster Management*, IIPA, New Delhi. 1995.
Singh T. *Disaster management Approaches and Strategies*, Akansha Publishing House, New Delhi. 2006

Sinha, D. K. *Towards Basics of Natural Disaster Reduction*, Research Book Centre, New Delhi. 2006

Smith, K. *Environmental Health, Assessing Risk and Reduction Disaster*, 3rd Edition, Routledge, London. 2001 21

Discipline Centric Elective Theory Course

(5 Credits, 60 Lectures, 15 Tutorials)

EDME-414A	**Environmental Education & Environmental Economics**	**Theory:60 Hours** **Tutorial : 15 Hours**

Unit I

1.1 Environmental Education, Global &Indian Scenario.
1.2 History & Future Aspects, Agenda 21.
1.3 Earth Summit,
1.4 Kyoto Protocol, Montreal protocol, Vienna Convention.

Unit II

2.1 Governmental agencies: Environmental Protection Agencies (EPA).
2.2 Ministry of Environment, Forest & Climate Change.
2.3 Indian Board Of Wild Life.
2.4 National wasteland Development Board.

Unit III

3.1 National Wetland Conservation Programme.
3.2 Coastal Area Regulation (CRZ).
3.3 Central Pollution Control Board.
3.4 World Health Organization
3.5 Environmental Economics: Introduction to Environmental Economics.
3.6 Values of Environment.

3.7 Ecology Vs Economy.
3.8 Cost Benefit Analysis.

Unit IV

4.1 Non-Governmental Agencies: World Wildlife Fund (WWF), IUCN, IES.
4.2 Different Rural and Urban Programme.
4.3 Case Studies: SardarSarovar Dam Project, Narmada Dam Project, Silent Valley Project, Chipkoandollan,, Tehri Dam project.

Unit V

5.1 Clean Technology: Imperatives of clean technology in the context of mitigation and adaptation measures.
5.2 CDM concept, CDM scenario in India, CDM projects sector-wise.
5.3 National Action Plan on Climate Change, sustainable habitat, concept of Green architecture.
5.4 Carbon trading; Carbon credits; Carbon sequestration; Carbon Footprint.
5.5 Issues of Energy security, Food Security and Social security.

Suggested Readings:

1) Edgar G. et al, 2008, Environmental education, Sense Publishers
2) J.M. Haris,2017, Environmental & natural Resource Economics: A Contemporary approach, 4th Edition, Routledge Publishers.

Discipline Centric Elective Theory Course

(5 Credits, 60 Lectures, 15 Tutorials)

EDME-414B	**Environmental Statistical Analysis & Research Methods**	**Theory:60 Hours Tutorial : 15 Hours**

Unit I

1.1 Sampling
1.2 Data Collection & Recording
1.3 Central Tendency- Concept; Arithmetic Mean, median, Mode of grouped & ungrouped data

Unit II

2.1 Measures of Dispersion: Absolute and relative Measures
2.2 Range, Standard Deviation (grouped and ungrouped data), Variance.
2.3 Probability: Normal, Poisson, Binomial

Unit III

3.1 Statistical Methods: Hypothesis Testing, Significance and correlation.
3.2 Linear models and Regression, Pearson and other correlation coefficients, Multiple Regression
3.3 Distribution: Normal, t-test, and chi square test.

Unit IV

4.1 Difference among means: F-test: 1way ANNOVA; F-test- 2 way ANNOVA
4.2 Computer applications in environmental modelling, Computer based modelling for population

Unit V

5.1 Matrices , Simultaneous linear equations,
5.2 test of hypothesis & Significance

Suggested Reading

Zar, Jerrold H (1998). Biostatistical Analysis, Prentice Hall, N.J

Sokal, Robert and James Rohlf (1997). Biometry, Freeman Press, N.J

Walpole R and R Myers (1993). Statistics for Engineers and Scientists, 5th Edition, Macmillian, N.J

Wayne R Ott (1995) Environmental Statistics and Data Analysis, CRC Press

Manly (2001) Statistics for Environmental Science and Management, Chapman and Hall/CRC press

Ramsay and Schafer (1997) The Statistical Sleuth, Duxbury Press

Discipline Centric Elective Theory Course

(5 Credits, 60 Lectures, 15 Tutorials)

EDME-414C	**Environmental Impact and Risk Assessment**	**Theory:60 Hours Tutorial : 15 Hours**

Unit I

1.1 Environmental Impact Assessment (EIA): Definitions, Introductions and Concepts.
1.2 Rationale and Historical Development of EIA.
1.3 Scope and methodologies of EIA.
1.4 Role of project Proponents, Project Developers and consultants.

