DEPARTMENT OF ENVIRONMENTAL SCIENCES
Session: 2017-18

M.Sc Environmental Biotechnology

Program Specific Outcomes

PSO1 The M.Sc. Environmental Biotechnology, curriculum is designed keeping in mind relevance of interdisciplinary approach.

PSO2 Students would be trained through appropriate theoretical background and laboratory demonstrations program.

PSO3 Students receiving postgraduate degree from the program will have advanced knowledge of principles of biotechnology and environmental science.

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 after second semester and undertaking projects IN final semester,which enhances the employability and innovative skills.

Credit Matrix for M.ScEnvironmental Biotechnology Program

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

Scheme of M.Sc Environmental Biotechnology Program
SEMESTER- 1

S.No.	Course No.	Nomenclature of Paper	L-T-P (Hours)	Credits	Evaluation Scheme		
					Theory	IA	Total marks
1	16ENB21C1	Environmental Biology	4-0-0	4	80	20	100
2	16ENB21C2	Analytical Techniques	4-0-0	4	80	20	100
3	16ENB21C3	Environmental Pollution	4-0-0	4	80	20	100
4	16ENB21C4	Cell and Molecular	4-0-0	4	80	20	100

		Biology					
5	16ENB21C5	Biochemistry	4-0-0	4	80	20	100
6	16ENB21C6	Lab Course –I (16ENB21C1,2 & 3)	0-0-8	4	-	-	100
7	16ENB21C7	Lab Course –I (16ENB21C4 &5)	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 marks
1	16ENB22C1	Immunology	4-0-0	4	80	20	100
2	16ENB22C2	Industrial Microbiology & Enzyme Technology	4-0-0	4	80	20	100
3	16ENB22C3	Biostatistics & Environmental Modeling	4-0-0	4	80	20	100
4	16ENB22C4	Lab Course – III (16ENB22C1,2 & 3)	0-0-12	6	-	-	150
5	16ENB22D1	Genetic Engineering Waste Water Treatment Technology Environmental Geology	4-0-0	4	80	20	100
6	16ENB22D4	Lab Course –I (16ENB22D1/2/3)	0-0-4	2	-	-	50
7		Foundation Course	2-0-0	2	40	10	50
8	16ENB01	Open Elective	3-0-0	3	80	20	100

Total Credits: 29
Total Marks: 750

SEMESTER- 3

S.No.	Course No.	Nomenclature of Paper	L-T-P (Hours)	Credits	Evaluation Scheme		
					Theory	IA	Total marks
1	16ENB23C1	Environmental Chemistry	4-0-0	4	80	20	100
2	16ENB23C2	Tissue Culture & Transgenics	4-0-0	4	80	20	100
3	16ENB23C3	Lab Course- V (16ENB23C1 & 2)	0-0-8	4	-	-	100
4	16ENB23D1 16ENB23D2	Fermentation and Downstream Processing Remote sensing and Geological Information	4-0-0	4	80	20	100

		Systems					
5	16ENB23D3 16ENB23D4	Elementary Concept of Physical Environment Environment Impact Assessment	4-0-0	4	80	20	100
6	16ENB23D5	Lab Course –VI (16ENB23D1/2 & 3/4)	0-0-8	4	-	-	100
7	16ENB02	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 marks
1	16ENB24C1	Environmental Laws	4-0-0	4	80	20	100
2	16ENB24C2	IPR & Biosafety	4-0-0	4	80	20	100
3	16ENB24C3	Dissertation	0-0-40	20	-	-	300

Total Credits: 28
Total Marks: 500
Grand Total Marks: 2650
Grand Total Credit: 112

SEMESTER-I

16ENB21C1 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

16ENB21C2AnalyticalTechniques

Course Outcomes

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

CO2 The students would be 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

16ENB21C3 Environmental 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

16ENB21C4Cell and Molecular Biology

Course Outcomes

CO1 Students would learn life processes at the cellular, sub-cellular and molecular level that occur in and between the cells.

