CVM UNIVERSITY

MASTER OF SCIENCE

BIOTECHNOLOGY (ENVIRONMENTAL BIOTECHNOLOGY)

PROGRAMME

Under Choice Based Credit Scheme

Structure with Effect From: 2021-22

CVM UNIVERSITY

Programme M.Sc. (Environmental Biotechnology)
(Under the Choice based Credit Scheme)

STRUCTURE WITH EFFECT FROM 2021-2022

Type of course	Course Code	Title	T/P	Credit	Exam Duration in Hrs	Component of Marks		
						Internal	External	Total
						Total / Passing	Total / Passing	Total / Passing
Semester - I								
Core Course	Core 1	Water & Waste Water Treatment Technologies	T	4	3	40/16	60/24	100/40
	Core 2	Biodegradation & Bioremediation	T	4	3	40/16	60/24	100/40
	Core 3	Environmental Toxicology	T	4	3	40/16	60/24	100/40
	Core 4	Practical Based on Core 1 & Core 2	P	4	3	40/16	60/24	100/40
	Core 5	Practical Based on Core 3 & Elective X	P	4	3	40/16	60/24	100/40
	Core 6	Comprehensive Viva-Voce		1			50/20	50/20
Elective Course (Any One)	Elective 1	Plant Biotechnology	T	4	3	40/16	60/24	100/40
	Elective 2	Microbial Technology	T	4	3	40/16	60/24	100/40
	Elective 3	Environmental Chemistry	T	4	3	40/16	60/24	100/40
	Elective 4	Clinical biochemistry	T	4	3	40/16	60/24	100/40
	Total Credit			**25**				

MASTER OF SCIENCE – BIOTECHNOLOGY
(ENVIRONMENTAL BIOTECHNOLOGY)
SEMESTER – I
NAME OF COURSE: WATER & WASTE WATER TREATMENT TECHNOLOGIES
COURSE CODE: CORE 1
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes

At the end of this course, the student will be able to:

1. Understand about water and wastewater characteristics and, fundamentals of water and wastewater treatment processes
2. Illustrate the process and microbiology of suspended and attached aerobic wastewater treatment processes: Activated Sludge Process, Trickling filter, Rotating Biological Contractors and Pond treatment processes
3. Describe the system, process and microbiology of suspended and attached anaerobic wastewater treatment processes: Septic tank, Anaerobic digester and Up flow Anaerobic Sludge Blanket processes
4. To impart knowledge on development of an overall treatment strategy for an industrial waste stream through case studies.

UNITI:

Water Characteristics, Indian standard and International standards for drinking water. Physical parameters (Color, taste-odor, Turbidity, suspended solids, Temperature. Chemical parameters (TDS Alkalinity, Hardness, salts, acids and alkalis, chlorides, fluorides, proteins, carbohydrates, organics, fats oil & grease, Hazen units, NTU,BOD, COD, DO, TDS, Trace metals, Heavy metals, tests on quality parameters Plate counts and Most probable number (MPN). Sewage and waste water treatments systems: A. Primary treatment methods B. Secondary treatment methods and C. Tertiary treatment methods.

UNIT II:

Aerobic Biological Treatment Processes: Suspended growth and attached growth wastewater treatments. Process fundamentals Methods of aeration, design considerations, Operational difficulties. Description, design and operation of aerobic treatment systems: Activated Sludge process- Trickling Filters, Bio-tower, RBC, MBBR, Membrane biological reactors (MBR), Sequencing Batch Reactors (SBR). Aerated lagoons, Waste stabilization ponds.

UNIT III:

Anaerobic Biological Treatment Processes: Process fundamentals Standard, high rate and hybrid reactors. Anaerobic digestion, Design of anaerobic digesters, Description, design and operation of attached and suspended growth processes: Anaerobic filters-Expanded /fluidized bed reactors-Up flow anaerobic sludge blanket reactors (UASB), Anaerobic Suspended growth reactors- septic tank, Imhoff tank. Cost benefit analysis of various treatment technologies.

UNIT IV:

Dairy: General Characteristics of Dairy Wastewaters and Treatment of Dairy Effluent Wastewater. Paper Pulp: Problems Related with Pulp and Paper Industry.
Textile industry: Characterization of textile industrial wastewater, Treatment Technologies of textile industrial effluents.
Tanning Industry: Characterization of Effluents, Environmental Impact of Tannery Effluents.
Pharmaceutical Industry: Characterization of effluents, treatment technologies for pharmaceutical effluents.

REFERENCE BOOKS:

1. Alan Scragg. Environmental Biotechnology. 2nd Edition. Oxford Press. ISBN: 0-19926867-3. 2. Canter, L. (1977) Environmental Impact Assessment. McGraw Hill.
3. Christon JH, Linda DS. Ronald LC, Guy RK and Michael JM. Manual of Environmental Microbiology. 2nd Edition. ASM Press. ISBN: 1-55581-199-X.
4. Clesceri LS. Greenberg AE, Eaton AD. (2004) Standard methods for examination of water & waste water. American Public Health Association.
5. Gabriel Bitton. Wastewater Microbiology. 3rd edition, A John Wiley & Sons, INC., Publication. ISBN: 0-471-65071-4.
6. Indu Shekhar Thakur. Environmental Biotechnology Basic concepts and applications. IK International Pvt, Ltd. ISBN 81-88237-52-3.
7. Metcalf and Eddy Inc. (1979) Waste water Engineering treatment, Disposal, Reuse. Tata McGraw Hill Publication. Co. Ltd.
8. Murray MooYoung. Comprehensive Biotechnology. Pergamon Press. ISBN: 81-8147333-7 (set).
9. Pradipta Kumar Mohaparta. Textbook of Environmental Biotechnology. I. K. International Publishing House Pvt. Ltd. ISBN: 81-88237-54-X.
10. Soli J. Arceivala. Wastewater treatment for pollution control. 2nd edition, Tata-McGrawHill Publishing Company Limited. ISBN: 0-07-463002-4. 11. M. N. Rao and A. K. Datta. Wastewater Treatment. ISBN: 8120402154.

PRACTICALS:

1. Determination of Dissolved oxygen
2. Determination of BOD of sewage
3. Determination of COD sewage
4. Estimation of Total Solids (TS)
5. Estimation of Total Suspended Solids (TSS)
6. Estimation of Total Dissolved Solids (TDS)
7. Estimation of MLSS/MLVSS
8. IMViC tests.
9. Routine Bacteriological analysis of water: a. Tests for coliforms: Presumptive test, Confirmatory test and Completed test.

10. Determination of MPN of coliform.
11. Field trip to a waste water treatment plant.

Book recommended for Practicals:

1. APHA (American Public Health Association) Handbook, 1998

MASTER OF SCIENCE – BIOTECHNOLOGY
(ENVIRONMENTAL BIOTECHNOLOGY)
SEMESTER – I
NAME OF COURSE: BIODEGRADATION & BIOREMEDIATION
COURSE CODE: CORE 2
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes

At the end of this course, the student will be able to:

1. Determination of biodegradability of xenobiotic, recalcitrant and toxic compounds.
2. Basics of microbial transformation of pesticides and chlorinated aliphatic compound.
3. Process, advantages and limitations of In-situ and Ex-situ bioremediation.
4. Role of plasmids, metagenomics and gene manipulation to improve bioremediation technologies.

