PANJAB UNIVERSITY CHANDIGARH-160014 (INDIA)

FACULTY OF SCIENCE

M.Sc. in Environment Science (Semester System)

Ist to IVth Semester

Department of Environment Studies, Panjab University, Chandigarh

EXAMINATIONS 2023-24

PREAMBLE

The course curriculum for post-graduate studies *viz*. M

COURSE OVERVIEW

1. **Name of the Degree Programme**: M.Sc
2. **Discipline**: Environmental Science
3.

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COURSE STRUCTURE

M.Sc. ENVIRONMENT SCIENCE

(SEMESTER I - IV)

SEMESTER I (Total Credits = 20, Marks=500)					
Subject code	**Subject name**	**Credits (T+P)**	**Subject code**	**Subject name**	**Credits (T+P)**
ENV-6101	**Environment Geoscience**	**4+1=5**	**ENV-6102**	**Ecological Principles**	**4+1=5**
ENV-6103	**Environmental Chemistry & Toxicology**	**4+1=5**	**ENV-6104**	**Solid Waste Management & Techniques**	**4+1=5**
SEMESTER II (Credits = 20, Marks = 500)					
Subject code	**Subject name**	**Credits (T+P)**	**Subject code**	**Subject name**	**Credits (T+P)**
ENV-6201	**Biodiversity & Conservation**	**4+1=5**	**ENV-6202**	**Environmental Analysis: Techniques & Instrumentation**	**4+1=5**
ENV-6203	**Environmental Pollution**	**4+1=5**	**ENV-**		

DEPARTMENT OF ENVIRONMENT STUDIES
PANJAB UNIVERSITY, CHANDIGARH

SEMESTER I

PATTERN OF END-SEMESTER QUESTION PAPER

(i) Nine questions in all with equal weightage (16 marks). The candidate will be asked to attempt five questions.
(ii) One Compulsory question (consisting of short answer type questions) covering whole syllabus. There will be no choice in this question.
(iii) The remaining eight questions will be in **Four UNITs**, each unit comprising of two questions.
(iv) Students will attempt one question from each UNIT and the compulsory question.

NOTE: To qualify for the degree, a student has to score a total of 50 percent marks in each semester with a minimum of 40 percent in each paper, including marks of internal assessment.

ENV-6101: ENVIRONMENT GEOSCIENCE

THEORY

Credits: 4 **Contact hours: 60 hrs**

Course objectives

To acquaint the students with the fundamental concepts of geo-science in relation to environmental aspects.

Course outcomes:

To enable the students to apply geoscience skills to solve environmental issues.

UNIT- I **12hrs**

Origin of earth, Internal structure of earth and formation of core, mantle, crust; Concept of minerals and rocks, Formation of rocks (igneous and metamorphic); Mineral resources and Reserves, Environmental impact of exploration, processing and smelting of minerals; Controls on formation of landforms - tectonic including plate tectonics and climatic; Energy budget of -chemical properties (texture, structure, inorganic and organic components); soil forming minerals and process of soil formation, Identification and characterization of clay minerals, soil types and climate control on soil formation, cation exchange capacity and mineralogical controls.

UNIT-II **12hrs**

Layered structure of atmosphere and its temperature relationships; Atmospheric stability, Temperature inversions and windroses; Coriolis force, pressure gradient force, frictional force, geo-strophic wind, gradient wind; Atmospheric general circulation, Air mass and weather fronts; Weather elements, Precipitation and its types; Indian monsoon, western disturbances and El Nino effect; Climates of India, draughts, La Nina, residence time and rates of natural cycles, geophysical fields, weathering reactions, transportation and deposition of sediments, Heat Islands, causes and consequences.

UNIT-III

12hrs

Distribution of water in earth, Hydrological cycle, Factors influencing the surface water,

conductivity; Major basins and groundwater provinces of India; groundwater tracers, Land subsidence, effects of excessive use of groundwater, Environmental impacts of dams with recent case studies; Land-use planning, Soil surveys in relation to land-use planning, Methods of site selection and evaluation.

UNIT-IV **12hrs**

hydrosphere and biosphere; Partitioning of elements during surficial geologic processes, Geochemical recycling of elements; Paleoclimate, Application of GIS in Geo-environment; Biogeochemical factors in environmental health.

ENV-6101: ENVIRONMENT GEOSCIENCE

PRACTICAL

Credit: 1

1.

DEPARTMENT OF ENVIRONMENT STUDIES
PANJAB UNIVERSITY, CHANDIGARH

SEMESTER II

ENV-6102: ECOLOGICAL PRINCIPLES

THEORY

Credits: 4 **Contact Hours: 60 hrs**

Course objectives

To acquaint the students with the concept of ecology and various interactions among organisms and dynamics of ecosystems in relation to human life.

