DEPARTMENT OF ENVIRONMENTAL SCIENCES

Session: 2015-17

M.Sc. Environmental Biotechnology

Credit matrix for M.Sc. Environment Biotechnology Program

Semester	Core Program (PC)	Program Elective (PE)	Interdisciplinary/Open Elective	Foundation course	Project work /Dissertation	Total
I	31	-	-	-	-	31
II	25	6	2	2	-	35
III	25	6	-	-	-	31
IV	8	-	-	-	20	28
Total	89	12	2	2	20	125

Scheme of M.Sc. Environmental Biotechnology Program

Choice Based Credit System

SEMESTER-1

S.No.	Course No.	Nomenclature of Paper	Type	L-T-P (Hours)	Credits	Evaluation Scheme		
						Theory marks	IA	Total
1	ENB-101	Biochemistry	PC	4-0-0	4	80	20	100
2	ENV-102	Environmental Biology	PC	4-0-0	4	80	20	100
3	ENV-103	Analytical Techniques	PC	4-0-0	4	80	20	100
4	ENB-102	Cell and Molecular Biology	PC	4-0-0	4	80	20	100
5	ENV-104	Environmental Pollution	PC	4-0-0	4	80	20	100
6	ENB-103	Lab Course-I	PC	0-0-20	10	-	-	150
7	ENV-104	Seminar-1	PC	0-1-0	1			50

Total Credits: 31

Total Marks: 700

SEMESTER-2

S.No.	Course No.	Nomenclature of Paper	Type	L-T-P (Hours)	Credits	Evaluation Scheme		
						Theory marks	IA	Total
1	ENB-201	Immunology	PC	4-0-0	4	80	20	100
2	ENB-202	Industrial microbiology & Enzyme Technology	PC	4-0-0	4	80	20	100
3	ENV-203	Biostatistics and Environmental Modeling	PC	4-0-0	4	80	20	100
4	ENB-203	Genetic Engineering	PC	4-0-0	4	80	20	100
5	ENB-204	Lab Course-II	PC	0-0-12	8	-	-	100
6	ENV-206 ENV-201	Waste water treatment Technology Natural Resources	PE PE	4-0-0 4-0-0	4 4	80 80	20 20	100 100
7	ENB-205	Lab Course-III	PE	0-0-4	2	-	-	50
8	ENB-206	Seminar- II	PC	0-1-0	1	-	-	50
9	ENV-210	Environmental issues and disasters (Foundation course)	-	2-0-0	2	-	-	50
10	ENV-211	IPR and Biosafety (Interdisciplinary)	OE	2-0-0	2	-	-	50

Total Credits: 35
Total Marks: 800

SEMESTER-3

S.No.	Course No.	Nomenclature of Paper	Type	L-T-P (Hours)	Credits	Evaluation Scheme		
						Theory marks	IA	Total
1	ENV-301	Environmental Chemistry	PC	4-0-0	4	80	20	100
2	ENV-302	Remote Sensing and Geographical Information	PC	4-0-0	4	80	20	100
3	ENB-301	Tissue culture and Transgenics	PC	4-0-0	4	80	20	100
4	ENB-302	Fermentation and Downstream Processing	PC	4-0-0	4	80	20	100
5	ENB-303	Lab Course-IV	PC	0-0-16	8	-	-	100
6	ENV-303 ENV-304	Elementary concept of Physical Environment Environment Impact Assessment	PE PE	4-0-0 4-0-0	4 4	80 80	20 20	100 100
7	ENB-304	Lab Course-V	PE	0-0-4	2	-	-	50
8	ENB-305	Summer Training Report	PC	0-0-0	01			50

Total Credits: 31
Total Marks: 700

SEMESTER-4

S.No.	Course No.	Nomenclature of Paper	Type	L-T-P (Hours)	Credits	Evaluation Scheme		
						Theory	IA	Total marks
1	ENV-401	Environmental Laws	PC	4-0-0	4	80	20	100
2	ENV-402	Environmental management & planning	PC	4-0-0	4	80	20	100
4	ENB-401	Dissertation	PC	0-0-40	20	-	-	300

Total Credits: 28
Total Marks: 500
Grand Total Marks-2700
Grand Total Credits – 125

