DEPARTMENT OF ENVIRONMENTAL SCIENCES

MAHARSHI DAYANAND UNIVERSITY, ROHTAK

SESSION: 2016-17

M.Sc. Environmental Science

Program Specific Outcomes

PSO1 The program addresses the problems of modern society in areas related to water, air, health and energy through teaching and research.

PSO2 Awareness among the society through students would be created about the role of environment in our daily lives.

PSO3 The students would attain academic excellence and professional competence to serve the society and environment.

PSO4 The introduced choice based credit system in the program offers more flexibility and opportunity to students to earn credits across departments with wider choice outside their discipline of study, thus enabling the flexible learning

PSO5 Students would be trained in industries which enhances the employability and innovative skills.

PSO6 Curriculum design is based on recent topics and advances in technology and project work is mandatory. Students are encouraged to do research based and application oriented projects.

Credit matrix for M.Sc. Environmental Science Program

Semester	Hard Core	Soft core	Interdisciplinary	Foundation course	Dissertation	Total
I	20T+8P	-	-	-	-	28
II	12T+6P	4+2P	3	2	-	29
III	8P+4P	8T+4P	3	-	-	27
IV	8T	-	-	-	20	28
Total	66	18	6	2	20	112

Scheme of M.Sc. Environmental Science Program

Semester-1

S.No.	Course No.	Nomenclature of Paper	L-T-P (Hours)	Credits	Evaluation Scheme		
					Theory	IA	Total
1	16ENV21C1	Environmental Toxicology	4-0-0	4	80	20	100
2	16ENV21C2	Environmental Biology	4-0-0	4	80	20	100
3	16ENV21C3	Analytical Techniques	4-0-0	4	80	20	100
4	16ENV21C4	Environmental	4-0-0	4	80	20	100

		Pollution					
5	16ENV21C5	Solid Waste Management	4-0-0	4	80	20	100
6	16ENV21C6	Lab Course-I	0-0-8	4	-	-	100
7	16ENV21C6	Lab Course-II	0-0-8	4	-	-	100

Total Credits:28

Total Marks: 700

Semester-2

S.No.	Course No.	Nomenclature of Paper	L-T-P (Hours)	Credits	Evaluation Scheme		
					Theory	IA	Total
1	16ENV22C1	Natural Resources	4-0-0	4	80	20	100
2	16ENV22C2	Biodiversity	4-0-0	4	80	20	100
3	16ENV22C3	Biostatistics & Environmental Modelling	4-0-0	4	80	20	100
4	16ENV22C4	Lab Course-III	0-0-12	6	-	-	150
5	16ENV22D1 16ENV22D2 16ENV22D3 16ENV22D4	Waste water treatment Environmental Geology Resource Management Concept of Biochemistry	4-0-0	4	80	20	100
6	16ENV22D5	Lab Course-IV	0-0-4	2	-	-	50
7		Foundation Course	2-0-0	2	40	10	50
8	16EN01	Open Elective	3-0-0	3	80	20	100

Total Credits:28

Total Marks: 750

Semester-3

S.No.	Course No.	Nomenclature of Paper	L-T-P (Hours)	Credits	Evaluation Scheme		
					Theory	IA	Total
1	16ENV23C1	Environmental Chemistry	4-0-0	4	80	20	100
2	16ENV23C2	Remote Sensing and Geographical Information System	4-0-0	4	80	20	100
3	16ENV23C3	Lab Course-V	0-0-8	4	-	-	100
4	16ENV23D1	Environmental Impact	4-0-0	4	80	20	100

	16ENV23D2 16ENV23D3	Assessment Bioremediation Agriculture and Environment					
5	16ENV23D4 16ENV23D5	Elementary concept of Physical Environment Environmental Microbiology	0-0-4	2	-	-	50
6	16ENV23D6	Lab Course-VI	0-0-8	4	-	-	100
7	16EN02	Open Elective	3-0-0	3	80	20	100

Total Credits:27

Total Marks: 700

Semester-4

S.No.	Course No.	Nomenclature of Paper	L-T-P (Hours)	Credits	Evaluation Scheme		
					Theory	IA	Total
1	16ENV24C1	Environmental Law	4-0-0	4	80	20	100
2	16ENV24C2	Environmetal Managment & Planning	4-0-0	4	80	20	100
3	16ENV24C3	Dissertation	0-0-40	20	-	-	300

Total Credits:27

Total Marks: 700

Grand Total Marks-2650

Grand Total Credits- 112

Semester -1

16ENV21C1 Environmental Toxicology

Course Outcomes

CO1 Students would get awareness about toxicity of chemicals in Environment.

CO2 Students will understand about toxic substances & xenobiotics and their mode of entry into human beings.

CO3 Students would understand about the possible imbalance of major and trace elements in human beings.

CO4 Students would know about biogeochemical factors and effect on environmental health.

Max. Marks: 80

Time: 3 Hours

Unit – I

Toxic chemicals in the environment - air, water & their effects, Pesticides in water, Biochemical aspects of arsenic, cadmium, lead mercury, carbon monoxide, ozone and PAN pesticide.

Unit - II

Mode of entry of toxic substance, Process of biotransformation of xenobiotics, Carcinogens in air, chemical carcinogenicity, mechanism of carcinogenicity, Environmental carcinogenicity testing.

Unit - III

Insecticides, MIC effects, Concept of major, trace and Rare Earth Element (REE)- possible effects of imbalance of some trace elements and human health, classification of trace elements, Mobility of trace elements.

Unit- IV

Biogeochemical factors in environmental health, Epidemiological issues goiter, fluorosis, arsenic poisoning, Diseases induced by human use of land.

References

- Environmental chemistry - Sodhi
- Principals of Environmental chemistry - Manhan
- Environmental hazards & human health R.B. Philip
- Toxicology - principles & applications - Niesink & Jon devries
- Parasitology - Chatterjee
- Preventive & Social medicines – Perk

16ENV21C2 ENVIRONMENTAL BIOLOGY

Course Outcomes

CO1 Student would be able to understand the vital connections between plants, animals and the world around them.