Course outcomes:

To develop the ability to corelate ecological dynamics and

UNIT-IV **12 hrs**

Industrial Ecology: Concept, a concise account

Human Ecology: Human settlement and impacts

Biological Invasion: Concept; Pathways of Invasion; Process of Invasion; Mechanism of Invasions; Impact of Invasive Species - Ecological, Environmental, Economical; Some examples of major invasive plants and animals in India.

ENV-6102: ECOLOGICAL PRINCIPLES

PRACTICALS

Credits: 1

1. To study the vegetation using a Quadrat method. How to determine minimum number

ENV-6102: ENVIRONMENTAL CHEMISTRY AND TOXICOLOGY

THEORY

Credits: 4 **Contact Hours: 60 hrs**

Course objectives

To acquaint the students with the dynamics and principle of environmental chemistry and their toxicological effects on environment.

Course outcomes

To enable students to apply functional knowledge for controlling toxic chemicals in the environment.

UNIT- I **12hrs**

Fundamental of Environmental Chemistry, Gibbs Energy Concept, Stoichiometry, Chemical Potential, Chemical equilibria, chemical kinetics, solubility of gases in water, the carbonate system, Hydrocarbon Classification, radioisotopes, pH and Redox potential (Eh)

Chemistry of Earth: Mineral and Organic components of soil; Reactions in soil solution; Ion Exchange (Physiosorption), Ligand Exchange, Precipitation and Dissolution.

UNIT-II **12hrs**

Chemical composition of Air: Classification of elements, chemical speciation. Particles, ions, and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Sources of trace gases in the atmosphere; Thermo-chemical and photochemical reactions in the atmosphere.; Oxygen and ozone chemistry. Chemistry of air pollutants. Role of hydrocarbons; Sulphur chemistry; Halogen Chemistry in the atmosphere

Green Chemistry: Concept and a Brief account, Principles of green chemistry.

UNIT-IV **12hrs**

Toxic Chemical in the Environment: Metals and other inorganic contaminants; Organic contaminants; Fate of organic contaminants; Pesticides; Biochemical aspects of Arsenic, cadmium, lead, mercury, Selenium, carbon monoxide, ozone and PAN, Pesticides; Insecticides, MIC, Photochemistry of Brominated Flame Retardants (BFR).

ENV-6102: ENVIRONMENTAL CHEMISTRY AND TOXICOLOGY PRACTICALS

Credits: 1

1. Preparation of standard solutions
2. Estimation of total hardness of a given sample of water by complexometric titration.
3. Determination of COD.
4. Determination of DO.
5. Determination of BOD.
6. Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH- meter.
7. Preparation of buffer solutions
8. Measurement of the pH of buffer solutions and comparison of the values with theoretical values.
9. Field Visit for collection of water sample

RECOMMENDED READINGS:

1. Banerji, S. K. Environmental Chemistry. 2nd ed. Prentice-Hall, New Delhi, India. 1999.
2. De, A. K. Environmental Chemistry. 4th ed. New Age International (P) Ltd., New Delhi India. 2000.
3. Harrison, R. M. and de Mora, S. J. Introductory Chemistry for the Environment

Construction, operation, closure and post closure aspects of Landfill, Dumpsite closure or

ENV-6102: SOLID WASTE MANAGEMENT AND TECHNIQUES

PRACTICALS

Credits: 1

1. A visit to Composting/Vermicomposting Unit /RDF plant/Sanitary landfill
2. Proximate and Ultimate analysis of Solid waste
3. To prepare a list of materials from municipal waste stream that can be reused /recycled
4. Solid waste data analysis in excel
5. To determine moisture content of sample
6. To determine the pH of the given sample.
7. Analysis of Swachh Survekshan parameter
8. Use of Swachhata App
9.

DEPARTMENT OF ENVIRONMENT STUDIES
PANJAB UNIVERSITY, CHANDIGARH

SEMESTER II

PANJAB UNIVERSITY, CHANDIGARH
OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FOR
M.Sc. ENVIRONMENT SCIENCE
EXAMINATION, 2023-2024

OUTLINES OF TESTS

OBJECTIVE OF THE COURSE

To teach the various concepts of Environment Science and their applications, the syllabus pertaining to M.Sc. Environment Studies (2 Year course & 4 Semesters) in the subject of Environment Studies been upgraded as per provision of the UGC. The syllabus contents are duly arranged UNIT wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills according to UGC.