- **Programme Core (PC):** These are core courses in every semester and the students have to compulsorily study these courses to complete the requirement of the programme.
- **Program Elective (PE):** This course has to be chosenby the student from the given program elective papers of the respective semester and the lab course-during IInd and IIIrd semester.
- **Foundation Course:** This course will be based upon the basics of the programme that leads to the better understanding of the student and will be compulsory.
- **Interdisciplinary Open Elective (OE):**The students are required to have one open elective paper in IInd semester of their choice from any other M.Sc. course/Department in the M.D. university campus.
- Student will deliver a seminar in Ist and IInd semester. The evaluation of the seminar will be done by the faculty members at the basis of presentation only.
- The candidate shall be required to undergo Summer Training (4-5 weeks) at the end of IIndsemester. She/he will be required to submit a comprehensive report before the commencement of the IIIrd next semester examination. The evaluation of the training report will be based on the Seminar/Presentation on the Training Report to be presented by each candidate in the department.
- In the IVth semester, the student will carry out dissertation work and the report has to be submitted by 30th June. The evaluation of the dissertation will be done by external examiner (approved by VC from the panel approved in PGBOS) and the internal examiner (Guide). The final marks will be mean of Internal + External. The written part of Dissertation report shall account for 250 marks and the viva voce will be conducted for the remaining 50 marks. One copy of dissertation has to be submitted in the department, one for the guide and soft copy for the library. Any Patent/IPR based on dissertation report will be in the name of MDU, student and the guide as inventor.

SYLLABI
M.Sc. EnvironmentalBiotechnology
Semester-I

ENB - 101 Biochemistry

M.M. : 80
Time : 3 Hrs.

Note 1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting one from each section.

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 aminoacids, 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 :

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

ENV - 102 Environmental Biology

Max. Marks : 80
Time : 3 Hours.

Note: 1. Nine questions will be set in all.
2. Question No. 1 will be objective covering th entire syllabus & compulsory. Theremaining eight questions will be set with two questions from each unit. The candidatewill be required to attempt five in total, Question I and four by selecting one from eachsection.

UNIT - I

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

UNIT - II

Ecosystem structure and functions, abiotic and biotic component, Energy flow, foodchain, food web, Ecological Pyramids-types, biogeochemical cycles, ecologicalsuccession, 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 theirfunctions, coastal management, criteria employed for disposal of pollutants in marineecosystem, coastal water system and man-made reservoirs, biology and ecology ofreservoirs.

References

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

ENV - 103 Analytical Techniques

Max. Marks : 80
Time : 3 Hours.

Note :1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus & compulsory. Theremaining eight questions will be set with two questions from each unit. The candidatewill be required to attempt five in total, Question 1 and four by selecting one from eachsection.

Unit - I

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

Unit - 2

Chromatographic techniques (Paper chromatography, thin layer chromatography, ionexchange chromatography, Column chromatography), Atomic absorptionspectrophotometry, cytophotometry and flow cytometry, Fixation and staining, Principlesand techniques of nucleic acid hybridization and Cot curves, Principle of biophysicalmethod used for analysis of biopolymer structure, Hydrodynamics methods, Plasma
emissionspectorocopy.

Unit - 3

Electrophoresis, solid and liquid scintillation, X-ray florescence, X-ray diffraction.Flamephotomtery, Gas-liquid chromatography, High pressure liquid chromatography – autoradiography, Ultracentrifugation.

Unit- 4

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

References :

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

ENB–102 Cell and Molecular Biology

M.M. : 80
Time : 3 Hrs.

Note:1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting one from each section.

Unit I

Cell: An introduction, classification of organisms by cell structure,Structure and functions of cellular organelles. Cell Division: Mitosis and Meiosis, Regulation of cell cycle.

Unit II

Organization of bacterial genome. Structure of eucaryotic chromosomes, DNA/RNA as the genetic material, Mitochondria and chloroplast DNA, DNA reassociationkinetics(Cot curve analysis); Repetitive and unique sequences.
DNA Replicationin prokaryotes and eukaryotes. DNA repair mechanisms, Recombination: Homologous and non-homologous; Site specific recombination, Transposons.

Unit III

Prokaryotic Transcription:Mechanism of transcription, Promoters- Constitutive and Inducible, Operators; Regulatory elements.
Eucaryotic transcription: Mechanism oftranscription. Post-transcriptional modifications of variousRNAspecies.Transcription inmitochondria and chloroplast.
The Operon: Positive and negative control of transcription, repressor-inducer complex, catabolite repression and attenuation.