CO2 Student wouldlearnprinciple, scope of ecology and ecosystem stability along with its regulation.

CO3 Students would be able to analyse the roles of organisms as part of interconnected food webs, populations, communities and ecosystems

CO4Students would get sufficient knowledge and understand the significance of competition, Predation, dispersal, mortality and survival strategies for changes and fluctuations in population sizes.

Max. Marks: 80
Time: 3 Hrs.

UNIT - I

Definition, principles and scope of ecology, human ecology and human settlements, evolution, origin of life and specification, Ecosystem stability-cybernatics and ecosystem regulation, evolution of biosphere.

UNIT - II

Ecosystem structure and functions, abiotic and biotic component, Energy flow, food chain, food web, Ecological Pyramids-types, biogeochemical cycles, ecological succession, Ecads and ecotypes.

UNIT - III

Population ecology- density, natality, mortality, survivorship curves, age distribution, growth curves and models, r & k selection, population interactions- Mutualism, Parasitism, Predator-Prey relations, System Theory and Ecological Model.

UNIT - IV

Earths major ecosystem - terrestial and aquatic ecosystem, soil microorganism and their functions, coastal management, criteria employed for disposal of pollutants in marine ecosystem, coastal water system and man-made reservoirs, biology and ecology of reservoirs.

References

- Basic ecology - E. P. Odum
- Ecology and field biology - R.L. Smith
- Ecology - P.D. Sharma
- Fundamentals of ecology -E.P. Odum
- Principles of ecology – Rickleff

16ENV21C3AnalyticalTechniques

Course Outcomes

CO1 Students would learnprinciples, instrumentation and applications of Spectrophotometry, Microscopy, Chromatography, Electrophoresis, Autoradiography, Centrifugation, X-ray florescence, X-ray diffraction etc.

CO2 The students wouldbe trained in the operation of instruments based on these techniques.

CO3 Students would learn the optimization of these techniques,so that they can make use of these techniques for the purpose of environmental analysis.

CO4 Students would be able solve the troubleshooting during the analysis of the samples.

Max. Marks : 80

Time : 3 Hours.

Unit - I

Principles and application of Spectrophotometry (UV-Visible spectrophotometry), Titrimetry, Gravimetry, Colourimetry, NMR, ESR, Microscopy-phase, light and flourscence microscopes, Scanning and Transmission electron microscopes.

Unit - II

Chromatographic techniques (Paper chromatography, thin layer chromatography, ion exchange chromatography, Column chromatography), Atomic absorption spectrophotometry, cytophotometry and flow cytometry, Fixation and staining, Principles and techniques of nucleic acid hybridization and Cot curves, Plasma emission spectorocopy.

Unit - III

Electrophoresis, solid and liquid scintillation, X-ray florescence, X-ray diffraction. Flame photomtery, Gas-liquid chromatography, High pressure liquid chromatography – auto radiography, Ultracentrifugation.

Unit- IV

Methods for measuring nucleic acid and protein interactions, DNA finger printing Molecular markers RFLP, AFLP, RAPD, Sequencing of proteins and nucleic acids, southern, northern, western blotting techniques, PCR polymerase chain reaction.

References

- Principles of Biophysical chemistry - Uppadahay -Uppadahay and Nath.
- Analytical Techniques - S.K. Sahani

16ENV21C4Environmental Pollution

Course Outcomes

CO1 Students would come to know the air pollution, their sources and behavior of pollutants in the atmosphere and methods for monitoring air pollution.

CO2 Students would study about the water pollution including sources and its consequences. They will learn about how to analyze the water quality and the treatment of wastewater.

CO3Students would know about soil pollution, analysis of soil quality control of soil pollution and the interaction of these pollutants with soil components.

CO4 Students would get the sufficient knowledge regarding noise pollution and marine pollution, their sources and control.

Max. Marks: 80
Time: 3 Hrs.

UNIT - I

Air pollution- natural and anthropogenic sources of pollution, primary and secondarypollutants, transport and diffiusion of pollutants, gas laws governing the behaviour ofpollutants in the atmosphere, Methods of monitoring and control of air pollution, SO2, NOx,CO, SPM.

UNIT - II

Water pollution - types sources and consequences of water pollution, physico-chemical andbacteriological sampling, Analysis of water quality, standards, sewage and wastewatertreatment and recycling, water quality and standards.

UNIT - III

Soil pollution chemical and bacteriological sampling as analysis of soil quality, soil pollutioncontrol, industrial waste effluents and heavy metals and their intreactions with soilcomponents.

UNIT - IV

Noise pollution - sources of noise pollution, measurement and indices, Marine pollution,sources of marine pollution and its control, Effects of pollutants on human beings, plants,animals and climate, air quality standards and air pollution.

References

- Air pollution and control - K.V.S.G. Murlikrishan
- Industrial noise control - Bell & Bell
- Environmental engineering -Peary
- Introduction to environmental engineering and science- Gilbert

16ENV21C5 Solid Waste Management

Course Outcomes

CO1 Students would learnsolid waste characterisation and about different solid waste management methods.

CO2 Students would understand about solid waste management plan and about various processes of effluent treatment.

CO3 Students would understand about hospital and hazardous waste management.

CO4 Students would get awareness about disaster management and its types

Max. Marks : 80

Time : 3 Hours.

Unit - I

Sources, generation, classfication & composition of solid wastes. Solid waste management methods - Sanitary land filling, Composting, Vermi composting, incineration and burial, energy recovery from organic waste.

Unit -II

Solid Waste Management Plan, Waste minimization technologies, Hazardous Waste Management, Sources & Classification, physicochemical properties, Hazardous Waste Control & Treatment.

Unit - III

Hospital Waste Management. Hazardous Waste Management & Handling rules, 1989 & 2000 (amendments), Recycling of waste materials, Garbage gravel yards.