UNIT I:

Biodegradation-I: Introduction, Determination of biodegradability, Principles of bacterial degradation, environmental factors affecting biodegradation, enzymes, toxicity. Aerobic degradation of hydrocarbons, growth associated aliphatic compound degradation, Degradation of Aromatic compounds. Anaerobic bacterial degradation-biopolymer, fats, lipids, hydrocarbon, N-alkyl, S-alkyl, ketones compound degradation.

UNIT II:

Biodegradation-II: Microbial transformation of pesticides, Fundamental reactions of pesticide metabolism-β-oxidation, oxidative dehalogenation, dealkylation, decarboxylation, epoxidation. Aromatic Non-heterocyclic Ring Cleavage-Hydrolysis, Halogen reaction, Nitro-reduction. Anaerobic degradation of 2,4 D, 2,4,5-T and PCB. Degradation of selected volatile organic compounds in ground water-Chlorinated alkanes-PCE, PCA, TCA, TCE, DCA and CT (biotic, abiotic, aerobic and anaerobic transformations).

UNIT III:

Overview of bioremediation strategies**,** Ex Situ versus In Situ Bioremediation**.** Factors affecting bioremediation.In-situ bioremediation- Biosparging, Bioventing, Bioaugmentation (Benefits, Limitation, Process and factors to consider). Ex-situ Bioremediation- Land farming, composting, Biopiles. Bioreactors. Phytoremediation: Types of phytoremediation technologies (phytoextraction, phytostabilization, phytovolatilaztion,rhizodegradation, rhizofilteration).

UNIT IV:

Use of bacteria fungi and algae in biosorption, Biomineralisation& Bioleaching: Microorganisms involved in Bioleaching of ores, mechanisms of bioleaching, Bioleaching & Metal recovery.Molecular techniques in bioremediation,Role of plasmids in bioremediation, Genetics and gene manipulation: Metagenomics in Bioremediation, Bio-surfactants in bioremediation, Microbial surfactants. Bioremediation of air pollutants-Microbial degradation of contaminants in gas phase, Biofilteration, Biofilter media, Microbial ecology of biofilters.

REFERENCE BOOKS:

1. Ronal L. Crawford, Don L. Crawford. Bioremediation: Principles and Applications. ISBN: 0521470412.
2. Anthony H. Rose. Microbial Biodeterioration. Academic Press. ISBN: 0125965567.
3. Dennis Allsopp, Kenneth J. Seal, Christine C. Gaylarde. Introduction to Biodeterioration. Cambridge University Press. ISBN 0521528879.
4. Alan Scragg. Environmental Biotechnology. 2nd Edition. Oxford Press. ISBN: 0-19926867-3.
5. Pradipta Kumar Mohaparta. Textbook of Environmental Biotechnology. I. K. International Publishing House Pvt. Ltd. ISBN: 81-88237-54-X.
6. R. Margesin and F. Schinner. Manual of Soil analysis: Monitoring and Assessing Soil Bioremediation. Springer Publishers ISBN: 3540253467.
7. James J. Valdes. Bioremediation Kluwer Academic Publishers ISBN 0792364597.
8. Subhas K. Sikdar and Robert L. Irvine Biodegradation Technology Developments Vol: II, Bioremediation: Principles and practice. CRC Press. ISBN-10: 1566763088.

PRACTICALS:

1. Isolation of hydrocarbon degrading microorganisms.
2. Analysis of Chromium.
3. Analysis of iron.
4. Isolation of metal detoxifying microorganisms.
5. Study of biodegradation of aromatic compounds using TLC.
6. Decolourization of dye.
7. Study of biofilm: slide immersion tech and staining

MASTER OF SCIENCE – BIOTECHNOLOGY
(ENVIRONMENTAL BIOTECHNOLOGY)
SEMESTER – I
NAME OF COURSE: ENVIRONMENTAL TOXICOLOGY
COURSE CODE: CORE 3
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes

At the end of this course, the student will be able to:

1. Toxicological concepts, dose-response relationships and risk assessment.
2. Study of toxicological chemistry of natural and synthetic toxicants.
3. Ecotoxicology and metabolic transformation of toxicants.
4. Assessment molecular toxicological effects of UV radiation and heavy metals.

UNITI:

Principle of toxicology, History, disciplines and importance of toxicology, Classification of toxic agents. Acute toxicity, chronic toxicity, Hazards, Risks, Benefit-to-risk-ratio, tolerance limits, Acceptable daily intake, Threshold value, NOEL. Factors affecting toxicity. Mechanisms of toxicology, Risk assessment-hazardous identification, Risk characteristics, exposure assessment. Physico-chemical properties of toxic substances, route and rate of exposure, Dose, Effect and response, Dose-response curves, & Dose effect relationships.

UNIT II:

Toxicological Chemistry: Toxicology of Natural Products-Toxic substances from bacteria, Mycotoxins (exo and endo toxin), viral toxins, algal toxin, protozoan toxin, toxic substances from plants, Insect toxins, Spider and Reptile toxins. Toxicology of Some Organooxygen compounds-Alcohols, Phenols, Formaldehyde, Ethers, Caboxylic acids, Esters, Organonitrogen Compounds-Nonaromatic Amines, Carbocyclic aromatic amines, pyridine, nitriles, nitrosoamine, isocyanates and carbamates.

UNIT III:

Ecotoxicology and Metabolic Transformation: Pathways of toxicants into Ecosystems, Bioconcentration and Biotransfer factors, Biomarkers. Metabolic Reactions of Xenobiotic Compounds: Phase I and Phase II reactions, Biochemical Mechanisms of Toxicity, Interference with enzyme action, Biochemistry of mutagenesis and carcinogens.

UNIT IV:

Molecular Toxicology: The role of environment in carcinogenesis, multi stage nature of carcinogenesis process, Selection of biomarker in event of toxic exposure. Genetic Toxicology: UVB and UVC induced DNA damage, DNA damage due to heavy metals and organic compounds. Epigenetic changes, due to due to heavy metal (Cr, Pb, Cd, As, Hg). Global DNA Hyper-methylation/Hypo-methylation due to heavy metal (Cr, Pb, Cd, metalloid As, Hg) exposure and polycyclic aromatic hydrocarbon. Apoptosis due to toxic exposure of metalloid As, Cd, Pd.

REFERENCE BOOKS:

1. Louis J Casarette, John Doull, Toxicology- The Basic Science of Poisons, Mc MillanPublishing Co. Inc. New York.
2. Stanley E. Manahan, Toxicological Chemistry and Biochemistry 3rd Edition,. Lewis Publishers, CRC Press.
3. Lorris G. Cockerham and S. Shane. Basic Environmental Toxicology, CRC Press.
4. Donald G. Crosby. (1998) Environmental Toxicology and Chemistry. Oxford University Press.
5. Maiti, SK. Handbook of Methods in Environmental Studies. Vol. 1& 2. ABD Publishers.
6. Wayne G.Landi Ming-Ho Yu, Introduction to Environmental Toxicology.