Semester II

PAPERS

Theory Papers:

ENV-6201:	Biodiversity & Conservation	100 Marks (4 credits)
ENV-6202:	Environmental Analysis: Techniques & Instrumentation	100 Marks (4 credits)
ENV-6203:	Environmental Pollution	100 Marks (4 credits)
ENV-6204:	Environmental Awareness, Impact Assessment & Auditing	100 Marks (4 credits)

Practicals:

ENV-P-6201:	Biodiversity & Conservation	25 Marks (1 credits)
ENV-P-6202:	Environmental Analysis: Techniques & Instrumentation	25 Marks (1 credits)
ENV-P-6203:	Environmental Pollution	25 Marks (1 credits)
ENV-P-6204:	Environmental Awareness, Impact	

PATTERN OF END-SEMESTER QUESTION PAPER

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(ii) One Compulsory question (consisting of short answer type questions) covering whole syllabus. There will be no choice in this question.
(iii) The remaining eight questions will be in **Four UNITs**, each unit comprising of two questions.
(iv) Students will attempt one question from each UNIT and the compulsory question.

NOTE:

ENV-6201: BIODIVERSITY & CONSERVATION

THEORY

Credits: 4 **Contact Hours: 60 hrs**

Course objectives*: To acquaint the students with the basic and applied aspects of protecting biodiversity and conservation of natural resources, while providing for human needs.*

Course outcomes:

To enable the students appreciate the need for biodiversity conservation.
To enable students to apply knowledge in general communication for public extension.

UNIT- I **12 hrs**

Conservation biology-basics and principal

levels of diversity; alpha, beta and gamma diversity, and their measurement

Valuing Biodiversity: Ecological Economics; Ecosystem Services; Direct Use Values; Indirect Use Value; Ethical Values

Biodiversity Hotspots

ENV-6201: BIODIVERSITY & CONSERVATION PRACTICALS

Credit: 1

1. To calculate index of diversity, richness, evenness and dominance of species.
2. To calculate alpha, beta and gamma diversity.
3. Project/Assignment on biodiversity (to be assigned by the instructor)
4. To undertake a field visit to understand the concept and consequences of soil degradation
5. To study different types of plantation systems.
6. A visit/case study of Restoration site/project
7. A visit to Ramsar site and assessment of various threats/challenges to wetlands.
8. A visit to National park/wildlife sanctuary to understand their role in protection and conservation of biota.

RECOMMENDED READINGS

1. Botkin, Daniel B. and Keller, Edward A. Environmental Science: Earth as a Living Planet. 6th ed. John Wiley & Sons, USA. 2007.
2. Enger, E.D. and Smith, B. F. Environmental Science: A Study of Interrelationships. 11th ed. McGraw Hill Inc., USA. 2006.
3. Frankel, O.H., Brown A.H.D. and Burdon, J.J. Conservation of Plant Biodiversity. Cambridge University Press, UK. 1995.
4. Gaston, K. J. and Spicer, J. I. Biodiversity: An Introduction. Blackwell, UK. 1998.
5. Gadgil, Madhav and Rao, P.R.S. Nurturing Biodiversity: An Indian Agenda. Centre or Environment Education, Ahmedabad, India. 1999.
6. Hunter, Malcolm L., Jr., and Gibbs, James P. Fundamentals of Conservation Biology. 3rd ed. Wiley-Blackwell. 2006.
7. Jeffries, M. Biodiversity and Conservation. 2nd ed. Routledge, UK. 1997.
8. Perrings, Charles, Maler, Karl-Goran, Folke, Carl, Holling, C. S. and Jansson, Bengt-Owe. Biodiversity Loss: Economic and Ecological Issues. Cambridge University Press, UK. 1997.
9. Riordan, Tim O' and Stoll-Kleemann, Susanne. Biodiversity, Sustainability and Human Communities: Protecting Beyond the Protected. Cambridge University Press, UK. 2002.
10. Van Andel, J. and Aronson, J. Restoration Ecology: The New Frontier. Blackwell, UK. 2005
11. Odum, E.P. Fundamentals of Ecology. W.B. Saunders, USA. 1991.
12. Primack, R.B. Essentials of Conservation Biology. 5th ed. Sinaeur Associates, Inc., USA. 2010.
13. Singh, H.P., Batish, D.R. and Kohli, R.K. Handbook of Sustainable Weed Management. Haworth Press, Inc., USA. 2006.
14. Singh, J.S., Singh, S.P. and Gupta, S.R. Ecology, Environment and Resource Conservation. Anamaya Publishers, New Delhi, India. 2006.
15. Townsend, Colin R. Ecological Applications: Toward a Sustainable World. Wiley-Blackwell. 2007.