Unit- IV

Disaster Management and Risk analysis, Fly ash generation & utilization, Primary, secondary & tertiary & advance treatment of various effluents, Beverage container deposit bill.

References

- Solid Waste Management CPCB. New Delhi.
- Ecotechnology for pollution control & environmental manage ment - By R.K. Trivedi &Arvind Kumar.
- Basic Environmental Technology - J.A. Nathanson

16ENV21C6 Lab Course-I

Course outcomes

CO1 Students would learn to analyze the toxic dosage of pesticides, heavy metals and antibiotics on plants, microbes and insects.

CO2 Students would learn the operation of instruments like UV- Visible spectrophotometer, atomic absorption spectrophotometer, flame photometer, paper, column and gas chromatography.

CO3. Students would be able to analyse species abundance, frequency and enrichment of a particular region.

CO4 Students would be analyzing soil nutrients of the given soil sample.

Max. Marks :100

Time : 6 Hours.

1. To study soil profile of a given area.

2. To determine the organic carbon in the soil sample.
3. To determine the calcium and magnesium in the soil samples.
4. To determine moisture content, water holding capacity, pH and conductivity of the soil samples.
5. To determine the chlorophyll content of the plant material.
6. To determine the distribution pattern of a plant community.
7. To determine the basal area and dominance of different species in a particular vegetational area.
8. To determine Important Value Index of a given vegetational area.
9. To verify Beer- Lambert's Law of absorption of light.
10. To study absorption spectrum of bromophenol blue as indicator dye at different pH range.
11. To perform paper chromatography of amino acids and calculation of R_f value.
12. Isolation of plant pigments by column chromatography and study their absorption spectrum.
13. Separation of nucleic acids by agarose gel electrophoresis.
14. To study effect of different antibiotics on growth of bacteria and calculation of their EC_{50}.
15. To study effects of pesticides on the insects and determination of LD_{50}.
16. To study the effect of industrial effluent on germination of seeds.

16ENV21C6 Lab Course-II

Course outcomes

CO1 Students would be able to analyze the physicochemical parameters like calorific value, different cations and anions present in the solid waste as compared to the soil.

CO2 By analysis they would get the practical knowledge about waste characteristic and the effects caused to our soil ecosystem.

CO3 Students would analyze the biological and chemical oxygen demand of the waste water.

CO4 Students would be able to analyze SOx, NOx and suspended particulate matter present in the air as pollutants.

Max. Marks :100

Time : 6 Hours.

1. To determine the physical properties of solid waste in comparison to soil.
2. To determine the following chemical properties of solid waste:
    a) Alkalinity
    b) Chloride
    c) Calcium
    d) Magnesium

3. To estimate the organic carbon content in given solid waste sample.

4. To estimate the ammonia in given solid waste sample.

5. To estimate the calorific value of solid waste using bomb calorimeter.

6. To estimate the pH, total dissolved solids (TDS) and electrical conductivity of given water samples.

7. To estimate the Chemical Oxygen Demand (COD) of industrial effluent samples.

8. To estimate the Biological Oxygen Demand (BOD) of waste water samples.

9. To estimate the sodium and potassium in given water samples using flame photometer.

10. To determine the residual chlorine and chloride content in the given water samples.

11. To calculate available phosphate in given soil and water sample.

12. To determine the suspended particulate matter (SPM), SOx and NOx in ambient air.

SEMESTER-2
16ENV22C1 Natural Resources

Course Outcomes

CO1 Students would gain an understanding of the need for using non-renewable sources of energy.

CO2 Students would get sufficient exposure of solar energy and fossil fuels classification, composition and their characteristics.

CO3 Students would learn about various renewable energy sources and carbon credits.

CO4 Students would understand the global energy pattern and impacts of exploitation of renewable energy sources

Max. Marks: 80
Time: 3 Hrs.

UNIT - I

Sun as a source of energy, solar radiations and its spectral characteristics, fossil fuelsclassification, composition, physico- chemical characteristics and energy content of coal,petroleum and Natural gas.

UNIT - II

Principles of generation of hydroelectric power, tidal power, thermal energy conversion,wind, geo thermal energy, solar collectors, photovoltaic, solar ponds, oceans, Soilmicroorganisms and their functions, Carbon credits.

UNIT - III

Nuclear energy- fission and fusion, bio energy -energy from biomass and biogas, anaerobicdigestion, energy use patterns in different parts of the world. Impacts of large scaleexploitation of solar, wind, hydro and ocean energy.

UNIT - IV

Mineral resources and reserves, ocean ore and recycling of resources, Environmental impactof exploitation, processing and smelting of Mineral, oceans as need areas for exploitation ofMineral resources.

References

- Living in the environmental - T.J. Miller.
- Natural resource conservation - Owen & Chiras.
- Encyclopedia Energy - I & II.

16ENV22C2 Biodiversity

Course Outcomes

CO1 Student would learn the global biodiversity crisis and would be able to articulate why society strives to conserve biodiversity.

CO2 Students would be able to identify key threats to biodiversity and learn the management options for conserving biodiversity

CO3 Students would be able to develop and analyse appropriate biodiversity conservation policy for conserving biodiversity across a range of mediums.

CO4 The students would be able to argue the case for local action to address the global loss of biodiversity and conserving biodiversity.

Max. Marks: 80

Time: 3 Hrs.

Unit - I

Biodiversity - definition, hot spots of Biodiversity, strategies for Biodiversity Conservation,National Parks, Sanctuaries and Biosphere reserves, gene pool, Sustainable development,Habitat.

Unit - 2

Aquatic common flora and fauna in India - phytoplankton, zooplankton and macrophytes,terrestrial common flora and fauna in India - forests, endangered and threatened species.

Unit - 3

Strategies for Biodiversity Conservation, cryopreservation, gene banks, tissue culture andartificial seed technology, new seed development policy 1988, conservation of medicinalplants.