CO2 Students would be able to address problems in the biochemical, biological and agricultural sciences.

CO3 Students would be able to link the structure of cell, cellular organelles and bio molecules with their functions in plants and animals, thereby enabling their survival.

CO4 Students would learn the molecular mechanisms by which DNA controls growth, development and morphological traits of organisms.

CO5 Students would be able to explain the emergence of mutations and their influence on individual and species with the roposal of method of targeted mutations that can be used for research or application in industry.

M.M.: 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, one question 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 Replication in 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 of transcription. Post-transcriptional modifications of various RNA species.Transcription in mitochondria 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

- Cell Biology- Smith and Wood by Chapman and Hall.
- Cell Biology: Organelle structure and function, Sadava, D E.(2004) Panima publishers, New Delhi.
- David Freifelder, Essentials of Molecular Biology, Narosa Publishing House.
- George M. Malacinski, Essentials of Molecular Biology, Jones and Bartlett Publishers.
- Harvey Lodish, Arnold Berk, 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.
- Genes VII, Lewin, Benjamin (2002) OUP, Oxford.
- Genomes,2nd ed, Brown, T. A.(2002) John Wiley and sons ,Oxford

16ENB21C5BIOCHEMISTRY

Course Outcomes

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

CO2 Studentswould understand 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

M.M.: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

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

16ENB21C6 Lab Course-I

Course outcomes

CO1 Students would analyze the biological and chemical oxygen demand of the waste water.

CO2 Students would be able to analyze Sox, NOx and suspended particulate matter present in the air as pollutants.

CO3Students would learn the operation of instruments like UV- Visible spectrophotometer, atomic absorption spectrophotometer, flame photometer, paper, column and gas chromatography.

CO4. Students would be able to analyse species abundance, frequency and enrichment of a particular region.

CO5 Students would be analyzing soil nutrients of the given soil sample.

Max. Marks: 100
Time :6 Hrs.

1. To study soil profile of a given area.
2. To determine the organic carbon of the different types of soils.
3. To determine the calcium and magnesium in the soil samples.
4. To determine moisture content, Water Holding Capacity in the given soil samples.
5. To estimate the pH, total dissolved solids (TDS) and electrical conductivity of given water/soil samples.
6. To estimate the sodium and potassium in given water/soil samples using flame photometer.
7. To determine the chlorophyll content of the plant material.
8. To determine the distribution pattern of a plant community.
9. To determine the basal area and dominance of different species in given vegetational area.
10. To determine Important Value Index of a given vegetational area.
11. To verify Beer- Lambert's Law of absorption of light.
12. To study absorption spectrum of bromophenol blue as indicator dye in different pH range.

13. To perform paper chromatography of amino acids and calculation of Rf value.
14. Isolation of plant pigments by column chromatography and study their absorption spectrum.
15. Separation of nucleic acids by agarose gel electrophoresis.
16. To estimate the Chemical Oxygen Demand (COD) of industrial effluent samples.
17. To estimate the Biological Oxygen Demand (BOD) of waste water samples.
18. To determine the residual chlorine and chloride content in the given water samples.
19. To calculate available phosphate in given soil and water sample.
20. To determine the suspended particulate matter (SPM), SOx and NOx in ambient air.

16ENB21C7 Lab Course-II

Course outcomes

CO1 Students will be able to estimate various biomolecules in the biological test samples

CO2 Students would be able to check the adulteration of fats and oils.

CO3 Students would be able to examine different kinds of cell present in the biological world.

CO4 Students would learn how the cells divide and regulation of their division.

Max. Marks: 100
Time :6 Hrs.

