MADHYANCHAL
PROFESSIONAL UNIVERSITY

Draft Rules & Syllabus
for the

Master of Science in Environmental Science

(M. Sc. EVS) Course

MADHYANCHAL PROFESSIONAL UNIVERSITY

DEPARTMENT OF SCIENCE

Scheme for M.Sc. CBCS Course

Semester I

S.No.	Subject Code	Subject Name & Title	Maximum Marks Allotted								Hours per week			Total Credits	Remarks
			Theory				Practical								
			End Sem	Mid Sem. MST	Quiz, Assignment	Total Marks	Lab Work	Assignment /Quiz/Term paper	End Sem	Total Marks	L	T	P		
1	M. Sc 101	Foundation Course in Ecology	60	20	20	100	-	-	-	-	3	1		4	One credit refers to one hour teaching in theory, Tutorial
2	M. Sc 102	Earth and its Atmosphere	60	20	20	100	-	-	-	-	3	1		4	
3	M. Sc 103	Aquatic Environment	60	20	20	100	-	-	-	-	3	1		4	
4	M. Sc 104	Environmental Microbiology and Biotechnology	60	20	20	100	-	-	-	-	3	1		4	
5	M. Sc 105	Global Environmental Change	60	20	20	100	-	-	-	-	3	1		4	
6	M. Sc 101 P	Lab work based on courses 101 and 102					40	20	40	100			4	2	
7	M. Sc 102 P	Lab work based on courses 103 and 104					40	20	40	100			4	2	
	Total		300	100	100	500	80	40	80	200	15	5	8	24	700

Semester II

S.No.	Subject Code	Subject Name & Title	Maximum Marks Allotted								Hours per week			Total Credits	Remarks
			Theory				Practical								
			End Sem	Mid Sem. MST	Quiz, Assignment	Total Marks	Lab Work	Assignment /Quiz/Term paper	End Sem	Total Marks	L	T	P		One credit refers to one hour teaching in theory, Tutorial
1	M. Sc 201	Biodiversity and Conservation	60	20	20	100	-	-	-	-	3	1		4	
2	M. Sc 202	Energy Resources and Conservation	60	20	20	100	-	-	-	-	3	1		4	
3	M. Sc 203	Environmental Pollution and Toxicology	60	20	20	100	-	-	-	-	3	1		4	
4	M. Sc 204	Environmental Monitoring and Management	60	20	20	100	-	-	-	-	3	1		4	
7	M. Sc 205	Natural Resources and Management - Minor Elective	60	20	20	100	-	-	-	-	3	1		4	
5	M. Sc 201 P	Lab work based on courses 201 and 202					40	20	40	100			4	2	
6	M. Sc 202 P	Lab work based on courses 203 and 204					40	20	40	100			4	2	
	Total		300	100	100	500	80	40	80	200	15	5	8	24	700

Chapter II Syllabus

101: Foundation Course in Ecology

- Organisms and Environment: Holocoenotic nature of environment; abiotic and biotic environment.
- Ecological adaptations: Morphological and physiological responses of organisms to temperature and water.
- Population ecology: Population characteristics, population growth, carrying capacity, population regulation, life history strategies (*r* and K selection), population interactions including Lotka – Volterra model, population differentiation.
- Community ecology: Concepts of community and continuum; community attributes; species diversity (α, β and γ); community coefficients; concept of ecological niche.
- Community development: Models and mechanisms of ecological succession; changes in ecosystem properties during succession; Concept of climax.
- Ecosystem organization: Ecosystem structure and functions, primary production (methods of measurement, global pattern, controlling factors); energy dynamics (trophic organization, energy flow pathways, ecological efficiencies); litter fall and decomposition; mineral cycles in terrestrial and aquatic ecosystems
- Ecosystem management: Concepts; sustainable development; sustainability indicators.

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.

102: Earth and its Atmosphere

- Weathering and erosion processes; Types and formation of soils and soil profile. Earthquakes, Volcanoes, Landslides and Floods: and their impact on environment.
- Major rock and ore forming minerals: Properties of minerals; Igneous, sedimentary and metamorphic rocks. Impact of mining on environment.
- Groundwater: Occurrence; Salt water intrusion; Pollution and management.
- Evolution of the earth's atmosphere, composition and thermal stratification, atmosphere and the earth's radiation balance, circulation of atmosphere, atmospheric stability, lapse rates and mixing heights, plume behavior; Gaussian plume model;

Photochemistry of nitrogen oxides, oxygen, ozone and chlorides in the atmosphere.

