

M.Sc., Environmental Sciences, 2015-16

Semester I

(CORE COURSE -I)

M1 ENV01-CC01

CREDITS :

04

BASIC CONCEPTS OF ECOLOGY AND ENVIRONMENT

Unit I

Basic concept of ecology and Environment: components- Topographic, climatic, edaphic factors; Scope of ecology and its relations with other disciplines; Principles pertaining to ecosystem; ecosystem components: food chains, food web, ecological pyramids; Ecosystem energetics; energy budget and ecological efficiency; Processes of primary productivity, gross and net productivity; Homeostasis; Principles of limiting factors.

Unit II

Biogeochemical cycles in Environment- concepts and significance, Carbon , Nitrogen, Phosphorus, oxygen ,hydrological, Sulphur cycle; Autecology and synecology- Basic principles; Concept of population growth and survivorship; population characteristics and dynamics; population growth forms and concept of carrying capacity; Population regulation K and R selection ,population changes.

Unit III

Biotic community: concept and classification; community characteristics- Qualitative, Quantitative, phytosociological methods: quadrats, Transects & IVI; Ecotone and continuum concept, Life forms and biological spectrum; Community coefficients; Ecological dominance and ecological niche; ecological succession, concept of climax and community stability; Biotic interactions, ecads; Ecological succession- types, causes and effects, climax community, succession models of ecosystem developments; Micro versus macro evolution.

Unit IV

Aquatic ecosystems: Lentic and lotic- Physicochemical characteristics of fresh water environment, Biotic communities of pond and lakes, thermal stratification of lakes, conservation and management of fresh water habitats; Physicochemical characteristics of Marine ecosystem, biotic communities of oceanic regions, coral reefs and mangroves;

estuarine ecology; Concepts of wetland ecosystem, Ramsar wetlands, wetlands with special reference to Rajasthan.

Unit V

Terrestrial Environment: Physicochemical characteristics; Biomes of the world- Forest, Grassland, Desert and Tundra; Flora and Vegetation of India with special reference to Rajasthan; Endemism, Age and Area hypothesis, Dispersal dynamics; Role of ecotone in conservation and management of Biomes .

M.Sc., Environmental Sciences, 2015-16

Semester I

(CORE COURSE- II)

M1 ENV02-CC02

CREDITS :

04

EARTH PROCESSES AND NATURAL CYCLES

Unit I

Evolution of atmosphere; Chemical composition and thermal stratification of present day atmosphere; Atmosphere and earth radiation balance, Latitudinal and seasonal variation of Insolation, temperature, pressure, wind belts , Humidity, cloud types & formation, precipitation; Circulation of earth's atmosphere and world precipitation pattern, precipitation to evaporation ratio; Hydrological cycle.

Unit II

Elements of climate: temperature, pressure, wind, Altitude, latitude, longitude, Horizontal and vertical distribution of air masses, Interrelationship between various elements of climate, properties of air masses, air circulation system in the tropic; Climate classification, World climate regimes; Climate types of India, Indian Monsoon; El Nino & La Nina; Climate control and distribution of plants and animals, Gaia hypothesis, Climate and biosphere-feedback mechanisms, Climate elements in crop production: temperature and crops, frost moisture, drought .

Unit III

Climate and habitable areas; climate and rural housing; climate and buildings; Micro climate and architectural design, modification of macro and micro climates with special reference to urban areas; Human body and heat balance; climate and human health, climate and race temperament, clothing insulation and clothing zones of the world.

Unit IV

Meteorology fundamentals– Pressure, temperature, wind, humidity, radiation, atmospheric stability adiabatic diagrams, turbulence and diffusion; Emission and absorption of terrestrial radiation, radiation windows, Net Radiation Budget- thermodynamic diagram; thermal inversion process ; entropy and enthalpy, thermodynamics of dry and moist air and adiabatic processes; Applications of micrometeorology to vegetated surfaces, urban areas,

human beings, animals; Application of meteorological principles to transport and diffusion of pollutants.

Unit V

Scavenging processes; Effects of meteorological parameters on pollutants and vice versa; Wind roses; Topographic effects; Pollution climatology; theories of climate change: forecasting climate, climate trends and climatic cycles; Preliminary concepts of climate change – global warming , sea level rise, ozone depletion, green house gases, smog, fog formation and dispersal.

M.Sc., Environmental Sciences, 2015-16

Semester I

(CORE COURSE- III)

M1 ENV03-CC03

CREDITS :

04

NATURAL RESOURCES AND THEIR CONSERVATION

Unit-I

Natural Resources : Definition, Types & Classification, Concepts of Reserves & Resource availability, Environmental impacts of resource exploitation, Understanding Resource Ecology & life supporting capacity of Natural Resources- Economic models: Green Building concept & Green technology concept, Natural Resource Management.

Unit-II

Definition of Energy-Types & units; Energy production and consumption pattern of world & India; Renewable and Non renewable Energy Resources, Principles of generation of Hydro electric power, Tidal power, Thermal energy conversion, wind and geothermal energy, Solar energy- Solar collectors, Photovoltaics, Solar ponds & Solar equipments- Heaters, driers, cookers; Harnessing Solar energy, solar electricity generation; Impact of large scale exploitation of solar, wind, hydro and ocean energy, Energy conservation policies.