Unit IV

Genetic Code, Properties of genetic code, Wobble hypothesis.
Protein Synthesis: Structure of prokaryotic and eukaryotic ribosomes and their role in protein synthesis. Regulation of translation in prokaryotes and eukaryotes. Post translational modifications of proteins.

References

1. Cell Biology- Smith and Wood by Chapman and Hall.
2. Cell Biology: Organelle structure and function, Sadava, D E.(2004) Panima pub., New Delhi.
3. David Freifelder, Essentials of Molecular Biology, Narosa Publishing House.
4. George M. Malacinski, Essentials of Molecular Biology, Jones and Bartlett Publishers.
5. Harvey Lodish, ArnoldBerk, Paul Matsudaira, Chris-A. Kaiser, Monty Krieger, Mathew P. Scott, S.LawrenceZipursky, James Darnell, Molecular Cell Biology (Fifth adition), W.H.Freeman and company New York.
6. Genes VII, Lewin, Benjamin (2002) OUP, Oxford.
7. Genomes,2nded, Brown, T. A.(2002) John Wiley and sons ,Oxford

ENV - 104 Environmental Pollution

Max. Marks : 80
Time : 3 Hours.

Note

1. Nine questions will be set in all.
2. Question No. 1 will be objective covering th entire syllabus & compulsory. Theremaining eight questions will be set with two questions from each unit. The candidatewill be required to attempt five in total, Question I and four by selecting one from eachsection.

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, SO_2,NOx, CO, SPM.

UNIT - II

Water pollution - types sources and consequences of water pollution, physico-chemicaland bacteriological sampling, Analysis of water quality, standards, sewage andwastewater treatment and recycling, water quality and standards.

UNIT - III

Soil pollution chemical and bacteriological sampling as analysis of soil quality, soilpollution control, industrial waste effluents and heavy metals and their intreactions withsoil components.

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

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

Semester –II

ENB – 201 Immunology

M.M. : 80
Time : 3 Hrs.

Note: 1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting one from each section.

Unit I

Immunology- fundamental concepts and anatomy of the immune system

Innate and acquired immunity; Humoral and cell mediated Immune response; Haematopoesis; Organs and cells of the immune system, Antigens – antigenic determinants (isotype, allotypeanidiotype), immunogens, haptens; Major Histocompatibility Complex , HLA typing.

Unit II

Immunoglobulins-basic structure, classes and subclasses of immunoglobulins.Organization and expression of immunoglobulin genes, generation of antibody diversity; class switching.Generation of B-Cell and T-CellResponses : Major histocompatibility complex, Antigen processing and presentation.

Cell mediated immunity: T-cell receptor, T-cell maturation, activation and differentiation.

ADCC; Cytokines-properties, receptors and therapeutic uses;

Unit III

Antigen-antibody interactions

Precipitation, agglutination and complement mediated immune reactions; Advanced immunological techniques - RIA, ELISA, Western blotting, ELISPOT assay, immunofluorescence, flow cytometry and immunoelectron microscopy; CMI techniques-lymphoproliferation assay, Mixed lymphocyte reaction, Cell Cytotoxicity assays, Apoptotosis.

Unit IV

Immune System in Health and Disease

Hypersensitive reactions.Auto immunity and immune response to infectious diseases.Tumor immunity.Immune response to transplants. Vaccines, Active and passive immunization, Hybridoma Technology, Monoclonal antibodies, Antibody engineering.

References

1. William E. Paul, Fundamental Immunology, Wolters Kluwer/ Lippincott Williams & Wilkins.
2. Herman N. Eisen, MD, General Immunology. J.B. Lippincott Company. F.M. Burnet, Immonology. W.H. Freeman and company
3. Jack G. Chirikjian, Plant Biotechnology, Animal cell culture Immunobiotechnology. Jones and Bartlett Publishers.
4. Kuby's Immunology, 5th ed. Goldsby, R A,.Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York.
5. Essential Immunology, 10th edRoitt, Ivon; Delves, Peter(2001) Blackwell Scientific Publications Oxford.

ENB – 202 Industrial microbiology and Enzyme Technology

M.M. : 80
Time : 3 Hrs.

Note

1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting one from each section.

Unit I

Morphology and cell structure of major groups of microorganisms e.g. bacteria, fungi, algae, protozoa and viruses. Microbial Taxonomy, Classification of Bacteria according to Bergey's manual; Molecular approaches.Current classification of bacteria.