PRACTICALS:

1. Toxicity Test
   A) Significance of Toxicity Tests
   B) Classification of Toxicity Tests
2. Measurement of Toxicity in Laboratory (Fish Bioassay).
3. Estimation of LC_{50} and LD_{50} for a given heavy metal using suitable organisms.
4. Effects of effluents containing heavy metals on germinating groundnut and paddy seeds.
5. Acetylcholine-esterase Inhibition assay.
6. Analysis of lead.
7. Estimation of Co^{2+} and Ni^{2+} by colorimetric/ spectrophotometry.
8. Analysis of copper by spectrophotometry.

MASTER OF SCIENCE – BIOTECHNOLOGY
(ENVIRONMENTAL BIOTECHNOLOGY)
SEMESTER – I
NAME OF COURSE: PLANT BIOTECHNOLOGY
COURSE CODE: ELECTIVE 1
SYLLABUS EFFECTIVE FROM: 2020-2021

Course Outcomes

At the end of this course, the student will be able to:

1 Tools and techniques of plant genetic engineering
2 Molecular biology of nitrogen fixation, nif gene transfer, herbicide resistant plants production
3 Transgenic plants for agriculture and commercial applications
4 Plant tissue culture techniques

UNIT I:

Plant biotechnology present scenario, Micropropogation and its application; Types of different organ culture and its application; Somaclonal variation: Introduction, Different pathways of somaclonal variation; factor affecting of somaclonal variation, Detection of somaclonal variation; Somaclonal variation its application in crop improvement.

UNIT II:

Chloroplast transformation: Structure of chloroplast; Plastid chromosome; Transformation methods-Agrobacterium mediated transformation, Particle gun method, Gene replacement, Gene insertion; Limitation of chloroplast transformation; Application of chloroplast transformation.

UNIT III:

Secondary metabolite: Role of secondary metabolites, Basic biosynthetic pathways,
Techniques used in biosynthesis, Source of secondary metabolites; criteria for cell selection, factor affecting the culture of cells, Different bioreactors and their use in secondary metabolites production, Production of bioactive secondary metabolites by plant tissue culture.

UNIT IV:

Transgenic plants production: Development of abiotic (Insect, Disease, Herbicide) and biotic (Drought) resistant plants.
Peptide production, biodegradable plastic and edible vaccine.
DNA barcoding in plants its application.

REFERENCE BOOKS:

- An introduction to Plant Tissue culture by MK Razdan. M.K. 2003. Oxford & IBH Publishing Co, New Delhi, 2003.
- Plant Biotechnology: An Introduction to Genetic Engineering by Adrian Slater, Nigel W. Scott, Mark R. Fowler. Oxford University Press, 2008.
- Biochemistry & Molecular Biology of Plants. Bob Buchanan, Wilhelm Gruissem, Russell Jones. John Wiley & Sons, 2002.
- Plant biotechnology – J Hammond, et. al., Springer Verlag.
- Plant cell and tissue culture for production of food ingredients – T J Fu, G Singh, et. al.
- Biotechnology in crop improvement – H S Chawla.
- Practical application of plant molecular biology – R J Henry, Chapman & Hall. ¾ Elements of biotechnology – P K Gupta.
- An introduction to plant tissue culture – M K Razdan.
- Plant propagation by tissue culture: The technology (Vols. 1 & 2) – Edwin George.
- Handbook of plant cell culture (Vols. 1 to 4) – Evans et. al., Macmillan. ¾ Plant tissue and cell culture – H E Street, Blackwell Scientific.
- Cell culture and somatic cell genetics of plants (Vols. 1 to 3) – A K Vasil, A. Press.
- Plant cell culture technology – M M Yeoman.
- Plant tissue culture and its biotechnological applications – W Bary, et. al., Springer Verlag.
- Principles of plant biotechnology: An introduction to genetic engineering in plants – S H Mantel, et. al.
- Advances in biochemical engineering / Biotechnology – Anderson, et. al.
- Applied and fundamental aspects of plant cell tissue and organ culture edited by Reinert & Bajaj Y P S, Springer Verlag.
- Plant cell and tissue culture – S Narayanswamy, Tata Mc Graw Hill Co.
- Introduction of plant biotechnology – H.S. Chawla. Third Edition; Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.

PRACTICALS:

1. Preparation of MS media for inoculation
2. Micropropogation through nodal explants
3. Callus induction
4. Mass multiplication of banana
5. Agrobacterium tumefaciens mediated plant transformation
6. Protoplast isolation
7. Embryo dissection and culture
8. DNA isolation of plant material

MASTER OF SCIENCE – BIOTECHNOLOGY
(ENVIRONMENTAL BIOTECHNOLOGY)
SEMESTER – I
NAME OF COURSE: MICROBIAL TECHNOLOGY
COURSE CODE: ELECTIVE 2
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes

At the end of this course, the student will be able to:

1. Exploitation microorganisms for industrial product production (primary metabolites)
2. Industrial production of secondary metabolites using microorganisms (e.g. antibiotics)
3. Steroidbiotransformation and ergot alkaloids production, biofuels.
4. Food and dairy products production e.g. Cheese, yoghurt, Beer, Wine.

UNIT I:

Scope of Microbial biotechnology.
Microbial production and applications of primary metabolites: Citric acid, Ethanol, L-Glutamic acid, Vitamin B_{12}
Industrially important microbial enzymes: Types, mode of action and industrial applications of microbial amylases and proteases

UNIT II:

Microbial production of therapeutically important products:-
Antibiotics: Penicillin, Streptomycin
Ergot alkaloids : Production by Saprophytic cultivation
Biotransformations of steroids: Hydroxylation and dehydrogenation,
Steroid biotransformations.

UNIT III:

Production of single cell protein from bacteria, fungi and algae, Characteristics, nutritional value and safety, substrates used, process examples, applications.
Cultivation of edible and medicinal mushrooms: Nutritional and medicinal properties
Production and applications of microbial exopolysaccharides: Classification, Biological functions, structure and biosynthesis of Xanthan and Alginate,
Factors affectingfermentative production of exopolysaccharides and downstream processing(recovery).
Production of bioplastics (Polyhydroxyalkonates)

UNIT IV:

Microbiology and technology of fermented dairy products:
Cheese making: Cheese varieties, manufacture of cheddar cheese,
Sources andproperties of rennets.
Yoghurt making
Beer and Wine production

REFERENCE BOOKS:

1. Biotechnology - Rehm and Reid.
2. Comprehensive biotechnology - Murray Moo Young.
3. Microbial Technology Vol I & II - Henry J. Peppler&D.Perlman
4. Microbiology & technology of fermented foods - Robert W. Hutkins. Blackwell publishing.
5. Modern Industrial Microbiology and Biotechnology 2nd edition - Nduka Okafor, Benedict C. Okeke - (2017, CRC Press)

PRACTICALS:

1. Production of cellulase enzyme by solid-state fermentation.
2. Saccharification of agro-waste by cellulase enzyme.
3. Bioassay of antibiotics
4. Production of citric acid by submerged fermentation
5. Production of protease by submerged fermentation.
6. Single cell oil production by Yeast
7. Production of Yoghurt
8. Downstream processing of penicillin

MASTER OF SCIENCE – BIOTECHNOLOGY
(ENVIRONMENTAL BIOTECHNOLOGY)
SEMESTER – I
NAME OF COURSE: ENVIRONMENTAL CHEMISTRY
COURSE CODE: ELECTIVE 3
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes

At the end of this course, the student will be able to:

1 Structure and composition of atmosphere, greenhouse effect
2 Water cycle, its pollutants, types of reactions in various water bodies
3 Organic and inorganic components of soil
4 Biochemical cycling of elements

UNIT I:

Atmospheric Chemistry and Air Pollution: Chemical processes for formation of inorganic and organic particulate matter, thermochemical and photochemical reactions in the atmosphere.Gaseous pollutants, sources, reactions, control and effects of air pollutants on living and non-living things. Effects of meteorological and topographical factors. Global Climate change: Ozone depletion, Acid Rain and Greenhouse effect. Formation and effects of Photochemical smog.