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. Extraction of proteins from bacterial cells and their estimation by Folin-Lowry's method.
5. Isolation of casein protein from milk.
6. Estimation of Chlorophyll in plant leaves sample.
7. To identify lipids in given sample by thin layered chromatography.
8. To perform gram staining of the bacterial isolates.
10. To study cell division mitosis in onion root tip.
11. To isolate genomic and plasmid DNA from bacterial cell.

SEMESTER-II

16ENB22C1Immunology

Course Outcomes

CO1 Students would be able to explain various cells, organ, immune response, MHC and HLA typing in immune system

CO2 Students would able to describe the structure, properties organization and generation of immunoglobulin, T cell and cytokines

CO3 Students would understand the experimental aptitude to analyses the antigen antibody interaction

CO4 Students would have knowledge about the various diseases caused by immune system and their importance toward health

MM: 80 marks
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

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-Cell Responses: 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 lymphoproliferationassay, 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

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

16ENB22C2 Industrial Microbiology and Enzyme Technology

Course Outcomes

CO1 The students will be able to isolate, screen, preserve and maintain industrially important microorganisms.

CO2 They will also be able to classify the microorganisms of economic importance and optimize the growth conditions of microorganisms depending upon the mode of operation.

CO3 They will be well versed with the technology used for production of organic solvents, alcoholic beverages, antibiotics, industrial enzymes. biopesticides and biofertilizers in industry.

CO4 The students will be able to purify enzymes from their natural resources and their application in industry, analytical purposes and medical therapy.

M.M.: 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, one question 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

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

PAPER: 16ENB22C3 BIOSTATISTICS AND ENVIRONMENTAL MODELING

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 LotkaVolterra 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

16ENB22D1Genetic Engineering

Course Outcomes

CO1 Students would be able to explain the role of enzymes and hybridization techniques used in genetic engineering

CO2 Students would able to elucidate the structure and importance of various types of cloning vector

CO3 Development of methodologies used in insertion of foreign DNA into host cell and explain the mechanism and function of various types of PCR in molecular diagnostic

CO4 Students would able to identify the importance of gene Sequencing, gene silencing and gene therapy to human welfare.

M.M.: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

DNA Structure and properties; Restriction Enzymes; DNA ligase, Klenow enzyme, T4 DNApolymerase, 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 Rias 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. PCR and types 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 Therapy Somatic and germ-line therapy- in vivo and ex-vivo; Suicide gene therapy.

References

- David P. Clark, Nanette J Pazdernik, Biotechnology Applying the Genetic Revolution, Elsevier.

- Jack G. Chirikjian, Genetic Engineering Mutagenesis Separation Technology, Jones and Bartlett Publishers.
- U. Satyanarayana, Biotechnology, Books and ALLIED (p) Limited.
- Michael P. Tombs, Biotechnology and Genetic Engineering Reviews volume 10. Intercept.
- Danniel L. Hart, Elizabeth W. Jones, essential Genetic (Second Edition) Jones and Batlett Publishers.
- E Johansen Nange, Arthur P Nange, Basic Human Genetics (Second Edition) SinauerAssociation, Ins Publisher Sunderland, Massachusetts.

16ENB22D2 Waste 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 Pollutants and their sources; Pollution of stream, lakes and phenomenon of eutrophication; Ocean pollution – 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; Membrane filtration 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 Distillary and fermentation industry; Fertilizers and pesticide manufacturing industries; Dyes and textile industries; Paper and pulp industries; Tanneries; Pharmaceuticals; Thermal power plants; Food and dairy industries; Iron and steel industries; Organic solvents; Chlorinated minerals 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.

16ENB22D3Environmental 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.

16ENB22C4 Lab Course-III

Practical outcomes

CO1 Students would understand human defense mechanism against the infectious microorganisms.

CO2 Students would be able to estimate Haemoglobin andanalyse blood groups in humans

CO3 Students would be able to calculate mean, median, mode and standard deviations of the given data set manually as well as using Microsoft excel.

CO4.Students would learn about applying different statistical methods to determine significance of the study.