Unit II

Microbial Growth and Metabolism: Growth curve (normal and biphasic) and generation time. Measurement of growth; Nutritional categories of microorganisms; Media Formulation; Sterilization; Microbial growth: Batch, fed-batch, continuous kinetics. Microbial Reproduction, Bacterial recombination: transformation, transduction and conjugation.

Unit III

Industrial Microbiology: Sources, isolation, screening, preservation and maintenance of industrially important microorganisms. Improvement of industrially important microorganisms; use of rDNA technology; selection of mutants.

Process technology for the Production of various Products: Primary metabolites (ethanol, acetone, butanol, citric acid, vinegar). Production of alcoholic beverages (wine and beer). Production of secondary metabolites: Antibiotics, Industrial enzymes. Biopesticides, Microbial proteins, Biofertilizers.

Unit IV

Enzyme Technology- Nomenclature and Classification of enzymes; Enzyme kinetics-MichaelisMenten equations; Coenzymes, Mechanism of enzyme action, acid base catalysis, covalent catalysis proximity and orientation effects.Purification of enzymes.Immobilized enzymes.Application of enzymes in industry, analytical purposes and medical therapy.enzyme/cell electrodes.

References

1. Michael J. Pelczar, Microbiology, Tata McGraw-Hill
2. L.E Casida, JR, Industrial Microbiology, New Age International , PJ Limited, Publisher.
3. Prescott and Dunn, Industrial Microbiology, C BS Publisher and Distributor
4. Process engineering in biotechnology. Jackson, A.T. (1991) Prentice Hall.
6. Manual of Industrial Microbiology and Biotechnology 2nd Edition. Ed. Arnold L. Demain and Julian E. Davies (1999) ASM Press WashingtonD.C.

ENV - 203 Biostatistics and Environmental modelling

Max. Marks : 80
Time : 3 Hours.

Note

1. Nine questions will be set in all.
2. Question No. 1 will be objective covering th entire syllabus & compulsory. Theremaining eight questions will be set with two questions from each unit. The candidatewill be required to attempt five in total, Question I and four by selecting one from eachsection.

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 ofprobability

UNIT - II

Definition of random variable, density function, Basic concepts of binomial and normaldistributions.Sampling measurement and distribution of attributes, moments, matrics andsimultaneous 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 inmodel building. Simple microbial growth kinetics monod equation, methods forformulation of dynamic balance equations mass balance procedures.

UNIT - IV

Models of population growth and interactions LotkaVolterra model, Leslies matrixmodel, Point source stream pollution, Box model, Gaussian plume model, Linear, simpleand multiple regression models, validation and forecasting.

References

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

ENB – 203 Genetic Engineering

M.M. : 80
Time : 3 Hrs.

Note

1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting one from each section.

Unit I

DNA Structure and properties; Restriction Enzymes; DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase; Cohesive and blunt end ligation; Linkers; Adaptors; Radioactive and non-radioactive probes, Hybridization techniques: Northern, Southern and Colony hybridization, Fluorescence *in situ* hybridization.

Unit II

Cloning Vectors**:** Plasmids, Bacteriophages,Phagemids, Insertion and Replacement vectors,Cosmids, Artificial chromosome vectors (YACs; BACs); Animal Virus derived vectors-SV-40; vaccinia/bacculo& retroviral vectors; Expression vectors, Plant based vectors, Ti and Ri as vectors.

Unit III

Cloning Methodologies**:** Insertion of Foreign DNA into Host Cells,Introduction of DNA into mammalian cells, cDNA and genomic libraries, Yeast two hybrid systems, Phage display.
PCRandtypes of PCR – multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products. PCR in molecular diagnostics: Viral and bacterial detection; PCR based mutagenesis, Mutation detection.

Unit IV

Sequencing methods; Enzymatic DNA sequencing; Chemical sequencing of DNA; Automated DNA sequencing; RNA sequencing; Chemical Synthesis of oligonucleotides; siRNA technology; Principle and application of gene silencing, Gene knockouts and Gene TherapySomatic and germ-line therapy- in vivo and ex-vivo; Suicide gene therapy.