Unit- 4

International conventions, treaties and protocols for Biodiversity Conservation, Biodiversityin the welfare of mankind, Species concept, Biological nomenclature theories of biologicalclassification.

References :

- Global Biodiversity - W.R. L.IUCN
- Ecology of natural resource - Ramade
- Ecology - P.D. Sharma

16ENV22C3Biostatistics and Environmental Modelling

Course Outcomes

CO1 Students will learn simple statistical methods as well as merits and demerits of applying different methods of statistics.

CO2 Students will understand the concept of probability and its function, different theoretical distributions and also tests of hypothesis and its relevance.

CO3 Students will be able to evaluate the role of modelling in environment sciences through classification of different models considering the stages involved in model building.

CO4 The students will be able to estimate point source stream pollution, growth and interaction among variables to understand prey predator effect in a population.

Max. Marks : 80

Time : 3 Hours.

UNIT - I

Measurement of central tendency - mean (Geometric and Harmonic), median, mode, Measurement of dispersion moments, standard deviation, skewness and kurtosis, Correlation and linear regression of one independent variable, Basic laws and concepts of probability

UNIT - II

Definition of random variable, density function, Basic concepts of binomial and normal distributions. Sampling measurement and distribution of attributes, moments, matrics and simultaneous linear equations, tests of hypothesis and significance.

UNIT - III

Role of modelling in environmental sciences, Model classification deterministic models, stochastic models, steady state models, dynamic models, different stages involved in model building. Simple microbial growth kinetics monod equation, methods for formulation of dynamic balance equations mass balance procedures.

UNIT - IV

Models of population growth and interactions Lotka Volterra model, Leslies matrix model, Point source stream pollution, Box model, Gaussian plume model, Linear, simple and multiple regression models, validation and forecasting.

References

- Dynamics of Environmental Bioprocesses-Modelling and simulation-Snape and Dunn.
- Environmental Modeling – Jorgensen

16ENV22D1Waste Water Treatment

Course Outcomes

CO1 Students would understand the water quality in relation to public health, principal forms of water pollution.

CO2 Students gain knowledge about Pollution of stream, lakes, Ocean and Ground water pollution and how prevention will be attained.

CO3 Students get exposure to various techniques used for monitoring pollution along with strategies for controlling pathogen transfer

CO4 Students gain insight knowledge about primary, secondary and tertiary methods used for treatment of sewage and waste water along with biological methods concerning pollution control.

Max. Marks: 80
Time : 3 Hrs.

Unit-I

Overview of standards of water quality in relation to public health - Potable and nonpotable Water; Methods of water sampling for pollution analysis. Principal forms of Water Pollutantsand their sources; Pollution of stream, lakes and phenomenon of eutrophication; Oceanpollution – oil pollution; Ground water pollution and its control; Water pollution prevention.

Unit II

Methods of monitoring Pollution; Biological methods; Detection methods for DO, BOD,Pathogen monitoring by heterotrophic plate count; Multiple tube method; Membranefiltration methods; Other emerging techniques such as enzyme detection, hybridization, PCR,Gene probe technology etc.; Strategies for controlling pathogen transfer; Chemical methods-Detection methods for COD, pH, alkalinity, TSS, TDS, Total organic carbon, oil, grease etc.;Biosensors for pollution

Unit III

Sewage and waste water treatments systems, Primary, secondary and tertiary treatments,Biological treatments - aerobic versus anaerobic treatments; Environmental pollution control-Bioremediation, Bioaugmentation and Biostimulation; Biofilms in treatment of waste water;Bioreactors for waste water treatments.

Unit IV

Physicochemical characteristics and treatment strategies for effluent generated by Distillaryand fermentation industry; Fertilizers and pesticide manufacturing industries; Dyes andtextile industries; Paper and pulp industries; Tanneries; Pharmaceuticals; Thermal powerplants; Food and dairy industries; Iron and steel industries; Organic solvents; Chlorinatedminerals and inorganic chemical industries and petrochemicals.

References

- Nicolas P Cherewsinott, Handbook of water and waste water Treatment Technology,Boston Oxford Auckland Johannesburg Melbourne, New Delhi
- Frederick W Pontinus, Water Quality and Treatment. American water works Association,MC Graw Hill Inc.
- S K Agarwal, Water Pollution, APH Publishing Corporation.
- Ronald L Dooste, Theory and Practical of water and waste water Treatment.
- Bill T. Ray, Environmental Engineering, PWS Publishing company.

16ENV22D2Environmental Geology

Course Outcomes

CO1 Students would gain knowledge about various earth processes, hydrological cycles and Biogeochemical cycles, Tectonic cycle, Rock cycle.

CO2 Students would gain knowledge about catastrophic geological hazards and their causes and effects.

CO3 Students would learn the geology of mineral resources, EIA of mineral development, Methods of extraction of mineral resources and recycling of mineral resources.

Max. Marks: 80
Time : 3 Hrs.

UNIT-I

Earth processes, Geological cycle, Tectonic cycle, Rock cycle, Hydrological cycle, Biogeochemical cycles, Special problems of time and scale in geology, concept of residence time and rates of natural cycles.

UNIT-II

Catastrophic geological hazards, Prediction and perception of the hazards and adjustment to hazardous activities. Predictions and perception of hazard and adjustment to hazardous activities.

UNIT-III

River flooding- causes, nature and frequency of floods. Landslides- causes, intensity and magnitude. Volcanism nature extent and causes, Volcanism and climate. Avalanches causes and effects.

UNIT-IV

Mineral and human use, geology of mineral resources, EIA of mineral development, Methods of extraction of mineral resources, recycling of mineral resources

References:

- Environmental geology-Edward A.Keller
- Physical geology-C.W. Montgomery.
- Geology of India-National book trust series.

16ENV22D3 RESOURCE MANAGEMENT

Course Outcomes

CO1 Student will be able to get knowledge about resource management, management of rangelands, watersheds, agricultural system.