CO5 Students would learn the growth curve and industrial production of alcohol and antibiotics.

Max. Marks: 150
Time :6 Hrs.

1. To determine the blood group and Rh factor of humans.
2. To determine the titre value of antibodies present in test serum due to the infection of *Salmonella* genus causing entire or typhoid fever by using quantitative tube agglutination test.
3. To study the reaction pattern of an antigen with a set of antibodies by Ouchterlony double diffusion method.
4. To separate lymphocytes from human blood using density gradient media.
5. To term the technique of latex agglutination
6. To determine the antigen concentration in blood serum by sandwich ELISA method.
7. To plot growth curve of bacterial culture and calculate the generation time.
8. Isolation of antibiotic producing microorganisms by crowded plate technique.
9. Isolation of amylase producing microorganisms from soil by serial plate dilution.
10. Batch fermentation for production of alcohol by *Saccharomyces cerevisae*.
11. Citric acid production by *Aspergillusniger* and recovery from fermented broth.
12. Production of amylase and its estimation in the culture broth.
13. Statistical analysis applying different methods of statistic:
    a. Mean
    b. Median
    c. Mode Geometric and Harmonic mean
    d. Standard deviation

16ENB22D4 Lab Course-IV

Practical 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 learn to isolate and estimate DNA and RNA from the microbial/plant cells..

CO4 Students would learn various techniques of genetic engineering as Polymerase chain reaction, DNA cutting and ligation.

CO5 Students would study the geomorphology and composition of various types of rocks present on earth.

Max. Marks:50
Time :6 Hrs.

16ENB22D1: Genetic Engineering

1. Isolation and purification of chromosomal DNA from bacteria and purity of nucleic acids using A260/A280 ratios and their quantification using spectrophotometer.

2. To perform Polymerase Chain Reaction (PCR) for 16rRNA gene from the genomic DNA.

3. To clone the amplicon into pGEM-T vector.

4. To prepare chemically competent cells of E. coli DH5α and transform them with pGEM-T vector.

5. Restriction analysis of DNA samples by agarose gel electrophoresis

16ENB22D2: 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.

SEMESTER-III

16ENB23C1 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, 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 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 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

- 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

16ENB23C2Tissue Culture and Transgenics

Course Outcomes

CO1 Students would be able to explain the role of medium and other condition in plant tissue culture alongwith different culture types and their application

CO2 Students would be able to describe the animal tissue culture, preservation and their maintenance.

CO3 Student would ddeveloped the methodologies used in insertion of foreign DNA into animal and discuss on *in vitro* fertilization and embryo transfer technology

CO4 Students will be able to explain the various mechanism for making transgenic plants and importance of transgenic plants in crop improvement

M.M.: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

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

References:

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

16ENB23D1 Fermentation and Down-Stream Processing

Course Outcomes

CO1 Students would learn about the conventional and unconventional reactors like Gas liquid, hollow fiber, membrane, and perfusion reactors used in the industry.

CO2 Students would develop understanding about the process of aerobic and anaerobic Fermentation, and processing of the biotechnological products, their characteristics and the byproducts.

CO3 Students would gain knowledge about the process of biotechnological product synthesis.

CO4 Students would learn the various separation and purification methods

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. Solidstate fermentations. Types of reactor: Batch, plug flow reactor

Unit-II

Unconventional bioreactors: Gas liquid reactors, hollow fiber reactor, membrane reactorand 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 downstreamprocessing.Characteristics of biotechnology products, classes of byproducts,physicochemical basis of bioseparation.

Unit-IV

Separation of particulate by filtration, centrifugation, settling, sedimentation, decanting andmicro filtration.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:

- Principles of fermentation technology, Stanbury, P. F. and Whitaker, A.
- Separation Process Principles, Seader, J.D. & Henley, E.J.
- Bioseparation: Downstream Processing for Biotechnology. Belter, P. A.; Cussler E. L.and Hu W. S.
- Multiphase Bioreactor Design. Edited by: Joaquim M.S. Cabral, Manuel Mota,Johannes Tramper
- Bioreactor & Ex Situ Biological Treatment Technologies – 5. Allerman Bruce,Allerman Bruce C, Leeson Andrea.