- Köppen's climate classification system; General relationship between landscape, biomes and climate.

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.

103: Aquatic Environment

- Diversity of aquatic habitats; hydrologic cycle
- Aquatic food webs including microbial loop; trophic cascade Measurement of aquatic primary productivity
- Lakes - Origin and classification, ecological zonation, thermal stratification, water circulation, physical and chemical characteristics
- Phytoplankton – diversity and models of nutrient-limited growth, paradox of plankton; a general account of zooplankton
- A general account of benthic and periphytic communities Characteristics of running water habitats; river continuum concept
- Oceans: Chemistry of seawater, circulation and ecological zonation in sea, marine biota, coral reefs
- A general account of estuaries and wetlands Eutrophication: Causes, consequences and control measures

Suggested Readings:

1. Dobson, M. and Frid, C. 1998. Ecology of Aquatic Systems. Longman.
2. Adams, S.M. (Ed). 2002. Biological Indicators of Aquatic Ecosystem Stress. American Fisheries Society, Bethesda.
3. Talling, J.F. and Lemoalle, J. 1998. Ecological Dynamics of Topical Inland Waters. Cambridge University Press.
4. Wetzel, R.G. and Likens, G.E. 2000. Limnological Analysis. Springer-Verlag.
5. Wetzel, R.G. 2000. Limnology: Lake and River Ecosystems. Academic Press.
6. Dodson, S. 2005. Introduction to Limnology. McGraw-Hill, New York.

104: Environmental Microbiology and Biotechnology

- Introduction to microorganisms: General characteristics, nutritional types, microbial diversity.
- A brief idea of techniques relating to isolation, purification and culture of microorganisms.
- Types of interaction between plants and microbes. Microorganisms and soil fertility.
- Microorganisms in extreme environments. Microbial toxins and environmental hazards.
- Brief account of plant diseases and their ecosystem level effects.
- Microbes and public health: Brief account of microbial diseases in humans. Microbially induced corrosions and biofilms.
- Bioremediation of organic and inorganic contaminants.
- Brief account of restriction enzymes, cloning vectors, DNA ligases, linkers, blotting techniques and gene libraries.
- Strategies of recombinant DNA technology and its applications.
- Release of genetically engineered microorganisms: safety and environmental risks. Vermicular and bio-fertilizer technology.

Suggested Readings:

1. Raina M. Maier. 2000. Environmental Microbiology. Academic Press.
2. Pepper, I. and C. P. Gerba. 2004. Environmental Microbiology (2nd Edition). Academic Press.

Global Environmental Change

- Global Environmental change issues.
- Stratospheric ozone layer: Evolution of ozone layer; Causes of depletion and consequences; Effects of enhanced UV-B on plants, microbes, animals, human health and materials; Biological action spectra; Global efforts for mitigation ozone layer depletion.
- Climate change: Greenhouse effects; Drivers of climate change; Greenhouse gases and their sources; Implications on climate, oceans, agriculture, natural vegetation, wildlife and humans; Effects of increased CO2 on plants; International efforts on climate change issues.
- Atmospheric deposition: Past and present scenario; Causes and consequences of excessive atmospheric deposition of nutrients and trace elements; Eutrophication; Acid rain and its effect on plants, animals, microbes and ecosystems.

Suggested Readings:

1. N. Adger , K. Brown , D. Conway. (Vol. 22). 2012. Global Environmental Change: Understanding the Human Dimensions. The National Academic Press.
2. Karl K. Turekian. 1996. Global Environmental Change-Past, Present, and Future. Prentice-Hall.
3. Richard Anthony Matthew. 2009. Jon Barnett, Bryan McDonald. Global Environmental Change and Human Security . MIT Press., USA.
4. Hester, R.E. and Harrison, R.M. 2002. Global Environmental Change. Royal Society of Chemistry.

Lab work based on courses ESM – 101 and ESM – 102

Lab work based on courses ESM – 103 and ESM – 104

SEMESTER – II

Biodiversity and Conservation

- Introduction to biodiversity: species, genetic and ecosystem diversity.
- Biodiversity magnitude and distribution: diversity gradients and related hypotheses, biodiversity and ecosystem function, methods for biodiversity monitoring.
- Biodiversity and ecosystem services: provisioning, regulating, cultural and supporting.
- Threats to biodiversity: Natural and anthropogenic, species extinctions, IUCN threat categories, Red data book, Invasions: causes and impact.
- Biodiversity conservation, principles and strategies; *in-situ* and *ex-situ* conservation, Protected Area Network.
- Biodiversity Hot spots: concepts, distribution and importance.
- Use of biodiversity: Source of food, medicine, raw material, aesthetic and cultural. Biodiversity prospecting.