CO2 Student will be able to learn about management of waste resources, forests, fresh water ecosystem, effects of deforestation and conservation strategies for non-renewable energy resources.

CO3 Student will be able to understand how to prevent soil erosion, manage wasteland and soil conservation.

CO4 Students will understand urban planning for India, Sustainable development, Land use policy for India.

Max. Marks: 80
Time : 3 Hrs.

Unit - I

Resource management meaning & concept, management of rangelands & watersheds,management of Agricultural system, International Biological Program, Man and Biosphere.

Unit - 2

Management of waste resources, Management of forests, effects of deforestation.Management of fresh water ecosystem conservation strategies for non-renewable energyresources.

Unit - 3

Wildlife Management & conservation efforts for threatened species, Water Management,Ganga Action Plan, Yamuna Action Plan, Environmental priorities in India.

Unit- 4

Reclamation & Management of waste lands, soil erosion, soil conservation, rural planning &land use pattern. Sustainable development, urban planning for India, Land use policy forIndia.

References:

- Natural resources conservation -Oliver Ss. Owen.
- Living of environment - T.J. Miller
- Ecology of Natural resources - Ramade
- Environmental Science- Cunningham Saigo
- Restoration of degraded lands- J.S. Singh

16ENV22D4 Concept of Biochemistry

Course Outcomes

CO1 Students would be able to explain the various concept of biochemistry and structure, metabolism of carbohydrate.

CO2 Students would be familiarised with the properties and structural organization, metabolism of amino acid and protein.

CO3 Students would understand the structure, biological function of lipids, nucleic acid and de novo biosynthesis of nucleic acid.

CO4 Students would have knowledge about the concept of photosynthesis and various mitochondrial mechanisms

Max. Marks: 80
Time : 3 Hrs.

Unit - I

Organisation of Biomolecules, Concept of pH, pK, acids, bases, buffers; Principle and biological application of diffusion osmosis, viscosity and Donnan membrane equilibrium. Carbohydrates-Structure and classification of carbohydrates, Metabolism of carbohydrates.

Unit – II

Amino acids & Proteins: Structure and properties of amino acids, Types of proteins and their classification. Different levels of structural organization of proteins. Amino acid metabolism,Urea cycle. Nitrogen cycle.

Unit - III

Lipids- Structure and functions, Classification of lipids and their biological significance. Essential fatty acids. Hydrolysis of fats, Saponification value, Rancidity of fats, Iodine number and Acid value. Nucleic Acids- Structure and properties. Nucleosides and nucleotides. Biologically important nucleotides. Catabolism, *de novo*-biosynthesis of purine and pyrimidine nucleotides. Formation of deoxyribonucleotides.

Unit – IV

Photosynthesis: Light absorption and energy conversion; Calvin cycle; Hatch-Slack Pathway; Photorespiration. Mitochondrial oxidative phosphorylation: Mitochondrial electron transport chain.

References :

- Biochemistry, 4th edition, by L. Stryer (1995). W.H. Freeman & Co. NY
- Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox (2000)Maxmillan/ Worth publishers.
- Fundamentals of Biochemistry by Donald Voet and Judith G Voet (1999) , John Wiley &Sons, NY

16ENV22C4 Lab Course-III

Course outcomes

CO1 Students would study the national parks, wild life sanctuaries and biosphere reserves of India.

CO2 Students would be able to calculate mean, median, mode and standard deviations of the given data set manually as well as using Microsoft excel.

CO3. Students would learn about applying different statistical methods to determine significance of the study.

CO4 Students would be able to apply and solve problems by understanding the concept of statistics with computer.

Max. Marks :150

Time : 6 Hours

1. To estimate protein content in the given plant material.
2. To determine the calorific value in the given plant material.
3. To estimate the Nitrogen content in the given plant material.

4. To locate major renewable energy resources in the map of India.
5. To locate major non- renewable energy resources in the map of India.
6. To identify and locate major renewable and non- renewable resources in the world map.
7. To identify igneous, sedimentary and metamorphic rocks and their features.
8. To determine the energy value of municipal solid waste.
9. To compare the biomass of the terrestrial and aquatic plant communities.
10. To study sampling methods used in biodiversity studies.
11. To determine the size of quadrate.
12. To determine the minimum number of quadrate
13. To determine the species frequency, species density and species cover by quadrate method.
14. To determine the Relative species frequency, relative species density and relative species cover by quadrate method and calculate the Importance Value.
15. Statistical analysis applying different methods of statistic:
    a. Mean
    b. Median
    c. Mode Geometric and Harmonic mean
    d. Standard deviation

16ENV22D5 Lab Course-IV

Course outcomes

CO1 Students would get overview about water Pollution of and its prevention.

CO2 Students would be exposed to various techniques used for monitoring pollution.

CO3 Students would be able to estimate the bio molecules present in given sample.

CO4 Students would study the geomorphology and composition of various types of rocks present on earth.

Max. Marks :50

Time : 6 Hours.

16ENV22D1: Waste water Treatment Technology

1. Determination of amount of bleaching powder required to disinfect a water sample by Horrock's test.
2. To determine pH, electrical conductivity. total solids, total suspended solids and total dissolved solids in given sample of water.
3. To determine the amount of oil and grease content present in the given water sample.

4. To determine phosphate content in a given sample of water.
5. To determine sulphate content in a given sample of water.
6. To determine the total chlorine (residual) by Iodometric method.
7. To determine the minimum dose of a coagulant required to coagulate a given sample.
8. To study heavy metals present in given waste water sample.

16ENV22D3: Resource management

1. To estimate the salinity of given soil sample.
2. To estimate the BOD of given water samples.
3. To estimate the Bulk Density of given soil sample.
4. To estimate the available phosphate in given soil samples.
5. To estimate the Nitrate in given water samples.
6. To estimate the exchangeable Sodium and Potassium in given soil sample.
7. To estimate the heavy metals in given soil samples.
8. To estimate the organic carbon in given soil samples.