ENV-6202: ENVIRONMENTAL ANALYSIS: TECHNIQUES AND INSTRUMENTATION

THEORY

Credits: 4 **Contact Hours: 60 hrs**

Course objectives: *To upgrade the students with knowledge on instrumental techniques of chemical analysis, practical work with the realistic samples from the environment so that they could become familiar with the instrumentation this is inevitable for contemporary investigations of environmental pollution.*

Course outcomes:

To develop skills required in the field of environmental instrumentation.

UNIT- I **15 hrs**

Concept of accuracy (standard reference material, certified reference material), precision and error, Types of errors (determinate, indeterminate, absolute, relative), significant figures, Sample preservations, handling and storage of samples and chemical in lab, Solvent partitioning, Quality Control and Quality Assurance

UNIT-II **12 hrs**

Instrumentation and analytical methods involved in the following techniques and their applications in environment, Infrared spectrometry, Flame photometry, Atomic Absorption Spectroscopy, ICPMS, ICP-AES, UV-V]TJ

ENV-6202: ENVIRONMENTAL ANALYSIS: TECHNIQUES AND INSTRUMENTATION
PRACTICALS

Credits: 1

1. Preparation of a standard solution a standard curve in lab
2. Analysis of sample using titrimetry.
3. To analyse the sample Using Spectrophotometery
4. A visit to different labs to demonstrate the functioning of instrumentation as listed in the syllabi.
5. Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given)
6. Identify and separate the components of a given mixture of two amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography.
7. Identification of organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols and carbonyl compounds etc).
8. Extraction of various compounds by Soxhlet apparatus.
9. Sample analysis using flame photometer.
10. Maintaining log book related to equipment.
11. Familiarity about various symbols used on the bottles of chemicals.
12. Phytochemical extraction and analyses.
13. Functional group identification through FTIR spectroscopy.
14. Visit to CIL/SAIF.

SUGGESTED READINGS

1. Chatwal, G. R., and Anand, S. K. Instrumental Methods of Chemical Analysis. Himalaya Publishing House, Delhi. 2007.
2. De, A.K. Environmental Chemistry, New Age International, New Delhi. 2000.
3. Murphy, W.J. Analytical Chemistry, American Chemical Society, USA. 1977.

ENV-6203: ENVIRONMNETAL POLLUTION

THEORY

Credits: 4 **Contact Hours: 60 hrs**

Course objectives*: The students shall be equipped with the knowledge of different types of pollution; their sources and intensity and its consequence on man animal plants and monuments over a period of time.*

Course outcomes:

To develop ability for pollution mitigation abetment strategies.

UNIT- I **12 hrs**

Air: Natural and anthropogenic sources of pollution. Primary and Secondary Pollutants; Criteria air pollutants, AQI, Meteorology and Dispersion of air pollutants; Gaussian plume model, stability, line source model and area source model. calculation of effective stack height; Transport and diffusion of pollutants. Mixing height/depth, lapse rates; plume behavior, Methods of monitoring of air

radiation exposure and radiation standards, radiation protection; The Environment (Protection) Act 1986.

UNIT-IV **12 hrs**

Noise: Sources of noise pollution, weighting networks, measurement of noise and indices (Leq, L10, L90, L50, LDN, TNI); Effect of meteorological parameters on noise propagation; Impact of noise and vibrations on human health; Noise dose and Noise Pollution standards; Noise control and abatement measures: Active and Passive methods; Noise Pollution (regulation and Control) Rules2000, Biological Pollutants and microbial pollutants; Means of
safety against them.

ENV-6203: ENVIRONMNETAL POLLUTION PRACTICALS

Credit: 1

1. To determine AQI of different locations (less polluted, heavily polluted) of city.
2. Sampling and Monitoring of SO2, NOx, CO, SPM in air
3. Collection and storage of surface and ground water sample
4. Analysis of DO, COD and BOD 3 and BOD 5 of Industrial effluent/Sewage
5. Collection and preparation of soil sample
6. To determine various physico-chemical properties of soil collected from polluted and non- polluted areas: Soil pH, conductivity, bulk density, organic carbon and organic matter.
7. To prepare vehicular emission inventory in a locality
8. Assignments/project as assigned by the teacher

RECOMMENDED READINGS

1. Botkin, Daniel B. and Keller, Edward A. Environmental Science: Earth as a Living Planet. 6th ed. John Wiley & Sons, USA. 2007.
2. Charbeneau, R.J. Groundwater Hydraulics and Pollutant Transport. Prentice Hall, India. 2000.
3. Cunningham, W. P. and Cunningham, M. A. Principles of Environment Science. Enquiry and Applications. 2nd

ENV-6203: ENVIRONMENT AWARENESS, IMPACT ASSESSMENT AND AUDITING

THEORY

Credits: 4 **Contact Hours: 60 hrs**

Course objectives*: To acquaint the students with importance of Environment Impact assessment and various methodologies of impact assessment and auditing.*

Course outcomes:

To enable the students understand EIA process and clearance regime.