Unit II

2.1 Terms of Reference, Impact Identification and Prediction.
2.2 Baseline data collection, Environmental Impact Statement, Environment Management Plan
2.3 EIA Regulations in India, Status of EIA in India, current issues in EIA, case study of Hydropower projects/ Thermal power projects

Unit III

3.1 Rapid EIA, Strategic Environmental Assessment, Social Impact Assessment, life cycle assessment.
3.2 Environmental Appraisal, Environmental Management, Environmental Audit.
3.3 Environmental Planning, Introduction to ISO and ISO14000

Unit IV

4.1 Risk Assessment: Introduction and scope.
4.2 Project planning, Exposure Assessment, Toxicity Assessment, Hazard identification and Assessment.
4.3 Risk Characterization and risk communication.

Unit V

5.1 Environmental monitoring
5.2 Community Involvement
5.3 Legal and Regulatory framework
5.4 Human and Ecological Risk Assessment

Suggested Books

Barrow, C.J 2000, Social Impact Assessment, Oxford University Press

Glasson J Therivel , R Chadwick A. 1994 ,Introduction to Environmental Impact Assessment, London Research Press, UK

Judith P. 1999, Handbook for environmental Impact Assessment, Blackwell Science

Marriot B, 1997 , Environmental Impact Assessment: A practical Guide, Mcgraw-Hill, New York, USA

Discipline Centric Elective Practical

(Credits: 05 Credits)

EDME/P-415A/ EDME/P-415B/ EDME/P-415C	**Discipline Centric Elective Practical EDME-413A: Rehabilitation, Reconstruction & Recovery of Disaster Management EDME-413B: Disaster Medicine EDME-413C: Towards Participatory**	**(5 Credits, 75 Lectures)**

	Management & EDME-414A: Environmental Education & Environmental Economics EDME-414B: Environmental Statistical Analysis & Research Methods EDME-414C: Environmental Impact & Risk Assessment	

Candidates have to choose any one of the practical, those who choose EDME-413A & EDME-414A, it is compulsory for them to choose EDME/P-415A. Similarly those who have choose EDME-413B & EDME-414B must have the practical EDME-415B, and those who choose EDME-413C &EDME-414C must have the practical EDME/P- 415C

EDME/P 415A	**Practical based on the courses EDME-413A & EDME -414A**	**(5 Credits, 75 Lectures)**

Sl no	Practical	Distribution of Marks
1	Preparation of digital map of disaster prone areas and report writing	20
2	Report on various preparatory models for rehabilitation	10
3	PowerPoint presentation/ report / chart on various resources in India	10
4	Report on interlining of rivers , its application and methods of rehabilitation	10
5	Practical Record	10
6	Viva Voce	10
	Total	**70**

1. Preparation of digital environmental zonation map for landslides in India.

2. Preparation for hazard zonation digital map for earthquakes.

3. Prepare a report on case studies of natural hazards in India e.g Tsunami, Himalayan Tsunami, Nepal-Bihar earthquakes, tropical cyclones.

4. Prepare a report on case studies of recent man made hazards in India e.g Bhopal gas Tragedy, Vishakhapatnam Gas Tragedy, fire in oil Refineries.

5. Prepare a report on various hazard Prediction models & preparatory plans.

6. Prepare a report on estimation of minerals from various sources.

7. Prepare a PowerPoint presentation / Report on visit to forest ecosystem using curated database.

8. Prepare a report on estimation of Non Renewable fuels and renewable fuels used in India by Various sources

9. Estimation of plant population by T-test and Z-test method.

10. Prepare a report on case studies of interlinking of Rivers & its applications.

11. Practical Record.

12. Viva Voice

EDME/P 415B	**Practical based on the courses EDME-413B & EDME -414B**	**(5 Credits, 75 Lectures)**

Sl no	**Practical**	**Distribution of Marks**
1	Calculations of mean, median mode with the bar graphs and histograms	20
2	Calculations of Standard deviation	10
3	Report on the types of medicines and practices used for local epidemics	10
4	PowerPoint presentation on disasters epidemics	10
5	Practical Record	10
6	Viva Voce	10
Total		**70**

1. Study of entry of data on Microsoft Excel Sheet.

2. Calculation of mean, median and mode from Microsoft Excel sheet.

3. Draw the different types of graphs, bar columns and pie charts by using given data in Microsoft Excel sheet.

4. Calculations of Standard Deviation by given data in Microsoft Excel Sheet.

5. Study and use of various computer applications/modes used in environmental practicals.

6. Prepare a report visit to the nearest civil hospital and find about the medicines used in a local epidemic.

7. Prepare a PowerPoint presentation on the list of epidemics and pandemic diseases throughout the world, the types of precautions, medicines and practices used.