UNIT II:

Water Chemistry and Water Pollution: Chemistry of Natural Waters, Water resources, hydrological cycle, physical and chemical properties of water, complexion in natural and waste water, role of microorganisms, Water pollutants, Types, Sources, Heavy metals, Metalloids Organic, Inorganic, Biological and Radioactive. Types of reactions in various water bodies including marine environment, Eutrophication and ecological magnification due to water pollution.

UNIT III:

Biogeochemical cycling of elements:Gaia Hypothesis, The Carbon cycle-Carbon transfer through food webs-Carbon cycling within Habitats-Carbon Monoxide cycling. The Hydrogen Cycle, The oxygen Cycle. The Nitrogen Cycle-Ammonification, nitrification and denitrification. The Sulfur Cycle-Oxidative and reductive sulfur transformation. The phosphorus Cycle, Iron cycle, Manganese Cycle and Calcium Cycle.

UNIT IV:

Soil chemistry & soil composition: Soil profile: Organic & Inorganic components of soil, Physical and Chemical Properties, cation exchange capacity, soil pH, environmental properties of soils. Leaching and erosion. Reactions with acids and bases. Geochemical reactions that neutralize acidity. Biological Process that neutralize acidity, Pesticide and Polymer Pollution. Physiochemical control of soil pollution.

REFERENCE BOOKS:

1. Environmental Chemistry, a global perspective. Gary W. Valoon& Stephen J. Duffy, Oxford University Press.
2. Environmental chemistry, B. K. Sharma.
3. Mahajan, S.P., Pollution Control in Process Industries, Tata McGraw-Hill, 1985.
4. M. Arora, Environmental management of toxic and hazardous waste.
5. Tyagi, O. D. and M. Mehra, Text book of Environmental Chemistry.
6. A.K. de. Environmental Chemistry 2000 (4th edition). New age International (P) Ltd., New Delhi, India.
7. Kenneth Wark , Cecil F. Warner, Wayne T. Davis, Air pollution origin and its control work, 3rd Edition, Prentice Hall.
8. R. M. Atlas. (1993) Microbial Ecology Fundamentals and Applications. 4th edition Pearson education Pte. Ltd. ISBN: 81-297-0771-3.
9. Stanley E. Manohar, Environmental Chemistry, Williard Grant press, Beston, Massachutes

PRACTICALS:

1. Spectrophotometric analysis of nitrate.
2. Spectrophotometric analysis of nitrite.
3. Analysis of ammonia.
4. Determination of sulphate by turbidometric method.
5. Determination of zinc by EDTA complexometic reaction.\
6. Analysis of Total Hardness, Ca^{+2} Hardness and Mg^{+2} Hardness.
7. Analysis of Ca^{+2} from egg shell.
8. Analysis of sulfite.

MASTER OF SCIENCE - BIOTECHNOLOGY
(ENVIRONMENTAL BIOTECHNOLOGY)
SEMESTER – I
NAME OF COURSE: CLINICAL BIOCHEMISTRY
COURSE CODE: ELECTIVE 4
SYLLABUS EFFECTIVE FROM: 2020-2021

Course Outcomes

At the end of this course, the student will be able to:

1 Specimen collection, preservation and transportation, composition of various body fluids
2 Acid base balance and disorders, types and functions of carbohydrates
3 Clinical enzymology, haemoglobin
4 General organ function tests

UNIT I:

Introduction to clinical biochemistry: Specimen collection, preservation and transportation (blood, urine, spinal fluid, saliva, synovial fluid, amniotic fluid).
Chemistry, composition & functions of lymph, CSF, ascitic fluid, pleural fluid & synovial fluid.

UNIT II:

pH and Acid base balance & disorders, Electrolytes balance & imbalance, Blood gases and blood buffers.
Types, function and importance of carbohydrates, proteins and lipid, Lipoproteins, Apolipoproteins, Lipoprotein metabolism and disorders.

UNIT III:

Clinical Enzymology: Principle of diagnostic enzymology, Liver, cardiac and skeletal enzyme, Digestive enzyme, Miscellaneous enzyme.
Hemoglobin (Biochemistry, synthesis and breakdown), Hemoglobinopathies, Thalessemia, Bilirubin metabolism, Jaundice, Vandenbergh test.

UNIT IV:

General Organ function tests: Liver function tests, Thyroid function tests, Pancreatic function tests, Cardiac Function Test.
Biochemistry of Diabetes mellitus, Atherosclerosis, Fatty liver, and obesity.

REFERENCE BOOKS:

1. Tietz Textbook of Clinical Chemistry, Carl A. Burtis, Edward R. Ashwood, Harcourt Brace & Company AisaPvt. Ltd. ISBN-13: 978-0721656106
2. Commercial Biosensors: Graham Ramsay, John Wiley & Son, INC. (1998). ISBN-13: 978-0-471-58505-3
3. Essentials of Diagnostic Microbiology, Lisa Anne Shimeld.

4. Diagnostic Microbiology, Balley& Scott's. Eleventh Edition. ISBN 0-323-01678-2
5. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics, 4th Edition By Carl A. Burtis, , Edward R. Ashwood, and David E. Bruns, - ISBN -9780721601892
6. The Science of Laboratory Diagnosis, Crocker Burnett. ISBN 1899066624
7. Text books of Medical Laboratory Technology – Dr. Praful B. Godkar
8. Henry's Clinical Diagnosis and Management by Laboratory Methods 2 Richard McPherson Matthew Pincus ISBN: 978-1-4160-0287-
9. Biochemistry for medical students: Vasudeven and Shreekumar Jay pee prakashan.
10. Practical Clinical biochemistry by Harold verly
11. Text book of medical biochemistry by- Chatterjea and Rana Shinde

PRACTICALS:

1. Preparation of standard solution, molar solution and other reagents
2. Analysis of normal and abnormal urine
3. Estimation of blood /serum glucose by various methods/ GTT
4. Glycosylated Hb, Hb Electrophoresis
5. Estimation Bilirubin , direct , total
6. Estimation of total protein and A/G ratio
7. Electrophoresis of plasma proteins
8. Estimation of total cholesterol and its fractions
9. Estimation of total lipids
10. Estimation of SGPT,SGOT
11. Hormone estimation: Determination of T3 or T4 by ELISA

CVM UNIVERSITY

MASTER OF SCIENCE

BIOTECHNOLOGY (ENVIRONMENTAL BIOTECHNOLOGY)

PROGRAMME

Under Choice Based Credit Scheme

Structure with Effect From: 2021-22

CVM UNIVERSITY

Programme M.Sc. Biotechnology (Environmental Biotechnology)
(Under the Choice based Credit Scheme)