Unit-III

Non-renewable energy resources: Fossil fuel classification, composition and physico-chemical characteristics; energy content of petroleum and natural gas -formation, reserves, exploration/ Mining and uses of Coal; Environmental problems associated with mining, processing & transportation ; uses of Fossil fuels.

Unit-IV

Bio energy: Biomass, Biogas, Refuse, Organic residues; Biomass fuel types- Solid, liquid and gaseous fuels, Availability of Biomass fuels in India; Biogas production and uses; Conversion processes– pyrolysis, charcoal production, compression, gasification and liquefaction; Anaerobic digestion; Energy from solid wastes- sources , types and energy production; Energy plantations- Carbohydrate crops, petro crops and Energy weeds.

Unit-V

Mineral resources- origin, distribution and uses of economic minerals; Impact of mineral exploitation on environment, conservation of mineral resources; Mineral resources with special reference to Rajasthan; Forest Resource Management: distribution, wood Production , forest land-use changes in India, future demand of forests - carbon sequestrations; Nuclear energy resources-fission and fusion, nuclear fuel types, sustainable use.

M.Sc., Environmental Sciences, 2015-16

Semester I

(CORE COURSE- IV)

M1 ENV04-CC04

CREDITS :

04

ENVIRONMENTAL POLLUTION AND MONITORING

Unit I

Environmental Pollution – concepts & Introduction, Global, regional and local prospective of environmental Pollution; Natural and anthropogenic sources of pollution; primary and secondary pollutants; Transport and diffusion of pollutants; Air pollution: source, effect of gaseous air pollutants on plants and animals, TSP and their effect on plants and animals; Principles of air monitoring; Air Pollution Tolerance Index, effect of meteorological & topographical factors on transport and dispersion of pollutants ; Lotka-voltera, prey-predator model, Gaussian plume model; Air Quality Standards, control of air pollution, Euro standards, Indoor and vehicular air pollution.

Unit II

Water pollution: types, Sources and consequences of water pollution; Principles of water quality monitoring, ecological and biochemical aspects of water pollution ,effects of domestic industrial and agricultural wastes on water bodies, physicochemical and bacteriological sampling and analysis of water quality; water quality standards; water pollutants and their control; Ganga Action Plan; Marine pollution; Thermal pollution.

Unit III

Radiation sources in environment- natural and man made; Sources and classification of Radioactive pollution, effect of radioactive pollution on biological system; Basic properties of noise, sound pressure, loudness and intensity levels, Sources and measurement of noise pollution, noise exposure levels and standards; noise pollution control and abatement measures; Noise survey - equipments and sampling.

Unit IV

Physicochemical and bacteriological sampling and analysis of soil; Sources of Soil pollution, Heavy metals sources and effects on biological systems; Pesticides sources and effect on biological systems, Detrimental effects of soil pollutants on soil micro biota, Ecological consequences and soil pollution control.

Unit V

Sources and characteristics of solid wastes, Environmental Problems associated with solid wastes disposal practices; Solid waste disposal and management, Biomonitoring of air, water and soil environment, concept of indicator species and their environmental significance, Introduction to pollutant- sensitive and resistant plants; environmental impacts of biomedical wastes: sources and waste minimization.

M. Sc. Environmental Sciences, 2015-16

Semester I (PRACTICAL COURSE – CPR-I)

M1 ENV05-CP01

CREDITS-
04

- 1.To determine minimum size of quadrat by species area curve method.
- 2.To study the vegetation by line transect method
- 3.To determine frequency, Density and Abundance of the given area
- 4.Find out the IVI of specified vegetational area
- 5.Find out the similarity and dissimilarity indices between disturbed and undisturbed grassland.
- 6.Determination of pattern (non randomness) in vegetation.
- 7.Estimation of total chlorophyll content of herbaceous vegetation on per square meter of land area basis
- 8.Study of biotic interactions and their ecological significance
- 9.Representation of climate data by
 - (1)Simple graph
 - (2)Hytherograph
 - (3)Rainfall variability graph
 - (4)Wind rose
 - (5)Combine bar and line graph
 - (6)Climograph
- 10.Observation of India weather maps.
- 11.Preparation of wind rose.
- 12.Construction, principle and working of weather instruments : Thermometer, Rain gauge, Anemometer, Barometer, Pedometer, Compass, lux meter ,hygrometer
- 13.To find out Index of Dominance in given area

➤**Spotting:**

- Thermometer,
- Rain gauge,
- Anemometer,
- Barometer,
- Pedometer,
- Compass,
- lux meter,
- hygrometer ,
- weather graph,
- temperature,

- wind rose
- WEATHER GRAPHS
- Biotic interactions: proto cooperation, mutualism, parasitism, amensalism, symbiosis
- Plant interactions : lichens ,root nodules, epiphytes, macrophytes, insectivorous plants