Suggested Readings:

1. Anne E. Magurran. 2003. Ecological diversity and its measurements. Blackwell Publications.
2. J.S.Singh, S.P. Singh and S.R. Gupta. 2008. Ecology, Environment and Resource Conservation. Anamaya Publications (New Delhi).
3. V.H. Heywood and Watson R.T. (Ed). 1995. Global Biodiversity Assessment: UNEP. Cambridge University Press.

Energy Resources and Conservation

- Introduction: Energy, work and power; Energy and people; Energy sources – Resource and reserves - an overview; an overview of the current global and National Energy Scenario.
- Fossil Fuels: Oil, coal, natural gas, shale, tar sands – Sources, exploration, exploitation; environmental consequences.
- Nuclear Energy: Nuclear fission and Fusion; Nuclear fuel cycle, Nuclear reactors (PWR, BWR, Gas Cooled Breeder) and nuclear power.
- Renewable and Alternative Energy Sources: Solar energy, solar power, photovoltaic cells; Wind power; Geothermal energy; Ocean energy; Fuel cells.
- Bio Energy: Biomass conversion processes; Biodiesel; Environmental consequences of biomass resource harnessing.

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

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.

Environmental Pollution and Toxicology

- Air pollution: Types and sources, Effects of SO_2, NO_2, O_3, HF, photochemical smog and particulates on plants and human health, aeroallergens and allergies.
- Ozone layer depletion: Causes and consequences.
- Noise pollution: Types, sources and effects on human health.
- Water Pollution: Types and sources; Effects on water quality, plants and human health; Thermal pollution.
- Soil pollution: Types and sources, Effects of pesticides and heavy metals on ecosystems, mechanisms of metal toxicity, metallophytes.
- Radioactive pollution: Sources and hazards. Solid waste: Sources and effects.
- Toxicology: Principles of toxicology, dose-response relationships, Chronic and acute toxicity; Effective concentration, LD_{50}, Median tolerance limit and Margin of safety; Toxicity testing (Holistic and Numeric approach).
- Uptake, bioaccumulation, bio-transformation and excretion of xenobiotics. Role of temperature and humidity in human health.

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 and Barlett Publications.

Environmental Monitoring and Management

- Ambient air monitoring; Methods of collection and analyses of gaseous and particulate pollutants.
- Methods of collection of water samples and analyses of physico-chemical characteristics. Methods of collection of soil samples and analyses of physico-chemical characteristics. Bio-monitoring and bio-indication.
- Principles of chromatography, spectrophotometry, electro-analytical and radio-analytical techniques.
- Environmental Management: Principles and strategies ; Indicators of environmental quality, economic valuation; pipeline model; closed loop model and material balance model; environmental cost-benefit analysis; sources of uncertainty in cost and benefit estimates; Fiscal incentives in pollution control and management.
- Environmental management system (EMS): ISO-14000; Environmental audit; Environmental clearance for establishing industries; Environmental Impact Assessment (EIA); EIA guidelines 1994, Environmental taxes.
- International trade and environment; Trade Related Intellectual Properties (TRIPs), Intellectual Property Rights (IPRs), Corporate environmental ethics.

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. Bryan F.J. Manly. 2009. Statistics for Environmental Science and Management. CRC Press.

205 Natural Resources and Management

- Atmosphere: Composition, atmospheric chemistry; weather pattern
- Aquatic system: Diversity, characteristics, watershed management, rain water harvesting. Biodiversity: Importance, threats, approaches for conservation and management.
- Soil: Resources, fertility and agricultural sustainability; Soil erosion and conservation; Restoration of contaminated soils. Waste management
- Energy: Basics of energy and its various forms; Energy management and audit.

Suggested Readings:

1. B.R. Gurjar, Chandra S.P. Ojha, L.T. Molina. 2010. Air Pollution. CRC Press.
2. W.N. Beyer and J.P. Meador. 2011. Environmental Contaminants in Biota. CRC Press.
3. E.N. Laboy-Nieves, M.F.A. Goosen and E. Emmanuel. 2010. Environmental and Human Health. CRC Press.
4. Vaughn Nelson. 2011. Introduction to Renewable Energy. CRC Press.

Lab work based on courses 201 and 202

Lab work based on courses 203 and 204