References

1. David P. Clark, Nanette J Pazdernik, Biotechnology Applying the Genetic Revolution, Elsevier.
2. Jack G. Chirikjian, Genetic Engineering Mutagenesis Separation Technology, Jones and Bartlett Publishers.
3. U. Satyanarayana, Biotechnology, Books and ALLIED (p) Limited.
4. Michael P. Tombs, Biotechnology and Genetic Engineering Reviews volume 10. Intercept.
5. Danniel L. Hart, Elizabeth W. Jones, essential Genetic (Second Edition) Jones and Batlett Publishers.
6. E Johansen Nange, Arthur P Nange, Basic Human Genetics (Second Edition) Sinauer Association, Ins Publisher Sunderland, Massachusetts.

Program Elective
ENV - 201 Natural Resources

Max. Marks : 80
Time : 3 Hours.

Note
1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus & compulsory. Theremaining eight questions will be set with two questions from each unit. The candidatewill be required to attempt five in total, Question I and four by selecting one from eachsection.

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.

UNIT - III

Nuclear energy- fission and fusion, bio energy -energy from biomass and biogas,anaerobic digestion, energy use patterns in different parts of the world. Impacts of largescale exploitation of solar, wind, hydro and ocean energy.

UNIT - IV

Mineral resources and reserves, ocean ore and recycling of resources, Environmentalimpact of exploitation, processing and smelting of Mineral, oceans as need areas forexploitation of Mineral resources.

References

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

Program Elective
ENV– 206 Waste Water TreatmentTechnology

M.M. : 80
Time : 3 Hrs.

Note
1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus & compulsory. Theremaining eight questions will be set with two questions from each unit. The candidatewill be required to attempt five in total, Question I and four by selecting one from eachsection.

Unit-I

Overview of standards of water quality in relation to public health - Potable andnonpotable water; Methods of water sampling for pollution analysis.Principal forms of Water Pollutants and their sources; Pollution of stream, lakes andphenomenon of eutrophication; Ocean pollution – oil pollution; Ground water pollution and its control; Water pollutionprevention.

Unit II

Methods of monitoring Pollution; Biological methods; Detection methods for DO, BOD, Pathogen monitoring by heterotrophic plate count; Multiple tube method; Membrane filtrationmethods; Other emerging techniques such as enzyme detection, hybridization, PCR,Gene probe technology etc.; Strategies for controlling pathogen transfer; Chemicalmethods- 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 anaerobictreatments; Environmental pollution control- Bioremediation, Bioaugmentation andBiostimulation; Biofilms in treatment of waste water; Bioreactors for waste water treatments.

Unit IV

Physicochemical characteristics and treatment strategies for effluent generated byDistillary and fermentation industry; Fertilizers and pesticide manufacturing industries;Dyes and textile industries; Paper and pulpindustries; Tanneries; Pharmaceuticals; Thermal power plants; Food and dairy industries;Iron and steel industries; Organic solvents; Chlorinated minerals and inorganic chemicalindustries and petrochemicals.

References

1. Nicolas P Cherewsinott, Handbook of water and waste water TreatmentTechnology, Boston Oxford Auckland Johannesburg Melbourne ,N Delhi
2. Frederick W Pontinus, Water Quality and Treatment. American water worksAssociation, MC Graw Hill Inc.
3. S K Agarwal, Water Pollution, APH Publishing Corporation.
4. Ronald L Dooste, Theory and Practical of water and waste water Treatment.
5. Bill T. Ray, Environmental Engineering, PWS Publishing company.

Foundation Course
ENV-210 Environmental issues and Disasters

Max. Marks : 40
Time : 3 Hours.

Note :
1. Seven questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining six questions will be set with three questions from each unit. The candidate will be required to attempt five in total, Question 1 and four by selecting two from each section.

UNIT I

Environmental Issues: Acid rain and its effects on ecosystem (flora, fauna and human beings), Climate change, global warming–causes and impact of global warming, International initiatives to control global warming ,carbon footprinting, clean Development Mechanism, coral reef, Biosafety protocol (1999-2000), Environmental ethics: Issues and possible solutions.

UNIT II

Hazards as Natural processes, Evaluation of Hazards, Human response to hazards, Global climate and Hazards, Population increase, land-use change and natural hazards. Rivers and flooding, Landslides, Snow avalanche, subsidence, Earthquakes and related phenomena Tsunami, Volcanic activity, Coastal hazards- tropical cyclones, tidal floods, Coastal hazards and engineering structures, Human activity and coastal hazards.