STRUCTURE WITH EFFECT FROM 2021-2022

Type of course	Course Code	Title	T/P	Credit	Exam Duration in Hrs	Component of Marks		
						Internal	External	Total
						Total / Passing	Total / Passing	Total / Passing
Semester - II								
Core Course	Core 1	Treatment Technologies for Municipal Solids, Hazardous & Biomedical Waste	T	4	3	40/16	60/24	100/40
	Core 2	Environmental Management	T	4	3	40/16	60/24	100/40
	Core 3	Environmental Pollution, Assessment & Monitoring	T	4	3	40/16	60/24	100/40
	Core 4	Practical Based on Core 1 & Core 2	P	4	3	40/16	60/24	100/40
	Core 5	Practical Based on Core 3 & Elective X	P	4	3	40/16	60/24	100/40
	Core 6	Comprehensive Viva-Voce		1			50/20	50/20
Elective Course (Any One)	Elective 1	Animal Biotechnology	T	4	3	40/16	60/24	100/40
	Elective 2	Bioseperation Technology	T	4	3	40/16	60/24	100/40
	Elective 3	Protein Engineering	T	4	3	40/16	60/24	100/40
	Elective 4	Environment Policy and Legislation	T	4	3	40/16	60/24	100/40
	Total Credit			**25**				

MASTER OF SCIENCE – BIOTECHNOLOGY
(ENVIRONMENTAL BIOTECHNOLOGY)
SEMESTER – II
NAME OF COURSE: TREATMENT TECHNOLOGIES FOR MUNICIPAL SOLIDS, HAZARDOUS & BIOMEDICAL WASTE
COURSE CODE: CORE 1
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes

At the end of this course, the student will be able to:

1. Waste water management
2. Aerobic and anaerobic biological treatment process
3. Paper pulp, dairy and textile industry

UNIT I:

Municipal Solid Waste Management: Introduction, Categories of wastes, Regulatory Development (Acts), Solid Waste Management Pyramid – Common components in MSW, Chemical properties of MSW, Physical properties of MSW Key Technologies for SWM (collection, handling, transformation, landfills, incinerators, composting), , MSW processing: Materials Recovery facilities: Screening, Size reduction, Incineration of MSW (Environmental consideration of mass burn), Refused derived fuel.

UNIT II:

Hazardous Waste management: Definition, sources, characteristics and categories of hazardous wastes. Toxicology and Risk Assessment, Environmental Fate of Hazardous Materials. Hazardous waste collection and transportation. Hazardous waste treatment technologies: Physical, chemical and thermal treatment of hazardous waste: solidification, chemical fixation, encapsulation, pyrolysis and incineration. Hazardous waste landfills: Site selections, design and operation. HW reduction, recycling and reuse, Regulatory aspects of HWM.

UNIT III:

Electronic Waste Management: Introduction, types of WEEE wastes. WEEE health and safety implications Collection, transportation, recycling and disposal of E-waste. Metal recovery from E-waste. Legislative influences on electronics, International perspective, the recycling Hierarchy. Future factors that may influence electronics.

Radiation Pollution: Types of radiation; Units of radioactivity; detecting measurements of radioactivity. Types of radioactive wastes, treatment and disposal technologies used.

UNIT IV:

Biomedical waste: Introduction, Types of biomedical waste, sources of biomedical wastes, Hazardous biomedical wastes. Waste segregation and labeling, Handling, Collection, Storage and transportation. Universal Wastes: Definition, Categories of universal wastes, Universal waste management.

REFERENCE BOOKS:

1. MerrilEisenbud and Thomas Gessell (1997) Environmental Radioactivity from Natural, Industrial and Military Sources, 4 th edition, Academic Press, London.
2. Hazardous Waste Management, 2nd Edition, MD LaGrega, PL Buckingham and JC Evans, McGraw-Hill, 2001.
3. Singh Anantpreet, Kam sukhjit. Biomedical waste disposal: ISBN: 9789350255544.
4. Hazardous wastes: Sources Pathways Receptors by Richard J. WATTS ISBN: 9780471002383.
5. Kreith, F. (Editor in Chief), Handbook of Solid Waste Management. McGraw-Hill, Inc. (1994).
6. Freeman, H. M., Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill, Inc. (1997).
7. Criteria for hazardous waste landfills – CPCB guidelines 2000.
8. R E Hester and R M Harrison. Electronic waste management: design, analysis and application. RSC publishing. ISBN: 978-0-85404-112-1.
9. Tandon. Recycling of Crop, Animal and Human Waste in Agriculture. (1995), Mc Graw Hill Publishing Co.
10. Hazardous Wastes and Solid Wastes, Liu, D.H.F and Liptak,B.G (2000), Lewis Publishers, New York.
11. LaGrega,M.D.,Buckingham,P.L., and Evans,J.C (2001) Hazardous Waste Management, II Ed Mc Graw Hill Inc.

PRACTICALS:

1. Dehydrogenase activity of soil microorganisms.
2. Analysis of soil respiration (CO_2-evolution method).
3. Estimation of Residual chlorine.
4. Analysis of chlorine demand.
5. Removal of Fluoride with natural materials.
6. Detoxification of Chromium.
7. Checking of biosurfactant production.
8. Total Kjeldahl Nitrogen (TKN).
9. Shake flask biodegradation testing measuring oxygen or hydrocarbon consumption under various conditions.
10. Membrane (MF) technique for microbiological analysis of water.

MASTER OF SCIENCE – BIOTECHNOLOGY
(ENVIRONMENTAL BIOTECHNOLOGY)
SEMESTER – II
NAME OF COURSE: ENVIRONMENTAL MANAGEMENT
COURSE CODE: CORE 2
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes

At the end of this course, the student will be able to:

1. Study of various initiatives, Biodiversity rules, regulations, legislation and conventions for ecosystem management.
2. For management for conservation of wildlife & biodiversity and study of agroforestry.
3. Economic importance of the wetlands and study of wetland management.
4. Remote Sensing & GIS provides concepts & foundations of Energy Sources.

UNIT I:

Biodiversity & Ecosystem Management: Concept of ecosystem management, Decision-making process in ecosystem management, Scientific basis of ecosystem management, Implementation of management decisions, Ecosystem management initiatives, International biodiversity law, Biodiversity rules and regulations, Biodiversity legislation and conventions, Environmental protection act (1986), Patents law, Biopircay, Bioprospecting, Bioethics, Organizations involved in biodiversity & ecosystem management (CBD, CITES, FAO, GEF, IBPGR, IUCN, TRIPs, UNCESCO, UNDP, UNEP, WWF)

UNIT II:

Forest Management (Agro forestry): Natural forest management, Sustainable forest management (Criteria, indicators, obstacles), Certification of forest management, Management of secondary forests (Techniques), Management of NTFP, Forest management for biodiversity conservation, Effects of forest management on wildlife, Reserves, Setting priorities for forest management; Agro Forestry: Scopes, Necessity, Objectives, Techniques, Participatory approach (PRA), Research and extension, Stages of tribal economy, Education, Cultural tradition, Customs, Ethos and participation for JFM programs.