M. Sc. Environmental Sciences, 2015-16

Semester I (PRACTICAL COURSE – CPR-II)

M1 ENV06-CP02

CREDITS-
04

1. Analysis of water samples:

a) PHYSICAL ANALYSIS : Temperature, Turbidity, Conductivity, PH

b) CHEMICAL ANALYSIS : bicarbonates and Carbonates , Total dissolved solids, Total suspended

particulates, Salinity, Free CO₂, Alkalinity, Dissolved oxygen, COD, BOD, Primary productivity, Phosphate, Silicate, DOC & DOM , Total hardness, Nitrates, Chlorides

2. To study faecal coli forms in water sample by M.P.N. method

3. Qualitative and quantitative analysis of water samples for zooplanktons and phytoplanktons.

4. Preparation of field report of any case study carried out in any areas to assess the pollution status.

5. Temporary slide preparation of phyto and zooplanktons

➤ SPOTTING :

- Sampling equipments : BOD Bottle, Sechhi disc, Plankton net, components of simple and compound microscope
- Phytoplanktons : microcystis, anabena, volvox, nostoc, occillatoria,
- Zooplanktons: moina, Cyclops, Daphnia, zoea larva, chironomus larva, nauplius larva, ticks, mites

M.Sc., Environmental Sciences, 2015-16

Semester II

(CORE COURSE- V)

M2 ENV01-CC05

**CREDITS :
04**

BIODIVERSITY CONSERVATION

Unit I

Concepts and component of biodiversity- genetic, species and ecosystem biodiversity, evolution of organisms & distribution in space and time, levels of biodiversity, biodiversity indices, value of biodiversity, biodiversity trends, modern techniques of measurement and monitoring of biodiversity, bio prospecting, patent protection and bio piracy .

Unit II

Major threats to biodiversity, IUCN threat categories, Red data book, threatened plants & animals of India; Endangered flora and fauna of India and Rajasthan, Mega diversity zones of India, Hot spot concept and hot spots of India, Biodiversity informatics, International efforts in biodiversity conservation

Unit III

Conservation of biodiversity- *In-situ*- Sanctuaries, biospheres Reserves, National Parks, Nature Reserves, Preservations plots; *Ex-situ* - Botanical gardens, Zoos, Aquaria, Home Garden & Herbarium, In vitro conservation: Germplasm & gene banks, tissue culture, pollen and spore bank, DNA bank; Wildlife reserves in India, Theory of reserve design, Restoration of biodiversity; Ecosystem people and traditional conservation mechanism; Importance of biodiversity in Ecotourism; endemic flora and fauna of tropics and India with special reference to Rajasthan

Unit IV

National and International programmes for biodiversity conservation; Conservation of wildlife - significance and status of India, Wildlife reserves- Biosphere and nature reserves, Project tiger, sanctuaries and national parks in India; Impact of tourism on wildlife and problem in wildlife protection; Role of WWF,WCU,CITES, TRAFFIC .

Unit V

Conservation of forests; Indian strategies and planning; Agroforestry, Social forestry; Management of forest products; Forests and tribals; Chipko Aandolan; Coral reefs, mangroves and estuarine biodiversity and their conservation; wetland conservation with special reference to Rajasthan; Biodiversity and agenda-21; Biodiversity conventions.

M.Sc., Environmental Sciences, 2015-16

Semester II

(CORE COURSE- VI)

M2 ENV02-CC06

**CREDITS :
04**

ENVIRONMENTAL CHEMISTRY

Unit –I

Concept and Scope of Environmental Chemistry; segments of environment; Principles and cyclic pathways in the environments; Chemistry of Biologically Important Molecules: Chemistry of Water: Unusual physical properties, hydrogen bonding in biological systems, unusual solvent properties, changes in water properties by addition of solute. Protein structure and biological functions, enzymes, enzyme metabolism.

Unit - II

Basic chemistry: Structure of atoms, their properties, their nuclear stabilities and their arrangement in the periodic table; fundamentals of chemical thermodynamics and solution formation-Normality, Molarity, Molality, Molecular weight, Equivalent weight, Mole concept; basic organic chemistry and biochemistry; Stoichiometry, Gibb's energy, Chemical potential, chemical equilibria, acid-base reactions; Solubility product, solubility of gases in water, the carbonate system, unsaturated and saturated hydrocarbons.

Unit – III

Classification of elements, chemical speciation, Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter; Thermochemical and photochemical reactions in the atmosphere; Basic concepts of surface and interface chemistry: Absorption, adsorption, catalysis; collides, surfactants; carbonate system, radionuclides, radioactivity, decay of parent and growth of daughter nuclides & methods of radiometric dating; C14 dating system and procedure, stable isotopes – their fractionation and application to geo thermometry and paleo climates.

Unit – IV

First law of thermodynamics, enthalpy, adiabatic transformations; second law of thermodynamics, Carnot's cycle, entropy, Gibb's free energy, chemical potential, phase equilibria, Gibb's Donnan equilibrium; third law of thermodynamics, enzymes catalysis,

Michaelis/ Menten equation; Concept, principle and utility of green chemistry, green reagents, green catalysts, industrial interest in green chemistry.