16ENB23D2 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 satellitesand 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 data via 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 requirement for GIS.Conceptual model of spatial information, Conceptual model of non spatial information.GPS.

References :

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

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.

16ENB23D4Environmental 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 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, Land use policy for India.

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:

- 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

16ENV23C3 Lab Course V

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 learn various techniques of tissue culture like preparation of culture media, tissue and organ culture of plants.

CO4 Students would be able to form artificial seeds in plants using encapsulation of somatic embryos.

Max. Marks: 100

Time :6 Hrs.

1. Preparation of Murashige and Skoog media for plant tissue culture.
2. Induction of shoot regeneration from chickpea/mungbean cotyledons culture.
3. Induction of roots *in vitro* regenerated shoots.
4. Transplantation of *in vitro* regenerated plant in soil and their acclimatization.
5. Preparation of synthetic seed by encapsulation of somatic embryos.
6. To find λmax value of $K_2Cr_2O_7$ and $KMnO_4$ solution using spectrophotometer.
7. To plot standard curve for Cr(VI) using $K_2Cr_2O_7$ and to find concentration of Cr(VI) in unknown sample.
8. To determine Total Organic Carbon present in given water/soil sample.
9. To determine total nitrogen content in given soil/water sample by Kjeldahl method..
10. To determine Biological Oxygen Demand of given unknown water sample.

16ENV23D6 Lab Course-VI

Practical 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 learn geo-referencing from toposheet in ERDAS domain.

CO4Students would be able to visually interpret landset imagery of various geographic regions.

CO5 Students would learn the kind of industrial fermentations in the industry.

Max. Marks: 100

Time :6 Hrs.

16ENB23D2: Fermentation and downstream Processing

1. To study design of different types of reactors used in the industry.
2. Batch fermentation for production of alcohol by *Saccharomyces cerevisae*.
3. Citric acid production by *Aspergillusniger*by solid state fermentation.
4. Production of amylase in submerged culture and its purification.
5. Production of biofertilizers using solid state/submerged fermentation.

16ENB23D2: Remote sensing and Geographical system

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.

16ENB23D3: Elementary concept of Physical Environment

1. Indexing of topographic sheet.
2. To study the GPS.
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.

16ENB23D4: Environment Impact Assessment

Case studies of

1. Hyrdoelectric Power Project.
2. Thermal Power Project.

3. Coal Mining Project.
4. Oil Refinery.
5. Ports and Harbours.
6. Natural Gas Power Plant.
7. Fertilizer Plant
8. Nuclear Power Project
9. Roads and Highways
10. Railway Project.

SEMESTER-IV

16ENB24C1 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 liability Insurance 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 act 1927.

UNIT - III

Air (prevention & control of pollution) Act 1981 as amended by amendment 1987 & rule 1982. 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 for environment protection.

References

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

16ENB24C2 IPR and Biosafety

Course Outcomes:

CO1 The students would learn about the different types of Intellectual property and will be motivated for outcome based research.

CO2 They would become familiar with the international agreements administered by WIPO. They will also understand the impact of signing GATT & TRIPS on the present economic status of the country.

CO3 The students would learn patent procedures, Patent licensing and agreement system.

CO4 The students would understand about the safety levels that will help them during their laboratory work while working with microorganisms and hazardous chemicals

CO5 They would also become familiar with the issues related to environmental release of GMOs.

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, one question 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.

Unit II

Agreements and Treaties: GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments

Unit III

Patent filing procedures

National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting – disclosure/non-disclosure; Financial assistance for patenting, Patent licensing and agreement, Patent infringement.

Unit IV

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

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