UNIT III:

Wetland Management: Introductory Approach: Ramsar convention, Ramsar's role in water resources management, Wetlands of international & national importance, National wetland policy, Wetland assessment and monitoring; Wetland Management - Physical: Water-level manipulation: Controlled marsh, Prescribed burns, Preburn preparation, Firing patterns, Mechanical: Cutting, Dredging, Shading, Herbicide, Biological: Controlled grazing, Habitat alteration, Plant propagation (Stock & Collection, Seed, Vegetative structures), Site preparation (Salinity, Liming, Fertilizing & Mulching); Planting – Propagule (Seed, Vegetative), Wetlands (Impoundments, Marsh fields, Riparian habitats, Coastlines, Mangroves, Sand dunes, Sea-grasses).

UNIT IV:

Remote Sensing & GIS: Concepts & Foundations: Energy Sources & Radiation Principles, Energy Interactions in Atmosphere & Earth Surface, Data Acquisition & Interpretation, Reference Data, GPS, Characteristics, Applications, GIS; Basic Principles: Geometric Characteristics of Aerial Photographs, Photographic Scale, Ground Coverage, Area Measurement, Relief Displacement, Image Parallax, Ground Control, Mapping, Flight Planning; Applications: Visual Image Interpretation (VII) – Fundamentals & Basics of VII Equipment, Land Use / Land Cover Mapping, Geologic & Soil Mapping, Applications of RS-GIS (Agriculture, Forestry, Rangeland, Water Resource, Urban & Regional Planning, Wildlife Ecology, Archaeological), Wetland Mapping, Environmental Assessment, Natural Disaster Management, Landform Identification & Evaluation.

REFERENCE BOOKS:

1. Conservation Biology by Fred Van Dyke (2008) Springer Publication, Netherlands. (ISBN: 978- 14020-6890-4).
2. Environment Management by PS Bhushana Rao. (2007) Regal Publications. (ISBN: 8189915088).
3. Environment, Ecology and Sustainable Management by Bose Probir& Bose Pradipta. (2005) Everest Publishing House (ISBN: 8176601357).
4. Global Environment Management by SN Prasad. (2006) Pointer Publishers. (ISBN: 8179101460).
5. International Environment Management by P Rathnaswamy. (2010) Officers Books, New Delhi. (ISBN: 817049091X).
6. Natural Resource Conservation and Environment Management by Navaid Shabir Qazi & SA Qazi. (1998) Aph Publishing Corporation. (ISBN: 8131304043).
7. Remote Sensing and Image Interpretation by Thomas Lillesand, Ralph Kiefer & Jonathan Chipman. (2004) John Wiley & Sons. (ISBN: 0471152277).
8. Techniques for Wildlife Habitat Management of Wetlands by Neil F. Payne. (1992). McGraw-Hill, Inc., USA. (ISBN: 0-07-048956-4).
   Tropical Forest Ecology by Florencia Montagnini& Carl Jordan (2005) Springer Publication, Netherlands. (ISBN: 3-540-23797-6).

PRACTICALS:

1. Measurement of Lake Area & Shore-line Length.
2. Estimation of Primary Productivity of Aquatic Ecosystem.
3. Study of Soil Texture, Bulk Density, Porosity and Water-holding Capacity.
4. Estimation of Conservation Values (CV) for Soil & Water for Vegetation Plot.
5. Determination of Important Value Index (IVI) of Plant Species.
6. Determination of Dominance Index (DI) of Terrestrial Ecosystem.
7. Study of Raunkiaer's Life Forms in Vegetation.
8. Determination of Basal Cover using Diameter at Breast Height (DBH) Method.
9. To compare Biomass & Net Primary Production of Ungrazed& Grazed Ecosystem.

10. Aerial photography interpretation, Satellite imagery (Visual & Digital).
11. GIS – Applications in forestry, Computer software.
12. Field excursion to natural or man-made ecosystems

MASTER OF SCIENCE – BIOTECHNOLOGY
(ENVIRONMENTAL BIOTECHNOLOGY)
SEMESTER – II
NAME OF COURSE: ENVIRONMENTAL POLLUTION, ASSESSMENT & MONITORING
COURSE CODE: CORE 3
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes

At the end of this course, the student will be able to:

1. Air and water pollution and study of ambient air and water quality parameters.
2. Comprehensive overview of noise quality and control of noise and thermal pollution.
3. An emphasis on assessing sources, monitoring and effects of marine pollutants.
4. Demonstrate current environmental issues of India and environmental auditing.

UNIT I:

Chemical aspect of air quality monitoring: Ambient Air quality standards, dispersion of air pollutants, air sampling and analysis, Environmental Lapse rate, stack sampling, stack height, plume behavior, wind profile, Air pollution control devices: settling chambers, cyclones, spray towers, electrostatic precipitators, venturi scrubber, packed tower etc. Biochemical process and catalytic processes. Water quality monitoring: Wastewater characterization. Methods for Measurement of water pollution. Biological aspects of Environment Monitoring: Bio indicators of environmental monitoring.

UNIT II:

Noise Pollution: Basic properties of sound waves, plane and spherical waves, sound pressure, loudness and intensity levels, decibel, sources of noise pollution. Special noise environments: Infra-sound, ultrasound, impulsive sound and sonic boom. Noise standards and limit values. Measurement and analysis of sound, effects of noise on health, measures to control noise pollution. Noise pollution and management in Mines, Power plants, Fertilizer plants, Cement plants, etc.

Thermal Pollution: Definition and sources, chemical and biological effects of thermal pollution, effects on water quality. Control of thermal pollution.

UNIT III:

Marine Pollution: Sources of marine pollution and its control. Effects of pollutants on human beings, plants, and animals. Oil spills and cleanup: sources, major accidental spills, fate of spilled oil on the sea, consequences of oil spills and treatment of oil spills. Macro algae, crustaceans and mollusks as indicator organisms for monitoring of trace metal pollution. Red tides: distribution, types of poisoning, effects and methods to minimize red tides in the sea. Monitoring strategies of marine pollution: Critical pathway approach and Mass balance approach. Marine corrosion: Definition, corrosion reactions, classification of corrosion, factors affecting corrosion of metals in sea water and prevention of marine corrosion.

UNIT IV:

Environmental Education and Awareness: Environmental Ethics and Global imperatives. Current Environmental issue in India. Context : Narmada Dam, Tehri Dam, Almetti Dam, River linking, Joint Forest Management, River cleaning initiative. Formation and reclamation of Usar, Alkaline and Saline Soil. Waste lands and their reclamation. Vehicular pollution and urban air quality. Epidemiological issues (e.g., Goitre, Fluorosis, Arsenic). Desertification and its control.

Environmental Auditing: Objectives, frequency and criteria; audit team, environmental appraisal, accounting and environmental audit. Environmental guidelines for siting of industry, green balance sheet (GBS), status of compliance of mandatory and voluntary requirements for industries – cement, pesticide.