Unit – V

Oxygen and ozone chemistry, Chemistry of air pollutants, Photochemical Smog, Chemistry of water, concept of D.O., B.O.D., and C.O.D. Water treatment: Sedimentation, Coagulation, Filtration, tertiary and advanced treatment; Redox potential; Inorganic and organic components of soil; nitrogen pathways and NPK in soils. Bio transformation and bio magnification; Principles of photo chemistry- Photo chemical & photo sensitized reactions, energy transfer.

M.Sc., Environmental Sciences, 2015-16

Semester II

(CORE COURSE- VII)

M2 ENV03-CC07

**CREDITS :
04**

Environmental Sustainability and Management

Unit I

Introduction, concept and scope of environmental management; Systems and approaches, environmental management of resources-water, forest, biological, minerals and agriculture; International summits and treaties-Vienna convention, Montreal protocol, Kyoto protocol, Copenhagen convention

Unit II

Sustainable development –concept & growth of idea, indicators of sustainability, Sustainable use of natural resources, Sustainability in industry and agriculture, eco restoration, green funding

Unit III

Basic concept of environmental economics, International trade & environmental integrity, eco labeling, eco marketing, current environmental issues in India- case studies, Narmada Dam, Tehri & Almeti dam; the role of risk assessment in environmental Management decisions.

Unit IV

Management systems-Quality, environment, Health and safety, Social responsibility (ISO 9000, 14000,18000, 8000); international organization of standardization (ISO) and their clarification; Relation of EIA to Sustainable development;

Unit V

Environmental Management of Industrial pollution, Management of Pollution due to mining, chemical & manufacturing industries (Petroleum, coal, cement, Paper & fertilizer)

M.Sc., Environmental Sciences, 2015-16

Semester II

(CORE COURSE- VIII)

M2 ENV04-CC08

**CREDITS :
04**

Environmental Hazards and Management

Unit I

Introduction to hazards, classification and types: –Natural Hazards, Chemical hazards, Physical hazards, Biological hazards; Basics of hazard management and mitigation, natural Hazards –causes, continental drift, plate tectonics and sea floor's spreading; hazard analysis, potential risk; Human perturbation and natural hazards – impact of deforestation, land use and developmental activities on natural hazards, Role of climate change; Man Made hazards - Dams & reservoirs, NPP; Desertification-causes, evaluation, Mitigation.

Unit II

Natural Disasters: nature, causes and effect, Cyclone, tornadoes, floods, earthquakes, avalanches, Tsunami ,land slides, drought, fires, volcanism, Case study of disasters- community reaction to disasters, coping mechanism; disaster management-pre disaster phase, actual disaster phase, post disaster phase.

Unit III

Disaster assistance-technological assistance, relief camps, food requirement, water needs, sanitation security, information administration, fire fighting training, Safety Measures – a general account, emergency rescue, disaster education- alternatives and new direction, Forecasting and warning systems

Unit IV

Concept of disaster recovery- mitigation and preparedness, program planning and management, Vulnerability analysis, Training needs – Target Groups, emergency preparedness plan, occupational risk analysis survey and health evaluation, behavioral studies, Man-made disasters- occupational injury, Industrial Safety Management Techniques – Industrial Safety Standards, Industrial Accidents and Disasters - Frequency Rate, Prevention and Control; Dispersion of Radioactive material and release of Toxic and inflammable materials

Unit V

Environmental hazards, protective measure while handling hazardous substance, hazardous waste disposal. Hospital waste handling and disposal, guidelines for their disposal, fire and explosion hazards, radiation hazards. Case studies related to hazardous waste accidents, simplified measures for their assessment. Various diseases related to handling of hazardous waste. Nasal cancer and other fatal diseases- their symptoms, prevention and control.

M. Sc. Environmental Sciences, 2015-16

Semester II

(PRACTICAL COURSE – CPR-III)

M2 ENV05-CP03

CREDITS-
04

1. Find out the percentage frequency values of grassland species using 1 x 1 size quadrat. Classify the species into frequency classes A to E and prepare the frequency diagram. Compare result with Raunkiers standard frequency diagram.
2. Determine the biomass of producers.
3. Find out the effect of various quadrat size 25 x 25, 50 x 50, 75 x 75 and 1 x 1 m on percentage frequency result on same grassland plot considered in exercise 1
4. Find out the species diversity index in disturbed and protected vegetation area.
5. Find out the leaf area index of crop field.
6. Study of anatomical features of ecological adaptation in selected hydrophytes and xerophytes.
7. Study of climatic conditions obtained in open field and under the shade of trees for temperature, light intensity, wind velocity, R. Hand comparison of ground vegetation of these areas.
8. To determine the age of forest patch by DBH.
9. To determine the vegetation by Point frame quadrat method.