Reference Books:

1. Environmental geology by Edward A. Keller.
2. Physical geology by C.W. Montgomery.
3. Botkin, Daniel B. and Keller, Edward A. Environmental Science: Earth as a Living Planet. 6th ed. John Wiley & Sons, USA. 2007.
4. Cunningham, W. P. and Cunningham, M. A. Principles of Environment Science. Enquiry and Applications. 2nd ed. Tata McGraw Hill, New Delhi. 2004.
5. Singh, J.S., Singh, S.P. and Gupta, S.R. Ecology, Environment and Resource Conservation. Anamaya Publishers, New Delhi, India. 2006.
6. World Commission on Environment and Development (WCED): Our Common Future, Oxford University Press, London. 1987

Interdisciplinary
ENV-211 IPR and Biosafety

M.M. : 40
Time : 3 Hrs.

Note
1. Seven questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining six questions will be set with three questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting two from each section.

Unit I

Introduction to Intellectual Property Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of GMOs. WIPO Treaties, PCT, Indian Patent Act 1970 & recent amendments

Unit II

Biosafety
Introduction to Biological Safety Cabinets; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India; Environmental release of GMOs; Overview of National Regulations and relevant International Agreements including Cartegana Protocol.

References
1. P. Narayanan, Intellectual Property Laws, Eastern Law House.
2. Meenu Paul, Intellectual Property Laws, Allahabad Law Agency.
3. Intellectual Property Law containing Acts and Rules, Universal Law Publication Company.

Semester-III

ENV - 301 Environmental Chemistry

Max. Marks : 80
Time : 3 Hours.

Note

1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus & compulsory. Theremaining eight questions will be set with two questions from each unit. The candidatewill be required to attempt five in total, Question I and four by selecting one from eachsection.

UNIT - I

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

UNIT - II

Classification of elements, chemical speciation, Particles, ions and radicals in theatmosphere. Chemical processes for formation of inorganic and organic particulatematter. Thermochemical and photochemical reactions in the atmosphere.

UNIT - III

First law of thermodynamics, enthalphy, 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.

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

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

ENV - 302Remote sensing and Geographical Information

M.M. : 80
Time : 3 Hrs.

Note :1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question 1 and four by selecting one from each section.

Unit - I

Definition, Introduction and scope of remote sensing. Electromagnetic radiation, atmosphere window, Platforms, Sensors and type of scaning systems. Basiccharacteristics 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 ofvisual 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, Land use, Agriculture, soils and geology, Disaster management.

Unit- 4

GIS technology and its uses in environmental science, Hardware and software requirement for GIS. Conceptual model of spatial information, Conceptual model of non-spatial information. GPS.

References :

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

ENB – 301 Tissue Culture and Transgenics

M.M. : 80
Time : 3 Hrs.

Note:1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting one from each section.

Unit- I

Plant Tissue Culture: Totipotency; Tissue culture media; Direct and indirect organogenesis; Direct and indirect embryogenesis; Cell suspension culture; Micropropagation – shoot tip culture, somatic embryos, artificial seeds; Applications of tissue culture; Embryo culture; Anther culture and dihaploids, Protoplast isolation and fusion, somatic hybridization, Somaclonal variations.

Unit- II

Animal Tissue Culture: Basic techniques of animal cell culture & their applications. Balanced salt solutions and simple growth media.Serum quality and cell culture.
Preservation and maintenance of animal cell lines: Cryopreservation and transport of animal germplasm (i.e. semen, ovum and embryos).

Unit- III

Transgenic animals Methodology: Retroviral vector method, DNA microinjection method and engineered embryonic stem cell method. Cloning by nuclear transfer. Yeast artificial chromosome transgenesis. *In Vitro* fertilization and embryo transfer technology.

Unit- IV

Gene transfer in plants: Direct transformation of protoplasts; Transformation by particle bombardment; *Agrobacterium* mediated transformations, Ti and Ri plasmids, T-DNA genes, mechanism of T-DNA transfer; Transgene silencing.

Transgenics in crop improvement: Resistance to stresses- disease resistance, herbicide resistance. Oxidative stress, salt stress and fruit ripening. Transgenicsfor : improved quality, longer lift, flower color and shapes, for male sterility, for terminator seed. Trangenic plants as bioreactors. Commercial transgenic crops.