16ENV22D4: Concept of Biochemistry

1. Estimation of carbohydrate by anthrone reagent method.
2. Determination of acid and saponification value of oil/fat.
3. Estimation of amino acid L-proline in the given sample.
4. Estimation of proteins by by Folin-Lowry's method.
5. Estimation of nucleic acid DNA by Diphenyl amine method.
6. Estimation of nucleic acid RNA by Orcinol method.
6. Estimation of Chlorophyll in plant leaves sample.

SEMESTER-3

16ENV23C1 Environmental Chemistry

Course Outcomes

CO1 Students would understand the basic concept of stoichiometry with reference to chemical equillibria in carbonate system, hydrocarbons and radionuclides.

CO2 Students would study about chemical processes occurring in atmosphere concerning with the formation of particles.

CO3 Students would be able to develop experimental aptitude to analyse water quality parameters and treatment methods.

CO4 Students would learn the chemistry of ozone, air, water quality treatment techniques and sewage and waste water treatment systems.

Max. Marks: 80
Time : 3 Hrs.

UNIT - I

Stochiometry, Gibb's energy, Chemical potential, Chemical equilibria, acid-base.reactions.Solubility product, solubility of gases in water, the carbonate system, unsaturated andsaturated hydrocarbons, Radio nuclides.

UNIT - II

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.

UNIT - III

First law of thermodynamics, enthalphy, adiabatic transformations, second law ofthermodynamics, Carnot's cycle, entropy, Gibb's free energy, chemical potential, phaseequilibria, Gibb's Donnan equilibrium, third law of thermodynamics, enzymes catalysis,Michaelis/ Menten equation.

UNIT - IV

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.

References

- Environmental Chemistry - G.S. Sodhi
- Environmental Chemistry - Mannhan
- Fundamantals of soil science - Henry D. Futh
- Textbook of limnology - G.A. Cole
- Environmental Chemistry - Sharma and Kaur

16ENV23C2 Remote Sensing and Geographic Information System

Course Outcomes

CO1 Student gets an understanding of the main concepts that define Geographic Information systems and their application in the environmental and life sciences.

CO2 Students would learn how pictures of the earth's surface are recorded from aircraft and satellites and interpret properly Remote Sensing Images.

CO3 Students gain an understanding of Remote Sensing products such as earth resources, satellite images, aerial photographs as well as more sophisticated research tools such as RADAR and multispectral scanner systems.

CO4 Students would learn to assess the usefulness of different types and scales of remotely sensed datavia on the ground comparisons.

CO5 Students would learn environmental remote sensing and GIS which can directly enhance service delivery on land use management, ground water management/prospects, agriculture, forestry, food and water security, disaster management, etc.

Max. Marks: 80

Time : 3 Hrs.

Unit - I

Definition, Introduction and scope of remote sensing. Electromagnetic radiation, atmosphere window, Platforms, Sensors and type of scaning systems. Basic characteristics of sensors;salient features of sensors used in LANDSAT, SPOT and Indian remote sensing satellites.

Unit - 2

Aerial photography- vantage point, cameras, Filters and types of films. Elements of visual image interpretation. Multispectral Remote sensing, Microwave Remote sensing, Photogrammetry - Introduction, Stereo- scopic vision, Projection types.

Unit - 3

Digital image and image structure, Image restroration and image and image enhancement.Image classification. Remote sensing application in Forestry, Ecology and environment,Landuse, Agriculture, soils and geology, Disaster management.

Unit- 4

GIS technology and its uses in environmental science, Hardware and software requirementfor GIS. Conceptual model of spatial information, Conceptual model of non spatialinformation. GPS.

References :

- Introduction to Environmental remote sensing - Curtis
- Principles of Remote sensing - Lily and kliffer.
- Remote sensing of the Environment – Jenson

16ENV23D1 Environmental Impact Assessment

Course Outcomes

CO1 Students will able to analyse and document the Environmental impact by understanding the Environmental guidelines in India.

CO2 Students will able to describe the generalised approach to impact assessment and monitor environmental impact assessment methodologies with reference to case studies.

CO3 Students will able to learn the baseline information, environmental auditing and land use policy in India.

CO4 Students will able to examine environmental risk by its assessment and management by understanding the steps involved.

M.M.: 80
Time : 3 Hrs.

Unit - I

Introduction to environment impact analysis, Environmental impact statement andEnvironmental management plan, ISO14000, EIA guidelines 1994, Notification of Govt. ofIndia.

Unit - 2

Impact assessment methodologies, Generalized approach to impact analysis. Case study: EIAof some dam, procedure for reviewing Environmental impact analysis and statement.

Unit - 3

Guidelines for Environmental Audit, Baseline information and prediction (land, water,atmosphere, energy), Restoration and rehabilitation technologies, Land use policy for India.

Unit- 4

Risk analysis - definition of risk, Environmental risk analysis, risk assessment and riskmanagement, Basic steps in risk assessment - hazard identification, dose- response assessment,exposure assessment, Risk characterization.

References:

- Environmental Impact Assessment- John Glasson.
- Methods of Environmental Impact Assessment - Morris and the rivel.
- Environmental Imapct Assessment - L. W. Canter.
- Chemical principles of Environmental pollution - Lalloway and Ayers.
- Industrial Environment - Assessment and strategy - S.K. Aggarwal

16ENV23D2Bioremediation

Course Outcomes

CO1 Students would gain knowledge about Bioremediation, Bioaugmentation, in situ, ex situ, intrinsic and engineered bioremediation.

CO2 Students would learn about phytoremediation, composting, bioventing and biosparging, Liquid phase bioremediation- suspended bioreactors, fixed biofilm reactors.

CO3 Students would gain knowledge about Hazardous Waste Management and Biotechnology application to hazardous waste management

CO4 Students would gain the knowledge of Concept of bioremediation, phytoremediation and its application.

Max. Marks: 80
Time : 3 Hrs.