➤ Spotting:

- **Xerophytes:** Nerium – Stem & leaf; calotropis stem; capparid stem; pinus needle; opuntia; euphorbia, casurina
- **Hydrophytes:** Ecchornia, Hydrilla, trapa, nymphaea, chara, potamogeton, scirpus, nelumbo
- Point frame
- **Xerophytic animals:** Phrynosoma, draco

·**Aquatic animals:** exocetus, hyla, gappi, katla, Rohu, gambusea

M. Sc. Environmental Sciences, 2015-16

Semester II

(PRACTICAL COURSE – CPR-IV)

M2 ENV06-CP04

CREDITS-
04

1. Analysis of Soil samples

(1) Texture

(2) Moisture

(3) pH

(4) conductivity

(5) Water holding capacity

(6) Bulk density & porosity

(7) Calcium carbonate

(8) Sulphate

(9) Carbonate and bicarbonate (10) Organic carbon & organic matter (11) Chlorides

(12) Nitrates (13) Available phosphorus

2. To compare the wilting coefficient of a xerophytic and mesophytic plant.

3. Assessment of noise pollution in different zones of the city by Sound level meter.

4. Study of soil for biotic components like bacteria, fungi & soil nematodes.

➤ Spotting:

· Instruments- Spectrophotometer, sound level meter, colorimeter, refrigerated centrifuge

· Foot prints- of wild animals as available for demarcation of territory.

· Soil fauna- Micro & macro fauna: Millipede, centipede, earthworm, nematodes, actinomycetes

· Soil fungi and soil bacteria

· Sieves set for soil texture

M.Sc., Environmental Sciences, 2015-16

Semester III

(CORE COURSE- IX)

M3 ENV01-CT 09

CREDITS :

04

Environmental engineering and Waste management

Unit I

Waste water treatment-primary, secondary and tertiary treatment; various technologies related to water treatment- ozonation, chlorination, reverse osmosis, ion exchange, disinfection, coagulation, UV treatment

Unit II

Air pollution control technologies-wet scrubbers, electro static precipitators, cyclone separator, gravitational settling chambers , bag filters, adsorption and absorption methods, incineration.

Unit III

Solid waste treatment technologies: land fill & sanitary land fill, composting, incineration; hazardous and industrial waste management; municipal solid waste management.

Unit IV

Energy conservation: renewable energy technologies-solar, wind, bio energy, geothermal, hydro power; nuclear energy production-process and functioning of nuclear reactors.

Unit V

Effluent treatment plant (ETP) & sewage treatment plant (STP) - design and working;
eutrophication – control and management procedure; reuse and recycling of plastic
and metals

M.Sc., Environmental Sciences, 2015-16

Semester III

(CORE COURSE- X)

M3 ENV02-CT 10

CREDITS :

04

ENVIRONMENTAL LAWS AND ETHICS

Unit – I

Environment (protection) act 1986; Environmental (prevention) rules 1986; Central and state boards for prevention and control of air and water pollution; provision of constitution of India regarding environment (Article 48 A & 58 A).

Unit - II

Air (prevention and control of pollution) Act 1981; Air (prevention and control of pollution) Amendment Act 1987 and rules 1982; The Water (prevention and control of pollution) Act 1974;

Unit - III

The water (prevention & control of pollution) amendment 1988 & rules 1975; Legislation related to forest and wild life conservation; Forest Conservation Act 1980; Indian Forest Act, 1970, revised 1982; Wildlife Protection Act 1972 and amendment 1991; Biological Diversity Act, 2002.

Unit - IV

Code of criminal procedure and environmental protection; guidelines issued by the government of India for inspection of Industries under pollution control laws; Scheme of labeling of environmentally friendly products (ecomark); Public liability Insurance Act. 1991; Environment guidelines for industries which required industrial licensing, Industrial licensing procedure; Environmental Clearance Process; Consents for handling hazard substances; Environment protection issues & problems, international & national efforts for environment protection,

Unit - V

Environmental ethics : Concept and definition ; Anthropocentrism and Ecocentrism;
Indian situation of ethics; shallow and deep ecology

M.Sc.,

Environmental Sciences, 2015-16

Semester III

(DISCIPLINE SPECIFIC COURSE- I)

M3 ENV03-DT O1

CREDITS : 04

ENVIRONMENTAL TOXICOLOGY

Unit I

Toxicology: definition, Origin, classification & general nature of toxicants in environment; Principles in toxicology: Concept of dose response relationship, Chronic toxicity, Sub acute toxicity and acute toxicity, concept of LC 50 & LD 50, Median tolerance limit, Statistical concepts of LD₅₀; Safe limits, MATC, threshold concentration, NOEL,NOAEL & bioaccumulation; Risk assessment; Biological and chemical factors that influence toxicity; Influence of ecological factors on the effects of toxicity.

Unit II

Toxicity testing: Holistic and numeric approach; Drug toxicity and abuse; Heavy Metal toxicity in animals; mutagenesis ,Teratogenicity and carcinogenicity; Practical problems in toxicity testing; Global dispersion of toxic substance; Dispersion and circulating mechanisms of pollutants; degradable andnon-degradable toxic substances in food chain; Eco-system influence on the fate and transport of toxicants.