8. Prepare a report on the medical practices used during war and its after effects.

9. Practical Record.

10. Viva Voice

EDME/P 415C	**Practical based on the courses EDME-413C & EDME -414C**	**(5 Credits, 75 Lectures)**

Sl no	**Practical**	**Distribution of Marks**
1	Report on EIA on river valley / mining projects	20
2	PowerPoint presentations on International agencies for recovery	10
3	Report/ chart explanation on case studies of different companies & EIA	10
4	Report/ PowerPoint presentation on Role of Women/ Indian relationships with its neighbouring countries	10
5	Practical Record	10
6	Viva Voce	10
	Total	**70**

1. Prepare a report on case studies on impact assessment : River valley mining projects.

2. Prepare a PowerPoint presentation / Report on general principles of environmental audit.

3. Prepare a report on case studies on effective utilization of environmental laws in oil refineries, petro chemical Industries.

4. Draw digital mapping of green belt zones in India.

5. Prepare a report on various mega building projects and its impact assessment.

6. Prepare a report on the achievements of Women's during the Rehabilitation and recovery.

7. Prepare a PowerPoint presentation on relationship of India with its neighbouring countries during disaster and Recovery phases.

8. Prepare a report on WHO and UNICEF for its international efforts for mitigating a disaster, special reference with Africa and South American Countries.

9. Practical Record.

10. Viva Voice

Dissertation & Project

(5 Credits, 75 Lectures)

EDMD-416 A, B &C.	**Dissertation /Project**	5 credit

Sl no	Practical	Marks Distribution
1	Project	50
2	PowerPoint presentation	10
3	Viva Voce	10
	Total	70

A dissertation project of minimum one month is to be carried out by the students in Reputed Institutes/ Laboratories/ Industries/ NGOs/University. A project Report along with a power point presentation is to be given in the exam.

Overall project dissertation may be evaluated under the following heads:

- Motivation for the choice of topic
- Project dissertation design
- Methodology and Content depth

• Results and Discussion

• Future Scope & References

• Participation in Internship programme with reputed organization

• Application of Research technique in Data collection

• Report Presentation

• Presentation style

• Viva-voce

Note:

(a) Each student must submit two copies of the dissertation work duly forwarded by the Head of the Department and duly signed by the supervisor concerned. The forwarded copies will be submitted to the concerned Department of University, for evaluation. The paper will consist of

• Field work/Lab work related to the project

• Preparation of dissertation based on the work undertaken.

• Presentation of project works in the seminar on the assigned topic & open viva there on.

(b) Each student shall have to complete a project work on a topic allotted by his/her Project Guide/Supervisor/Department in Semester -IV. This is compulsory and the candidates shall ensure that his project is on a relevant topic completed by him independently with the help and inputs from his/her guide/supervisor. Other guidelines pertaining to this paper shall be provided by the Department.

(c) Student alone or in a group of not more than five, shall undertake one Project approved by the Subject Teacher/H.O.D. of the Department/College concerned. The progress of the Project shall be monitored by the faculty members at regular intervals.

(d) Students will select topics for the project work in consultation with a teacher of the Department. The Seminar will be held in the concerned Department of University.

The Dissertation/Project shall be presented with the following specifications:

(a) Size of Paper: A4. Dissertation/Project must be printed on one side of the paper.

(b) Font Type: Times New Roman.

(c) Font Size: Font size for English text is 12pt. in standard form

(d) Font of Chapter Headings and Sub-Headings:

• Chapter headings may be written in all Capitals, bold text infont size 15

• Sub-headings are written with left margin alignment

• First level sub-headings are written in normal sentence case using bold text in point size 14

• Second level sub-headings are point size 13

(e) Spacing and Paragraphing:

• Printing shall be in standardised form with 1.5 line spacing

• Leave as triple spacing (2 empty lines) in basefont size 12 before and after subheadings and one empty line after all sub-headings

• Use one empty line between left-justified paragraphs

(f) Margin: Left margin should be 4cms and right and top margin should be 2cms. Bottom margins should be 2.5cms. No ornamental bordering of sides is permitted.

(g) Page Numbering: Preliminary pages of the Dissertation/Project, i.e. those preceding in text are to be numbered in Roman numbered. Text should be numbered in Arabic beginning with Pg No 1 on the first page of chapter 1

. (h) Preliminary sections of the Dissertation/Project should include, Declaration of Attendance, Certificate from Supervisor, Declaration by Candidate and Supervisor regarding Plagiarism, Acknowledgement, Table of Contents, List of Tables, List of Figures/Diagrams, List of Abbreviations (if any) and an Abstract of the Dissertation/Project.

(i) **Referencing and Citation Style**: Citation i.e. a way of giving credit to individuals for their creative and intellectual works that you utilised to support your research, differs by faculty in the style of ordering, punctuating and formatting of name, date, page, work etc. The referencing of work and Citation style in the Dissertation/Project submitted in Faculty of Science (Environmental Science & Disaster Management) will be in **American PsychologicalAssociation (APA)** style (6th edition).