UNIT I

Introduction, constraints and priorities of Bioremediation, Biostimulation of naturally occurring microbial activities, Bioaugmentation, in situ, ex situ, intrinsic and engineered bioremediation.

UNIT II

Solid phase bioremediation – land farming, prepared beds, soil piles, phytoremediation, composting, bioventing and biosparging; Liquid phase bioremediation- suspended bioreactors, fixed biofilm reactors.

UNIT III

Hazardous Waste Management; Biotechnology application to hazardous waste management – Example of biotechnology to hazardous waste management- cyanide detoxification, detoxification of oxalate, urea etc. toxic organics –phenols.

UNIT IV

Concept of bioremediation (in situ & ex situ), bioremediation of toxic metal ions-biosorption and bioaccumulation principles, Concept of phyoremediation, Microbial leaching of oredirect and indirect mechanism in augmentation of augmentation of petroleum recovery, Biotechnology with special reference to copper and iron.

References:

- Environmental Biotechnology by S.K. Agarwal
- Biodegradation % Bioremediation (1999), Martin Alexander, Academic Press.
- Stanier R.Y., Ingram J. L., Wheelis M.L., Painter R.R., General Microbiology, McMillan Publication,1989.
- Foster C. F., John Ware D.A.,(1987).Environmental Biotechnology, Ellis Horwood Ltd.

- Karrely D., Chakrabarty K., Omen G.S., Biotechnology and Biodegradation, Advances in Applied Biotechnology Series, Vol. 4, Gulf Publication Co. London, 1989. Bioremediation Engineering; design and application (1995) John. T. cookson, Jr. Mc Graw Hill, Inc.
- Environmental Biotechnology by A.K.Chatterjee 8. Environmental Biotechnology by S.N. Jogdand Himalaya Publishing

16ENV23D3Agriculture and Environment

Course Outcomes

CO1 Students would gain knowledge about agriculture, organic farming, irrigation, use and impact of various types of pesticides on environment.

CO2 Students would gain knowledge about various revolution and irrigation merits and demerits.

CO3 Students would gain the knowledge of vermicomposting, synthetic fertilizers and various process including in biogas production.

Max. Marks: 80
Time : 3 Hrs.

Unit - I

Agriculture ecosystem, sustainable agriculture, organic farming and eco-friendlyagroforestry, social forestry, dryland agricultute and zero tillage

Unit - II

Irrigation and secondary salinization, water logging and environmental impact ofmultipurpose projects, Weather and crop productivity- impact of global warming in
Agriculture and food security, Green, blue and white revolution.

Unit - III

Pesticide classification, pesticide resistance, biology and ecology of pest control, integratedpest management, pesticide safety, Biopesticides. Biofertilizers, vermicomposting and cropresidue as a source of fertilizer, Synthetic fertilizer and their impact on agriculture.

Unit- IV

Biogas technology, Plant design, construction and their operation, Biofuel, Soilmicroorganisms and their function, Degradation of different insecticide, fungicides andweedicides in soil.

References :

- Sustainable Agriculture- H.R. Sharma
- Global Climate Change- Pry Martin

- Environmental Chemistry- Mannahan
- Soils- Miller and Donhau
- Environment and Agriculture- Dhaliwal, Jairath and Hansra

16ENV23D4 Elementary Concept of Physical Environment

Course Outcomes

CO1 Students will be able to Study of ecosystems and their components will lead towards the interaction between Man and Earth.

CO2 Students will be able to understand the structure and composition of Earth and its biomes.

CO3 Students gain knowledge about the atmospheric changes and climate of different regions.

CO4 Students gain sufficient knowledge about meteorology and clouds.

Max. Marks: 80

Time : 3 Hrs.

UNIT - I

Definition, Principles and scope of Environmental Science. Earth, Man and Environment, Ecosystem, Pathways in Ecosystems, Physico- chemical and biological factors in the Environment.

UNIT - II

Geographical classification and zones. Structure and composition of Biosphere. General relationship between landscapes, biomes and climates. Atmospheric instability, inversions and mixing heights, wind roses.

UNIT - III

Primary differentiation and formation of core, mantle and crust. Igneous, sedimentary and metamorphic rocks, weathering, erosion, transportation and deposition of earth's material by running water, wind and glaciers.

UNIT - IV

Mass and energy transfer across the various interphases, Material Balance, Heat Transfer processes, scales of Meteorology, various kinds of lapse rates, vertical stability of atmosphere, cloud classification & formation.

References

- Ecology - P.D. Sharma
- Concepts of physical environment- Savinder Singh
- The Atmosphere- an Introduction- F.K. Lutagens
- Atmospheric weather and climate - Navarra.

16ENV23D5 Environmental Microbiology

Course Outcomes

CO1 Students would understandmicrobiology, microbial reactors, and biogas technology.

CO2 Students wouldlearn about basic concepts of environmental planning and about land use planning and its methods

CO3 Students would be able to understand the principle and working of Batch culture, continuous culture, and various technologies of biogas production.

CO4 Students would know about the biotransformation, bioconversion, bioremediation and various environmental monitoring techniques through microorganisms.

Max. Marks: 80
Time : 3 Hrs.

Unit - I

Microbiology- organisms in nature & their importance, sampling, culture & cultivation ofmicroorganisms, microbes in service of nature & mankind, Batch culture & continuousculture of microbes for commercial use.

Unit - 2

Microbial Reactors, genetically modified microbes & their uses in Environmentalmanagement recycling & up gradation technologies, Production of products, energy formwaste.

Unit - 3

Biogas technology, plant design, construction, operation, biogas form organic wastes, waterweeds, landfills, microbiology of anaerobic fermentation.

Unit- 4

Biotransformation, bioconversion, bioremediation, phytoremediation technology,fermentation technology, development of stress tolerant plants, Environmental problems &Environmental monitoring through microorganism, microbiology of water, air and soil,microbes as pathological agent in plant, animal and man.