Unit III

Route of entry of pollutants into ecosystem-Surface water, land, Air; Uptake of toxic substances by plants, metabolic basis of toxicity of SO₂, NO₂, O₃ and heavy metals in plants; Microbial transport of toxic metals; Air and water borne toxins and diseases; Radiation toxicity and safety measures; Biomonitoring and bioindicators of toxicants; response of ecosystem to toxicants ; biodegradable andnon-biodegradable toxic substance.

Unit IV

Uptake of toxic substances by animals; Accumulation and chemical localization of toxic substances by animals; detoxification and excretion of toxic substances by animals; Metabolism of toxic substances by animals.; Aquatic toxicity testing ,Response of planktons to animals; pest & pesticides: classification, surveillance, resistance & residual effects.

Unit V

Toxic effect of pollution on terrestrial animals; xenobiotics in environment, bioconcentration, biological and non biological degradation, detoxification; chemical hazard assessment and communication; Information management system in Eco-toxicology; fumigatoris and masticatoris; Microbial toxicology-concepts and principle , Algal toxins, Mycotoxins, Cynobacteria; Eco toxicology- legal perspectives and animal ethics.

M.Sc., Environmental Sciences, 2015-16

Semester III

(DISCIPLINE SPECIFIC COURSE- II)

M3 ENV04-DT O2

CREDITS :

04

Instrumentation and Environmental Analysis

Unit I

Basic concepts of instrumentation, current, voltage and power; pH meter, conductivity meter, TDS meter, Visible spectrophotometer, Homogenizer, Autoclave, colony counter.

Unit II

Introduction of basic field instruments: Handy air sampler, Noise level/Sound level meter; lux meter; pedometer; compass; Anemometer; High volume air sampler-construction, principle and working.

Unit III

Introduction to advanced concepts of Instrumentation –theory, principle & working and application of UV- Spectrophotometer, flame photometer, CO₂ analyzer, AAS, methane analyzer, refrigerated centrifuge, plant growth chamber, HPLC, gas chromatography, Paper chromatography, NMR, X-ray, Infrared gas analyzer.

Unit IV

Introduction to solution preparation; calculation of concentration of solution using specific gravity and molecular weight; units of concentration of solution; inter conversion; ionic product of water, pH, p_{OH}, buffer solutions.

Unit V

Selection of sampling sites, analytical methods and selection of appropriate analytical technique; sample blank preparation and solvent blank preparation ; efficiency of sampling; preparation of serial dilutions and standard curves for air, water,soil and plant analysis.

M. Sc. Environmental Sciences, 2015-16
Semester III
(PRACTICAL COURSE – CCPR-V)

M3 ENV05-EP01

CREDITS-
O4

1. Determination of the dust capturing capacity and percent leaf area injury of selected plant species.
2. Effect of heavy metals on seed germination and early seedling growth.
3. Effect of heavy metals on ascorbic acid content in plant leaves.
4. Effect of heavy metals on chlorophyll content, soluble protein, phenols and carbohydrates.
5. To calculate the LC 50 in fishes for heavy metals calculation of MATC and threshold concentration.
6. Short term bioassay lists of industrial pollutants in relation to fresh water animals.
 - a) Calculation of 96 hours LC 50
 - b) Assessment of threshold concentration.
 - c) Calculation of MATC (Maximum acceptable toxicant concentration)
 - d) Calculation of application factor or safe concentration)
7. Observation of stomatal movement and measurement of stomatal aperture
8. Observation of various stages of cell division in onion root tips with special reference to heavy metals
9. Observation of plant cell structure in onion peel
10. Study of petiole plants and energy weeds
11. Principle, construction and working of biogas plant

➤ **Spotting :**

- Study and identification of minerals and rocks.
- Toxicity curves
- Heavy metal identification

- Principle & working of STP's and ETP's
- Identification and study of coal : bituminous, lignite, anthracite, peat
- Biomass pellets
- Different types of woods : briquettes
- Solar equipments: solar cooker, solar lantern, solar water heater, solar dryer, photovoltaic cell

M. Sc. Environmental Sciences, 2015-16
Semester III
(PRACTICAL COURSE – DSE PR-I)

M3 ENV06-EP02

CREDITS-
O4

1. Working and principles of handling various equipments:

- a) High volume air sampler
- b) Spectrophotometer
- c) Refrigerated centrifuge
- d) Homogenizer
- e) Flame photometer
- f) Gas analyzer
- g) Growth chamber
- h) Atomic Absorption Spectrophotometer
- i) Autoclave
- j) Polarograph
- k) Muffle furnace
- l) Bomb calorimeter

Diagram, working and instrumentation of all the equipments mentioned above

➤ **Spotting :**

- pH meter, conductivity meter, TDS meter, turbidity meter, weigh balance
- Identification and study of local and migratory birds in and around the wetlands of Udaipur
- Study and ecological significance of endemic plants and animals of southern Rajasthan
- Field excursion

M.Sc., Environmental Sciences, 2015-16

Semester IV

(CORE COURSE- XI)

M4 ENV01-CT 11

CREDITS :

04

ENVIRONMENTAL AND OCCUPATIONAL HEALTH

Unit I

Basic principle of environmental health; Environmental factors and human health; Physiological responses of man to relevant stresses in the environment; Disease causing infectious organisms (Virus, bacteria, and parasites); teratogens and mutagens; Detailed account of AIDS and sexually transmitted diseases (STD); Environmental health management.