UNIT-I **12 hrs**

Introduction to Environmental Impact Assessment, , Environmental impact statement & environmental management plan, EIA guidelines: notification of the Government of India, and amendments from time to time various appendices and forms for application, Environmental Clearance, Types of Project activities requiring Environmental Clearance, Procedure of Public

17. Glasson, J., Therivel, R., Chadwick, A., 2013. Introduction To Environmental Impact Assessment. Routledge.
18. Mareddy, A.R., Shah, A., Davergave, N., 2017. Environmental Impact Assessment: Theory and Practice. Butterworth-Heinemann.
19. Marsden, S., Koivurova, T., 2013. Transboundary Environmental Impact Assessment in the European Union: The Espoo Convention and its Kiev Protocol on Strategic Environmental Assessment. Routledge.
20. Murthy, D.B.N., 2004. Envir
and Deep Publications.
21. Poonia, M.P., Sharma, S.C., 2017. Environmental Studies. Khanna Publishing.
22. Sumit, N., Swapnil, R., Archana, S., 2018. Environmental Awareness and the Role of Social Media. IGI Global.
23. Weston, J., 2014. Planning and Environmental Impact Assessment in Practice. Routledge.
24. Wood, C., 2014. Environmental Impact Assessment: A Comparative Review. Routledge.

PANJAB UNIVERSITY, CHANDIGARH
OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FOR
M.Sc. ENVIRONMENT SCIENCE
EXAMINATION, 2023-2024

OUTLINES OF TESTS

OBJECTIVE OF THE COURSE

To teach the various concepts of Environment Science and their applications, the syllabus pertaining to M.Sc.

PATTERN OF END-SEMESTER QUESTION PAPER

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(iii) The remaining eight questions will be in **Four UNITs**, each unit comprising of two questions.
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NOTE: To qualify for the degree, a student has to score a total of 50 percent marks in each semester with a minimum of 40 percent in each paper, including marks of internal assessment.

ENV-6301: ENVIRONMENTAL TECHNOLOGY

THEORY

Credits: 4 **Contact Hours: 60 hrs**

Course objectives*: To acquaint the students with latest environmental technology on how to combat with common environmental issues and related problems without altering the natural environmental conditions.*

Course outcomes:

ENV-6301: ENVIRONMENTAL TECHNOLOGY

PRACTICALS

Credits: 1

1. To study the different methods of air monitoring
2. Collection and analysis of effluent from STP
3. Collection and analysis of effluent from ETP
4. Disinfection of potable water Bacteriological analysis of water samples from different sources.
5. A visit to nearby Sewage Treatment Plant
6. A visit to nearby Effluent Treatment Plant
7. Ambient air monitoring for SO2, NOx, CO, SPM
8. Study characteristic of Water and waste water from RO unit
9. Project work as assigned by the teacher

Recommended Readings

1. Bhargava, S. K. Practical Methods for Water and Air Pollution Monitoring, New Age International Pub., New Delhi. 2008.
2. Bhatia, S.C. Textbook of Air Pollution and Its Control. Atlantic Pub., New Delhi. 2007.
3. Clarke, Andrew G. Industrial Air Pollution Monitoring, Gaseous and
4. Eckenfelder. Industrial Water Pollution Control 3rd ed. McGraw-Hill Education (Asia). 2003.
5. Evans, G. Biowaste and Biological Waste Treatment. James and James (Science Publishers) Ltd,
6. U.K. 2005.
7. Gurnham, C. F. Principle of Industrial Waste Treatment. John Wiley & Sons Inc, New York. 2004.
8. Hammer, M.J. and Hammer Jr, M.J. Water and Wastewater Technology. 3rd ed. Prentice Hall of India. 2000.
9. Hammer, M.J. and Hammer, M.J. Jr, Water & Waste Water Technology. Prentice Hall, USA. 2000.
10. Heck, R.M. and Farrauto, R. J. Catalytic Air Pollution Control:
11. Kumar, R and Singh, R.N. Municipal Water and Wastewater Treatment. Capitol Pub. Co., New Delhi. 2006.
12. Ray, T.K. Air Pollution Control in Industries. Tech Books International, New Delhi (2 volumes). 2006

ENV-6302: MAJOR ENVIRONMENTAL ISSUES

THEORY

Credits: 4 **Contact Hours: 60 hrs**

Course objectives*: To provide assessments of the current status and trends in major developmental and environmental issues at the national, sub regional, regional and global levels.*

Course outcomes:

To develop ability of students to critically address the environmental issues.