REFERENCE BOOKS:

1. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (TB)
2. Wanger K.D., (1998). Environmental Management. W.B. Saunders Co. Philadelphia, USA.
3. Tyler Miller Jr. G. (2005). Living in the Environment. Wadsworth Publishing Company, Belmont California.
4. Botkin, D.B and Keller E.A., (2000), Environmental Studies: The earth as a living plant. Charles E. Merrill, Publishing Co. London.
5. Singh J.S., Singh S.P. and Gupta S.R., 2006, Ecology Environment and Resource Conservation, Anamaya Publishers, New Delhi.
6. Abbasi, S. A. and E. Ramasami. (1999). Biotechnological Methods of Pollution Control, University Press, Hyderabad.
7. Fellenberg, G. (1999). Chemistry of Pollution, John Wiley and Sons, New Delhi.
8. Mahajan S.P. (1998). Pollution control in process industries, Tata McGraw Hill, ND.
9. Trivedi, R.K. and Goel, P.K. (2010). An introduction to Air pollution, DVS Publication, New Delhi.
10. Wadhwa Y. (2009). Air Pollution: Causes and Control. Cyber Tech Publications, ND.
11. Clark, R.B. (1986). Marine Pollution, - Oxford science Publications.
12. Chandler, K.A. Butter Worths. (1985) Marine and offshore corrosion, London.
13. Sharma, B. K and Kaur, H. (1994). Water Pollution. Krishna Prakasham Mandir, Meerut.
14. Phillips J.D.H. (1980). Quantitative aquatic biological indicator. Applied Science Publishers.
15. Cunniff, P. E. (1987). Environmental Noise Pollution. McGraw Hill, New York.

PRACTICALS:

1. To analyze physical and chemical properties of water.
2. Anaerobic digestion of cattle waste.
3. Visit to industry for a survey of air pollution control equipment.

4. Analysis of pesticides residues using TLC.
5. Quantitative analysis of soil organic carbon.
6. Analysis of food to microorganism (F/M) ratio.
7. OTR

MASTER OF SCIENCE – BIOTECHNOLOGY
(ENVIRONMENTAL BIOTECHNOLOGY)
SEMESTER – II
NAME OF COURSE: ANIMAL BIOTECHNOLOGY
COURSE CODE: ELECTIVE 1
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes

At the end of this course, the student will be able to:

1 Introduction and scope of Anmial Biotechnology
2 Basic techniques of animal cell culture
3 Applications of animal tissue culture
4 Techniques for producing transgenic animals

UNIT I:

- Introduction and scope of Animal Biotechnology
- Basic requirements for animal tissue culture: Infrastructure, necessary equipments and accessories for animal tissue culture lab.
- Culture Media: Different types of media-Natural media, Defined media, Serum free media Chemical, physical and metabolic functions of different constituents of culture media.
- Role of serum in tissue culture media
- Sterilization techniques
- Biohazards and Bioethics

UNIT II:

- Biology and characterization of cultured cells
- Basic techniques of animal cell culture: Primary culture techniques,
- Enzymatic and mechanical disaggregation techniques
- Sub culture methods
- Development of cell lines, nomenclature and types of cell lines.
- Explant culture, Organ culture – 3Dimentional culture
- Large scale culture of cells-suspension and monolayer culture
- Cell separation methods
- Cell cloning
- Transformation and immortalization

UNIT III:

- Application of animal tissue culture
- Contaminants- source, types and prevention
- Cell viability Cytotoxicity assays
- Cryopreservation of cultured cells
- Hybridoma technology – production of MAbs.
- Vaccine Production

UNIT IV:

- Transgenic Animal Technology:
- Techniques for producing transgenic Animals,
- Application of transgenic animals
- Artificial animal breeding, Artificial insemination,
- In vitro fertilization (IVF), Embryo Transfer, Embryo sexing
- Tissue Engineering- scaffold materials, synthesis of scaffold, cell sources and applications of Tissue engineering

REFERENCE BOOKS:

1) Culture of animal cells: A manual of basic technique- R. Ian Freshney, Wiley Publication.
2) Animal cell culture & technology-M. Butler.
3) Animal cell culture techniques- M. Clynes, Springer.
4) Animal Biotechnology- M. M. Ranga. Agrobios (India).
5) Animal Biotechnology-Young, Murray, Moo. Pergamon Press, Oxford.
6) Methods in Cell Biology-Vol. 57, Animal cell culture methods- Mather, J.P., Academic Press.
7) Animal Cell Biotechnology-Spier, R.E. Academic press.
8) Animal biotechnology – P. Ramadass, MJP Publishers
9) Biotechnology- U.Styanarayan, Books and Allied (P) Ltd.

PRACTICALS:

1. Introduction of animal tissue culture laboratory with necessary equipments and accessories.
2. Preparation of culture media
3. Sterilization of culture media
4. Primary culture from Chick embryo.
5. Cell counting using hemocytometer.
6. Cell viability
7. Organ culture – trachea culture
8. Short term lymphocyte culture.
9. Chromosome preparation from cultured cells.
10. Cytotoxicity test-MTT

MASTER OF SCIENCE – BIOTECHNOLOGY
(ENVIRONMENTAL BIOTECHNOLOGY)
SEMESTER – II
NAME OF COURSE: BIOSEPARATION TECHNOLOGY
COURSE CODE: ELECTIVE 2
SYLLABUS EFFECTIVE FROM: 2020-2021

Course Outcomes

At the end of this course, the student will be able to:

1. Students able to understand about varios downstream processing
2. Product isolation and purification methods
3. Final Product Purification and Preparation

UNIT I:

Introduction to downstream processing, Characteristics of fermentation broth and its pretreatment, Separation of cells and suspended solids: Filtration: theory of filtration, use of filter aids, Batch filters, Continuous filters, cross flow filtration.

Membrane processes – Dialysis, ultrafiltration, Reverse osmosis and electrodialysis

UNIT II:

Product isolation methods:

Centrifugation: Cell aggregation and flocculation, Types of commercial centrifuges
Cell disruption by physical and chemical methods,
Liquid-liquid extraction-choice of solvent, co current and counter current extraction, Centrifugal extractor, Solvent recovery, Two-phase aqueous extraction system, Super critical fluid extraction.

UNIT III:

Chromatography techniques for product isolation and purification:

Adsorption chromatography, Gel permeation chromatography, Ion-exchangechromatography, Hydrophobic chromatography, Affinity chromatography, High performance chromatography (HPLC). FPLC, Expanded bed chromatography

UNIT IV:

Final Product Purification and Preparation Crystallization; Drying and lyophilisation; Formulation Strategies

Case studies: Recovery of Ethanol, Citric acid, Penicillin.

REFERENCE BOOKS:

1. Principles of Fermentation Technology – Peter F. Stanbury, Allan Whitaker and Stephen J. Hall.
2. Fermentation Microbiology and Biotechnology – E.M.T. El-Mansi and C.F.A. Bryee.

3. Comprehensive Biotechnology – Murray Moo Young
4. Biochemical Engineering Fundamentals – J.E.Bailey& D.F. Ollis.
5. Downstream industrial biotechnology : recovery and purification / edited by Michael C. Flickinger

PRACTICALS:

1. Determination of dry weight and wet weight of cells
2. Determination of total protein of cells by alkali lysis
3. Recovery and estimation of penicillin
4. Ammonium Sulphate fractionation of protein
5. Dialysis of fractionated proteins
6. Recovery of protein by acetone precipitation
7. Demonstration of chromatography techniques

MASTER OF SCIENCE – BIOTECHNOLOGY
(ENVIRONMENTAL BIOTECHNOLOGY)
SEMESTER – II
NAME OF COURSE: PROTEIN ENGINEERING
COURSE CODE: ELECTIVE 3
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes

At the end of this course, the student will be able to:

1. Different tools and methods used in proteomic study.
2. The sources of protein, Industrial and medical application of proteins,
3. Different expression of proteins for large scale purifications,
4. Protein engineering strategy.