References:
1. R.H.Smith, Plant Tissue Culture: Techniques and Experiments, Academic Press, San Diego. 1992.
2. M. J. Chrispeels and D.F. Sadava (eds), Plants, Genes and Crop Biotechnology, 2nd Edition, Jones and Barlett Press, 2003
3. J.H. Hammond, P. Mcgarvey, and V. Yusibov (eds), Plant Biotechnology, Springer Verlag, Heidelberg. 2000
4. R. I. Freshney, Culture of Animal Cells, 5th Edition, Wiley-Liss, 2005.

ENB - 302 Fermentation and Down-stream Processing

M.M. : 80
Time : 3 Hrs.

Note:1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting one from each section.

Unit-I

Fermentations: Aerobic and anaerobic, Shake flask, batch and continuous operations. Solid state fermentations. Types of reactor: Batch, plug flow reactor (PFR), continuous stirred tank reactor (CSTR), Fluidized bed reactor, bubble column, air lift fermenter, Packed bed with immobilized enzymes or microbial cells, Trickling filter.

Unit-II

Unconventional bioreactors: Gas liquid reactors, hollow fiber reactor, membrane reactor and perfusion reactor for animal and plant cell culture. High Performance Bio Reactors, Reactors for Solid state fermentation.

Unit-III

Down-stream Processing: Scope of downstream processing in biotechnology, problems, requirement of purification. Overview of a bioprocess including upstream and downstream processing.Characteristics of biotechnology products, classes of byproducts, physicochemical basis of bioseparation.

Unit-IV

Separation of particulate by filtration, centrifugation, settling, sedimentation, decanting and microfiltration. Primary isolation methods including solvent extraction, sorption. precipitation, ultra filtration, reverse osmosis, super critical fluid extraction, evaporation, super liquid extraction and foam based separation.
Purification methods: Fractional precipitation, electrophoresis, electro dialysis and various kinds of chromatography.

References:

1. Principles of fermentation technology, Stanbury, P. F. and Whitaker, A. (1984), Pergamon press.
2. Separation Process Principles, Seader, J.D. & Henley, E.J. (1998) John Wiley & Sons, Oxford.
3. Bioseparation: Downstream Processing for Biotechnology. Belter, P. A.; Cussler E. L. and Hu W. S. (2003) John Wiley & Sons. OXFORD.
4. Multiphase Bioreactor Design. Edited by: Joaquim M.S. Cabral, Manuel Mota, Johannes Tramper(2001)CRC Press.
5. Bioreactor & Ex Situ Biological Treatment Technologies – 5. Allerman Bruce, Allerman Bruce C, Leeson Andrea, (1999). Battelle publisher.

Program Elective
ENV - 303 Elementary Concept of Physical Environment

Max. Marks : 80
Time : 3 Hours.

Note

1. Nine questions will be set in all.
2. Question No. 1 will be objective covering th entire syllabus & compulsory. Theremaining eight questions will be set with two questions from each unit. The candidatewill be required to attempt five in total, Question I and four by selecting one from eachsection.

UNIT - I

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

UNIT - II

Geographical classification and zones.Structure and composition of Biosphere.Generalrelationship between landscapes, biomes and climates.

UNIT - III

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

UNIT - IV

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

References

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

Program Elective
ENV - 304Environmental Impact Assessment

M.M. : 80
Time : 3 Hrs.

Note :
1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question 1 and four by selecting one from each section.

Unit - I

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

Unit - 2

Impact assessment methodologies, Generalized approach to impact analysis. Case study: EIA of 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.

Unit- 4

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

References :
1. Environmental Impact Assessment- John Glasson.
2. Methods of Environmental Impact Assessment - Morris andthe rivel.
3. Environmental Imapct Assessment - L. W. Canter.
4. Chemical principles of Environmental pollution - Lalloway andAyers.
5. Industrial Environment - Assessment and strategy - S.K.Aggarwal

Semester-IV

ENV - 401 Environmental Laws

Max. Marks : 80
Time : 3 Hours.

Note

1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting one from each section.

UNIT - I

Scheme of lebelling of environmentally friendly products (ecomark). Public liability Insurance Act. 1991. Provision of constitution of India regarding environment (article 48A & 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 act 1927.

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 effortsfor environment protection.

.

References

1. Environmental administration & law - ParasDiwaa.
2. Environmental planning, policies & programs in India - K.D. Saxena.

ENV –402 Environmental Management and Planning

Max. Marks : 80
Time : 3 Hours.

Note

1. Nine questions will be set in all.
2. Question No. 1 will be objective covering th entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting one from each section.

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

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