UNIT- I **12 hrs**

International efforts for environmental protection: Stockholm conference, Creation of UNEP and its role; Vienna Convention, Montreal protocol; World Earth Summits; Conference of Parties (COPs), Agenda 21, Convention on Biodiversity; Aichitargets; S D G s , M D G s , Convention on Climate Change, Climate Change and Global Warming; Climate change-Adaptability; Ramsar Convention on Wetlands (1971), , Global Environmental Facility (GEF), , Sea level rise and its implications; Copenhagen Summit, Paris Agreement; IPCC and IGBP its reports (a brief account), Climate change and society, Human health and climate refugees.

UNIT- II **12 hrs**

Sustainable development Goals (SDGs), environment Ethics, Environmental rights and governance, Green economy, Environmental conflicts and challenges at local, national and global levels, role od stakeholders (NGO, Media etc) in environment protection, Environmental Communications, Environmental Justice, Smoking and its environmental impacts . Bio-terrorism and Eco-terrorism; Green criminology Current Environmental Issues in India: hydropower projects, Vehicular emission norms in India, Epidemiological Issues, Environmental Disasters.

UNIT- III **12 hrs**

Stratospheric Ozone depletion, Ozone hole, history, reasons and Impacts on Biota; Concept of Carbon Trading; Carbon credits; Carbon Sequestration; REDD, REDD+; Ecological

Credits: 1

1. To prepare a list of various preservatives and additives commonly used in food stuff /eatable.
2. Profiling and Analyses of smokers in the region
3. Project report on a visit to a Green building
4. A case study of any major environmental issue
5. Project/case study on Climate change risks and adaptability
6. To calculate the carbon footprint of anthropogenic activities
7. A case study to estimate impacts of climate change on poverty
8. Study of REDD/REDD+ programme in India

Suggested Readings

1. Andel, J. Van and Aronson, J. Restoration Ecology: The New Frontier. lackwell, UK. 2005.
2. Botkin, Daniel B. and Keller, Edward A. Environmental Science: Earth as a Living Planet. 6th ed. John Wiley & Sons, USA. 2007.
3. Burroughs, W.J. Climate Change: A Multidisciplinary Approach. 2 ed. Cambridge Press.

ENV-6303: ENVIRONMENT AND ENERGY MANAGEMENT

THEORY

Credits: 4 **Contact Hours: 60 hrs**

Course objectives*: To provide the students with information on how to manage the natural resources on a sustainable basis, reducing the threat of degradation and conforming to various environmental regulations*

Course outcomes:

To motivate students to spread awareness about the benefits of using renewables sources of energy.

UNIT-I **12 hrs**

Environmental Economics and Management: Planning Levels, physical planning and development Cost-Benefit, analysis, methods of economic evaluation of intangible environmental resources; contingent method, travel cost, opportunity cost concept of consumer behaviour, environmental consumerism

Disaster Management: Definition, nature, types and classification of disasters, risk analysis; Disasters- causes and effects; Factors affecting damage- Type, scale, population density, socio-economic status of population, Factors affecting mitigation measures- Prediction, preparation, accessibility, population density, Planning for disaster mitigation.

UNIT-II **12 hrs**

Forest Conservation Chipko movement, Silent Valley movement and Gandhamardhan movement. Environmental Disasters: Minnamata Disaster, Love Canal Disaster, Bhopal Gas Disaster, 1984, Chernobyl Disaster, 1986, Fukusima Daiichi nuclear disaster, 2011 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.

UNIT-III **12 hrs**

Watershed Management: Definition, concepts, principles; Water conservation-development of watersheds, importance of Rain water harvesting. Water balance approach; Water budgeting; Water management- Participatory Rural Appraisal in watershed Programmes. Environmental implications of energy use; energy use pattern in India and the world, emissions of CO2 in developed and developing countries including India. Concept of Global warming and its causes and issues. (12 lectures)

UNIT-IV **12 hrs**

Principles of generation of hydroelectric power, tidal, wind, ocean thermal energy conservation, Bioenergy: methods to produce energy from biomass. Sun as source of energy; solar radiation and its spectral characteristics, solar collectors, solar ponds. Nuclear energy - fission and fusion, Nuclear fuels, Nuclear reactor principles and types.