Unit II

Air pollution and human health; causes of air pollution and air borne diseases, Soil pollution- Sources and effect on human health; Water pollution- sources and effects on human health; water borne diseases; Risk assessment and preventive measures; Toxicogenomics- interaction of pollutants with biological systems at different levels-organism, organ and organelles.

Unit III

Environmental health management in India; Occupational health safety and health administration; Environmental health in indigenous tribal communities- problems and remedies; Environmental health protection - Issues and problems ;Industrial safety management techniques and standards.

Unit IV

Definition of occupational health, Occupational hazards and associated diseases- silicosis, anthrax and other lung diseases; WHO standards of working conditions; factors affecting occupational health (physical, chemical and biological); prevention of occupational diseases; Various international organizations (WHO, ILO, UNICEF) on human health, Lead poisoning, occupational cancers, Dermatitis.

Unit V

Nuclear pollution and human health- case studies; Agriculture chemicals and human health; Hazardous wastes- human health and management; Noise pollution and human health hazards; Human health education and awareness. Hazard evaluation in polluted environment with specific emphasis on radiological health; causes and consequences of hazardous wastes in soil, water and air with respect to human health; Industrial hygiene application and statistical methods through medical records, in study of health problems of human population in green environment

M.Sc., Environmental Sciences, 2015-16

Semester IV

(CORE COURSE- XII)

M4 ENV02-CT 12

CREDITS :

04

ENVIRONMENTAL PLANNING AND BIOSTATISTICS

Unit I

Basic concepts of Environmental planning; Environmental problems of urban planning; Environmental policies.

Environmental priorities in India; urban planning; rural environmental planning; national and state

Unit II

Land use and degradation; land use planning; waste land and their reclamation; water logging; Salinization of lands; strategies for sustainable land management.

Unit III

Watershed management and planning in India; Structure and functioning of MOEF, CPCB, SPCB; wetlands planning and management; eco friendly technologies for natural resources.

Unit IV

Fundamentals of bios statistics -basic concept & introduction to sampling methodology; measures of central tendency and graphical representation of data: Mean (arithmetic, harmonic and geometric), Median and Mode; Measures of central tendency & dispersion; skewness and kurtosis, Poisson and binomial distribution; Standard deviation; Standard error of mean.

Unit V

Null hypothesis, t test and pair T test; Chi square test, Coefficient of association (measure of association); Analysis of variance; Probability –definition, addition and multiplication laws; concept of random variable; Correlation coefficient- testing of significance of correlation coefficient; Regression coefficient and the line of best fit; relationship between correlation

and regression; introduction to multivariate methods for environmental sciences – ANOVA (one way & two way), PCA, factor analysis and clusteranalysis.

M.Sc., Environmental Sciences, 2015-16

Semester IV

(DISCIPLINE SPECIFIC COURSE- III)

M4 ENV03-DT O3

CREDITS :

04

ENVIROMENTAL IMPACT ASSESSMENT

Unit-I

Introduction to environmental impact assessment; origin and development of environmental impact assessment; relationship of environmental impact assessment to sustainable development; basic concepts, objectives and its significance of EIA; EIA guidelines -1994 and modified in 2006; Generalized approach to impact analysis.

Unit II

Environmental Impact statement process; environmental impact assessment methodologies- Adhoc method; Check list methodologies-Matrix method, LCA method

Unit III

Introduction to environmental planning, Baseline Information and predictions- land, water, atmosphere, energy and socio-economic status and demographic profile; environmental audit- guidelines concept and process; concept of public participation- public hearing; ISO 9000,14000 & 18001.

Unit IV

Prediction and assessment of impact on water, air, Noise, soil and biological systems; cost benefit analysis.

Unit V

R & R plan(Act).2007; Green belt development; National environmental policies and guidelines in India; condition and approach for EIS review; Case–studies-River valley projects, Thermal power plants, Mining projects, Dams and reservoirs, Oil refineries,

Petro chemicals, national Highway Projects; Identification and prediction of Impact mitigation measures.

M.Sc., Environmental Sciences, 2015-16
Semester IV
(DISCIPLINE SPECIFIC COURSE- IV A)

M4 ENV04-DT O4

**CREDITS :
04**

ENVIRONMENTAL MICROBIOLOGY AND BIOTECHNOLOGY

Unit-I

Classification, characteristics, occurrence, distribution and ecological importance of microorganisms; Photo autotrophs, chemo lithotrophs, organotrophs, parasites and their environmental importance; Soil microorganisms and their interactions relative to soil fertility; Detection of microbial toxins.

Unit-II

Fermentation technology; wastes as a source of microorganism; compost and processes of composting; factors effecting the process of composting; microbes in biogas production, microbes in hydrogen and hydrocarbon production; application of immunofiltration; immunoprecipitation and DNA probing methods for detection of microbial pathogens in aquatic environment.