UNITI:

Proteomics: Sample preparation, Gel-based proteomics - two-dimensional gel electrophoresis (2-DGE), two-dimensional fluorescence difference in-gel electrophoresis (DIGE), Staining methods, PF-2D, Tandem FPLC, Mass spectroscopy: basic principle, ionization sources, mass analyzers, different types of mass spectrometers (MALDI-TOF Q-TOF, LC-MS)

UNIT II:

Multidimensional proteomics: SELDI-TOF. Quantitative proteomics - stable isotope labeling by amino acids in cell culture (SILAC), isotope-coded affinity tag (ICAT), isobaric tagging for relative and absolute quantitation (iTRAQ); Label-free proteomics., Nuclear magnetic resonance spectroscopy (NMR), basic principles, chemical shift, spinspin interaction, NOE, 2D-NMR, NOESY,COSEY.

UNIT III:

X-ray Crystallography: Principle of X-ray diffraction, scattering vector, structure factor, phase problem, reciprocal lattice and Ewald sphere, Miller indices, Zone axes, crystal lattice, Lane Equations, Bragg's law, special properties of protein crystals, model building, refinement and R-factor.

UNIT VI:

Protein Engineering: Protein sources, Industrial and medical application of proteins, different expression of proteins for large-scale purifications, protein engineering strategy, rational and random mutagenesis. Applications of protein engineering protein in Chemical and Medical Industries: Generation of heat stable, pH stable enzymes, application in vaccine development, drug development, sensor development. Practicals, Protein electrophoresis-1D+2D, HPLC, FPLC, MALDI-TOF & LC-MS

REFERENCE BOOKS:

1. Principles of Protein X-Ray Crystallography *[3rd ed.]* by Jan Drenth
2. Protein engineering in industrial biotechnology by L Alberghina,Net Library, Inc.

3. Protein Engineering Protocols *[1 ed.]* by Kristian Müller, Katja Arndt
4. Protein Engineering by C Kohrer, U Rajbhandary
5. Protein Engineering Handbook Volume 3 *[1 ed.]* by Stefan Lutz, Uwe Theo Bornscheuer
6. Protein Engineering by P. Kaumaya
7. Protein Structure Prediction: Methods and Protocols by Webster, David (Southern Cross Molecular Ltd., Bath, UK)
8. Essential Bioinformatics by JinXiong

PRACTICALS:

1. To perform protein extraction.
2. Determine an importance of various electrophoresis techniques in protein engineering.
3. A study an application of liquid chromatographic technique.
4. To understand the importance of gas chromatographic techniques with demonstration.
5. Understanding of principles and applications of MALDI-TOF and SELDI TOFF

MASTER OF SCIENCE – BIOTECHNOLOGY
(ENVIRONMENTAL BIOTECHNOLOGY)
SEMESTER – II
NAME OF COURSE: ENVIRONMENT POLICY AND LEGISLATION
COURSE CODE: ELECTIVE 4
SYLLABUS EFFECTIVE FROM: 2021-2022

Course Outcomes

At the end of this course, the student will be able to:

1. Legal structure of India and fundamentals of environmental legislation and policy making.
2. Understand the environmental performance including compliance with environmental legislation.
3. Implementation of environmental policies and practices and raise awareness about the emerging environmental issues.
4. Study of various acts, laws and rules related to air, water, environment and wastes in India.

UNIT I:

International Law and Environmental Protection: Fundamental Principles of International Environmental Law. United Nations Conference on Human Environment, 1972 (Stockholm Conference) – Aims and Objectives of the Conference, Stockholm Declaration. UNEP- Vienna Convention & Montreal Protocol, World Charter for Nature, 1982. WCED – The Brundtland Commission, Brundtland Report 1987. United Nations Conference on Environment and Development (UNCED/Earth Summit) – Aims and Objectives of Conference, Rio Declaration 1992, Agenda 21, Convention on Biological Diversity. Earth Summit Plus Five - Kyoto Protocol, 1997; Millennium Development Goals.Johannesburg Conference 2002 (WSSD) - Johannesburg Declaration & Major Outcomes.

UNIT II:

History and Development of Environmental Law in India: Environmental Protection in Ancient Indian Tradition and Culture - Protection of Environment in Ancient India and During Medieval Period. Protection of Environment during British Period – Major Legislations. Protection of Environment during Post Independence Period – Pitambar Pant Committee, Tiwari Committee, NCEP, Department of Environment, MOEF Guidelines and Notifications, Appellate Authority Act, Other related Notifications.

UNIT III:

Protection of Environment under the Indian Constitution: Introduction – Indirect Provisions, International Obligations, 42nd Constitution Amendment Act, 1976. Directive Principles of State Policy - Fundamental Duties. Development of Fundamental Right to Environment - Judicial Role, Expansion of Locus Standi, PIL, Constitutional Remedy for Protection of Environment, Dynamic Interpretation of Article 21, 14 & 19 of the Constitution. Right to Wholesome Environment – Right to Clean and Pollution-free

Environment, Right to Sweet Water. Incorporation of International Principles under Indian Constitution – Sustainable Development - Precautionary and Polluter Pays Principles, Absolute and Strict Liability.

UNIT IV:

Protection of Water, Air and Environment in India:

EP Act 1986, Air (Prevention and Control of pollution) Act, Water (Prevention and Control of pollution) Act, Mines and Mineral Act, Factories Act, Pesticides Act, Indian Forest Act, Wildlife Act, Ancient Monuments and Archaeological Sites and Remains Act, Hazardous Waste Management and Handling Rules / Biomedical Rules / Solid Waste Management Rules, Environment Tribunal Act, Climate change Protocols and Conventions,

REFERENCE BOOKS:

1. S.C. Shastri, *Environmental Law*, (3rdEdn.), Eastern Book Company, Lucknow, 2008.
2. Maheshwara Swamy, *Textbook on Environmental Law,* (2ndEdn.), Asia Law House, Hyderabad, 2008.
3. Shyam Divan and Armin Rosencranz, *Environmental Law and Policy in India,* Oxford University Press, New Delhi, 2005.
4. Amod S. Tilak, *Environmental Law,* (1stEdn.), Snow White Publication, Mumbai, 2009.
5. I.A. Khan, *Environmental Law,* (2ndEdn.), Central Law Agency, Allahabad, 2002.
6. P Leelakrishnan, *Environmental Law in India,* (2ndEdn.), Lexis Nexis, New Delhi, 2005.
7. S. Shantakumar, *Introduction to Environmental Law*, (2ndEdn.), Wadhwa & Company, Nagpur, 2005.

PRACTICALS:

1. Bio-ethanol production from waste materials.
2. Production of biodiesel from vegetable oil.
3. Production of biofuel from algae.
4. Physico-chemical analysis soil.
5. Isolation of *Actinomyctes* from soil.
6. Demonstration of Lab scale biogas production plant.
7. Saponification value of an oil sample.