ENV-6303:

ENV-6304: INDUSTRIAL AND BIOMEDICAL WASTE MANAGEMENT

PRACTICALS

Credits: 1

1. Survey of the town to make a list of various clinics/nursing homes/tertiary medical care centres/dispensaries/health care centers/multi-specialty hospitals and medical centres
2. Sterilisation using autoclave
3. Role of color coding in BMW management
4. Data on the various methods of handling and transport of hospital wastes in the city
5. A visit to the Hazardous waste Generation or disposal site.
6. Visit to University health centre/dental institute to study Biomedical waste management practices.
7.

DEPARTMENT OF ENVIRONMENT STUDIES

PANJAB UNIVERSITY, CHANDIGARH
OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FOR
M.Sc. ENVIRONMENT SCIENCE
EXAMINATION, 2023-2024

OUTLINES OF TESTS

OBJECTIVE OF THE COURSE

To teach the various concepts of Environment Science and their applications, the syllabus pertaining to M.Sc. Environment Studies (2 Year course & 4 Semesters) in the subject of Environment Studies been upgraded as per provision of the UGC. The syllabus contents are duly arranged UNIT wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills according to UGC.

Semester IV

PAPERS

Theory Papers:

ENV-6401:	Statistical Applications and Research Methodology	100 Marks (4 credits)
ENV-6402:	Environmental Biotechnology	100 Marks (4 credits)
ENV-6403:	Remote Sensing and GIS in Environmental Studies	100 Marks (4 credits)
ENV-6404:	Training of atleast 4 weeks, Project report, Presentation	100 Marks (4 credits)

Practicals:

ENV-P-6401:	Statistical Applications and Research Methodology	25 Marks (1 credits)
ENV-P-6402:	Environmental Biotechnology	25 Marks (1 credits)
ENV-P-6403:	Remote Sensing and GIS in Environmental Studies	25 Marks (1 credits)
ENV-P-6404:	Training of atleast 4 weeks, Project report, Presentation	25 Marks (1 credits)

Total: 500 Total Marks (20 Total cred 12 02 0 612 700000912 0 612 792 reW*nBTF1 12 Tf1 0 0 1 320.69 33

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PATTERN OF END-SEMESTER QUESTION PAPER

(i) Nine questions in all with equal weightage (16 marks). The candidate will be asked to attempt five questions.
(ii) One Compulsory question (consisting of short answer type questions) covering whole syllabus. There will be no choice in this question.
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ENV-6401: STATISTICAL APPLICATIONS AND RESEARCH METHODOLOGY

THEORY

Credits: 4 **Contact Hours: 60 hrs**

Course objectives*: To acquaint the students with fundamentals of statistics and research methodology.*

Course outcomes:

To develop statistical skills of the students for use in environmental science.

UNIT-I **12 hrs**

Biostatistics basic definition and its applications in environmental sciences, Data Collection, data cleaning and representation of data, Formation of table, data plotting, type of graph etc. Measure

UNIT-IV **12 hrs**

Introduction to Intellectual Property: General Introduction to intellectual property rights and its

ENV-6401: STATISTICAL APPLICATIONS AND RESEARCH METHODOLOGY PRACTICALS

Credits: 1

1. Collection of data
2. Calculation of mean, mode, median, standard error, standard deviation
3.

ENV-6402: ENVIRONMENTAL BIOTECHNOLOGY

THEORY

Credits: 4 **Contact Hours: 60 hrs**

Course objectives*: To acquaint the students with information on how to improve understanding, identification, and prevention of environmental problems, remediation & restoration through biotechnological methods*

Course outcomes:

To acquaint students with the skills of biotechnological methods for mitigating environmental issues.

UNIT-I **12 hrs**

Bioremediation: Planning and management of bioremediation; In situ and Ex situ bioremediation; Constrains and priorities of bioremediation; Evaluating Bioremediation; Bioremediation of VOCs. Concepts of bio-stimulation and bioaugmentation

Phytoremediation: Phytoremediation of xenobiotics and bioaccumulation of metals using plants.

UNIT-II **12 hrs**

Biodegradation: Factors affecting process of biodegradation; Methods in determining biodegradability; Contaminant availability for biodegradation. Xenobiotics; Persistence and biomagnification of xenobiotic molecules; Microbial interactions with xenobiotics; Phase I and Phase II reactions; Cyt P 450 mediated reactions; Xenobiotics and microbial biotransformation. Use of microbes (bacteria and fungi) and plants in biodegradation and Biotransformation.