Unit III

Environmental biotechnology- scope and application, scope of cleaner technology, tools and techniques of biotechnology; Application of plants tissue culture technology for micro propagation of stress tolerant plants.

Unit IV

Microbes and their genetic engineering for degradation of pollutants; Application of microbes as biofertilizers and biopesticides; Microbes in bio mining, bio hydrometallurgy and bio mineralization; Application of recombinant DNA technology for improvement of

bacterial strains; Microbial degradation of Xenobiotics, Microorganism in abatement of heavy metal pollution; Bioremediation

Unit V

Principle and application of biosensors for detection of pollutants; Risk assessment for recombinant biosensors; Anaerobic biotechnology for sustainable waste treatment; oil spills-causes and recovery; Biodegradation of petroleum (hydrocarbon); use of super bugs for removal of oil spills; Aero microbiology, Aeroallergens and microbial pathology in human health.

M.Sc., Environmental Sciences, 2015-16
Semester IV
(DISCIPLINE SPECIFIC COURSE- IV B)

M4 ENV04-DT O4

**CREDITS :
04**

Restoration Ecology

Unit I

Contaminated lands: Types of contaminated lands and contaminants; effects of contaminants on biota; Ecology of Disturbed Ecosystems: disturbance and its impact on the structure and functioning of terrestrial and aquatic ecosystems; Types of waste and its characteristics.

Unit II

Aims and strategies of restoration: Concepts of restoration, single vs. multiple endpoints; ecosystem reconstructions; physical, chemical, biological and biotechnological tools of restoration; Restoration of biological diversity: Acceleration of ecological succession, reintroduction of biota.

Unit III

Degradation and restoration of natural ecosystems: Forests, Grasslands, Savanna, Aquatic; Selection of plant species for restoration

Unit IV

Restoration of degraded soils: Restoration of contaminated soils and soil fertility; mine spoil restoration. Phytoremediation, phytostabilization, rhizofiltration, phytodegradation, Conditioning strategies

Unit V

Advances and possibilities in phytoremediation: Plant biochemistry, genetic engineering, transgenic plants, use of bacteria. Application and performances; Case studies: In India and abroad

M. Sc. Environmental Sciences, 2015-16

Semester IV

(PRACTICAL COURSE – CCPR-VI)

M4 ENV05-EP03

**CREDITS-
04**

1. To determine the LAI, chlorophyll content, soluble leaf protein, ascorbic acid, phenol, carbohydrate and air pollution tolerance index (APTI) of selected plants species and comparison of plants for their relative susceptibility to pollution
2. Permanent Preparation of slides- xerophytes, hydrophytes, zooplankton and phytoplankton in polluted and non polluted areas.
3. Assessment of respiratory activity with increasing branch diameter
4. Qualitative and Quantitative analysis of plant enzymes
5. Estimation of chlorophyll a, b and total chlorophyll from commercial, roadside and industrial areas.
6. Estimation of crude proteins
7. To evaluate bryophytes and lichens for their sensitivity to different pollutants
 - (a) Number of species
 - (b) Degree of cover
 - (c) Frequency of each species
 - (d) Growth and development
 - (e) Biomass
 - (f) Chlorophyll content
8. Use of animals in terrestrial and aquatic ecosystem as bio indicators/ bio monitors (mammals/micro arthropods/earthworms/wood lice/molluscs)

M. Sc. Environmental Sciences, 2015-16

Semester IV

(PRACTICAL COURSE – DSE PR-II A)

M4 ENV06-EP04

**CREDITS-
04**

1. Test the difference between means of two samples using 't' test and paired t test.
 2. To determine the correlation between two variables.
 3. Test of null hypothesis by computing SE of difference between two means.
 4. To determine the association between two species by using chi-square test.
 5. To determine mean, median and mode between various samples.
 6. Introduction of biotechnological tools and techniques: principles and applications.
 7. Isolation and culture of excised plant parts for micropropagation studies.
 8. Isolation, purification and identification of aerobic bacteria from different soil and water sources.
 9. Application of stage and ocular micrometer for measurements of microbes.
 10. Preparation of different type's media for culture of bacteria, algae and plant tissues.
 11. Isolation, purification and identification of mycorrhizal fungi.
 12. Demonstration of biogas production by methanogen bacteria.
 13. Study of the following:
 - a) Organisms as bio fertilizer- *Azolla*, *Anabena*, *Nostoc*, *Aulosira*, *Plectonema*, *Oscillaloria*, *Tolypothrix*, *Glomus*, *Gigaspora*, *Sclerocystis*, *Rhizobium*
 - b) Different stages of micropropagation -shoot multiplication, rooting, in vitro hardening
- **Spotting :**
- Laminar Flow
 - Auto Clave
 - Hot Air oven
 - Sterilizer
 - Spirit lamp
 - Instruments for inoculation
 - Plant growth chamber

- Micro Pipette
- Stage & ocularMicro meter
- Compound Micro scope