References :

- Principles of microbiology - Pelzar
- Microbial bio technology - A.N. Glazer
- Microbial ecology - R.M. Atlas
- Molecular biology - H.D. Kumar
- Environmental bio Technology - Sayler & Fox

16ENV23C3 Lab Course-V

Course Outcomes:

CO1 Students will understand the applicability of stoichiometry in real world.

CO2 Students will able to develop experimental aptitude to analyse water quality parameters.

CO3 Students would be able to visually interpret landset imagery of various geographic regions.

CO4 Students would learn geo-referencing from toposheet in ERDAS domain.

Max. Marks :100

Time : 6 Hours.

1. To study the annotation on given image or imagery and write discussion.
2. To study the imagery of different sensors and discuss the comparison.
3. To study out the construction and operation of multiband ground truth radiometer.
4. To determine percentage of reflection of different object using radiometer.
5. To differentiate different object by using multispectral remote sensing.
6. To calculate the vegetative index of vegetation by radiometer.
7. To study the visual interpretation of imagery.
8. Georeference the imagery with toposheet by image to image method
9. Georeference the imagery through keyboard method.
10. To find λmax value of $K_2Cr_2O_7$and $KMnO_4$solution using spectrophotometer.
11. To plot standard curve for Cr(VI) using $K_2Cr_2O_7$ and to find concentration of Cr(VI) in unknown sample.
12. To determine the concentrations of heavy metals present in the water/soil samples.

16ENV23D6 Lab Course-VI

Course outcomes

CO1 Students will able to analyse and document the Environmental impacts caused by various projects

CO2 Students will able to monitor environmental impact assessment methodologies with reference to case studies.

CO3 Students would be able to Index toposheet and note the coordinate by GPS.

CO4 Students would be able to examine the microorganisms present in water, air and soil.

CO5 Students would learn about the beneficial and pathogenic microorganisms present in the environment.

Max. Marks :100

Time : 6 Hours.

1. Indexing of topographic sheet.
2. To study the Global Positioning System.
3. Diagrammatically show the formation of depositional land forms such as Alluvial Fans, Alluvial cones, Natural levees and delta.
4. To define and draw the prevailing surface wind and location of major high and low pressure belts of the world. Also plot the pattern of well know summer monsoon in the world.
5. To separate soil aggregates of the given soil sample.
6. To determine the maximum water holding capacity of soil.
7. Environment impact assessment case studies of
    a) Hyrdoelectric Power Project.
    b) Thermal Power Project.
    c) Coal Mining Project.
    d) Oil Refinery.
    e) Ports and Harbours.
    f) Natural Gas Power Plant.
    g) Fertilizer Plant
    h) Nuclear Power Project
    i) Roads and Highways
    j) Railway Project.

SEMESTER-4

16ENV24C1 Environmental Laws

Course Outcomes

CO1 Students would learn eco-friendly techniques i.e. eco-marks and provisions given in the constitution of India regarding environment.

CO2 Students would be able to describe of environmental policy resolution, legislation and public policy strategies in pollution control with reference to wildlife protection act 1972 and its amendment in 2002, forest conservation act 1980 and India forest act 1927.

CO3 Students would learn to analyse the environmental issues and problems with national and international efforts for environment protection with special reference to the water (prevention and control of pollution) Act 1974, its amendment 1978 and rules 1975.

CO4 Students would understand the efforts done at national and international level for environmental protection issues and problems.

Max. Marks: 80
Time : 3 Hrs.

UNIT - I

Scheme of lebelling of environmentally friendly products (ecomark). Public liabilityInsurance Act. 1991. Provision of constitution of India regarding environment (article 48 A &58A).

UNIT – II

Environmental policy resolution, legislation, public policy strategies in pollution control.Wild life protection act, 1972 amended 2002. Forest conservation act, 1980. Indian forest act1927.

UNIT - III

Air (prevention & control of pollution) Act 1981 as amended by amendment 1987 & rule1982. Motor vehicle act, 1988, The environment (protection) Act, 1986, rules 1986.

UNIT – IV

The water (prevention & control of pollution) Act, 1974 as amended by amendment 1978 &rules 1975. Environment protection issues & problems, international & national efforts forenvironment protection.

References

- Environmental administration & law - Paras Diwaa.
- Environmental planning, policies & programs in India - K.D. Saxena.

16ENV24C2 Environmental Management and Planning

Course Outcomes

CO1 Students will get aware about role of NGO's in environmental movements and know about various international initiatives in environment.

CO2 Students will be learn the effects of air pollution, fly ash utilization and eutrophication process.

CO3 Students will come to know about basic concepts of environmental planning and about land use planning and its methods

CO4 Students will come to know about Environmental Sustainability and Cost-benefit analysis and will get aware about various International convention and treaties for Sustainable development.

Max. Marks: 80
Time : 3 Hrs.

UNIT - I

Role of NGO's public participation in environmental movements, Concepts of Environmental education and awareness Internationals environmental initiatives – the club of Rome report, Stockholm Declaration, environmental ethics.

UNIT - II

Vehicular pollution and urban air quality, Fly ash utilization, Eutrophication and restoration of Indian lakes, Wet land conservation, Water crisis-conservation of water. Narmada dam, Tehri dam, Almetti dam.

UNIT - III

Basic concepts of environmental planning, Environmental priorities in India, Land use planning : The land use plan (India). Soil surveys in relation to land use planning. Methods of site selection and evaluation, global imperatives, soil erosion, Formation and reclamation of Usar, alkaline and saline soil, waste lands and their reclamation, Desertification and its control.

UNIT - IV

Urban planning and rural planning for India. Sustainable development- principles and practices in relation to economics and ecology. Cost-benefit analysis- its relevance. Ramsar convention on wetlands, Vienna convention and Montreal Protocol, Kyoto protocol, Earth Summit, Agenda-21.

References

- Natural Resource Conservation Owen and Chiras.
- Environmental planning, policies and programs in India- K.D. Saxena.
- Conservation Ecology- G.W.Cox.
- Global Biodiversity - W.R. L. IUCN