Toxicology and Microbiology: Absorption, distribution and excretion of toxic agents, acute and chronic toxicity, LC-50, LD-50 concept of bioassay, threshold limit value, margin of safety, therapeutic index, biotransformation. Major water borne diseases and air borne microbes.

UNIT-III **12 hrs**

Biodegradation of petroleum constituents and associated heavy metal; Biodegradation of halogenated hydrocarbons; polycyclic aromatic hydrogen; Pesticides and Detergents.

Biosorption: Biotechnology and heavy metal pollution; Oil field microbiology; Improved oil

ENV-6402: ENVIRONMENTAL BIOTECHNOLOGY

PRACTICALS

Credits: 1

1. Preparation of solid and liquid culture media (Luria agar, Luria broth etc.) for growth of *E. coli* and fungus.
2. Culturing of *E. coli* in liquid and solid medium.
3. Study of Growth Curve of *E. coli.*
4. Finding the LC-50, LD-50 values of *E. coli* for standard antibiotics.
5.

Recommended Readings

1. Evano, G.H. and Furlong, J.C. Environmental Biotechnology Theory and Application. John Wiley and Sons, USA. 2004.
2. Jjemba, P.K. Environmental Microbiology Theory and Application. Science Pub. Inc., USA. 2004.
3. Pepper, I.L. and Gerba, C.P. Environmental Microbiology - Laboratory Manaul. Elsevier, USA. 2005.
4. Ratledge, C. and Kristiansen, B. Basic Biotechnology. 2nd ed. Cambridge University Press, Cambridge, UK. 2002.
5. Rittman, B. and McCarty, P. L. Environmental Biotechnology: Principles and Applications. 2nd edition. Tata McGraw-Hill, USA. 2000.
6. Rittmann, B.E. and McCarty, P.L. Environmental Biotechnology Theory and Application. McGraw Hill, USA. 2001.

ENV-6403: REMOTE SENSING AND GIS IN ENVIRONMENTAL STUDIES

THEORY

Credits: 4 **Contact Hours: 60 hrs**

Course objectives*: To introduce the students with the applications of Earth observation technology and Geoinformatics in environmental studies and research.*

Course outcomes:
To enhance students' decision-making capabilities for the management of environmental problems.

UNIT-I **12 hrs**

Fundaments of Remote Sensing

Introduction to Remote Sensing: Meaning, Types and Applications
Energy and radiation principles, Electromagnetic Radiation (EMR)
Energy-atmosphere and Energy-earth surface interaction
Sensor Platforms, Scanning System, Resolution and Spectral signatures
Data Reception and Data Products, Fundamentals of Visual Image Interpretation

UNIT-II **12 hrs**

Fundamentals of Geographic Information Systems (GIS)

GIS: Concept, Significance, Components and Applications
Spatial data base: Types, Models and Representations
Attribute Data Management and Metadata Concept
Concept of Map, Coordinate System, Projections and Transformations

Fundamentals of Global Positioning System (GPS)

Concept and Principles of Operation, GPS Segment
GPS Positioning, GPS Receivers, GPS Accuracy and GPS Applications and Ground truthing

UNIT-III **12 hrs**

RS & GIS in Environmental Management

Water Resources Monitoring; Water pollution; Water logging
Hydrological and Morphometric Assessment
Deforestation and Forest degradation; Forest fires
Land use/cover Change Detection; Flood-plain Management

UNIT-IV **12 hrs**

RS & GIS in Disaster Management

Disaster Management: Geoinformatics Perspective
Hazard Analysis and Mapping, Prediction of hazards and mitigation of their impacts

Risk and Vulnerability Assessment

RS & GIS in Landslide Hazard, Flood hazard and Earthquake Hazard Analysis, volcanism, avalanche, tsunami and cloud bursts

ENV-6403: REMOTE SENSING AND GIS IN ENVIRONMENTAL STUDIES PRACTICALS

Credits: 1

1. Analysis of Spectral Signatures of surface features
2. Interpretation of Satellite Image
3. Digitization of Raster Map: Point, Line and Polygon Features in GIS Environment
4. Preparation of Attribute Table, Table Joining & Data Import in GIS Environment
5.

ENV-6404: RESEARCH TRAINING

Credits: 4 **Contact Hours: 60 hrs**

Course objectives*:*

To acquaint the students with the ongoing and upcoming research in the field of environment science.

To enhance the skills required for research report writing, research ethics, use of reference organizing software and anti-plagiarism databases.

Course outcomes:

To develop skills in Research Methodology- to frame research query, develop methodology, analyse the data, interpret the results and suggest suitable solutions and recommendations.

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