JYOTI NIVAS COLLEGE AUTONOMOUS
SYLLABUS FOR 2018 BATCH AND THEREAFTER

Programme: B.Sc. **Semester: VI**

BIOCHEMISTRY PAPER VIII
ENVIRONMENTAL BIOCHEMISTRY

Course Code:18VIBC8 **No. of Hours: 45**

COURSE OBJECTIVES:

Through this course, the student is imparted knowledge of

- The importance of conservation and sustainable development.
- Waste-volume mitigation through bioremediation
- The role of xenobiotics in bioremediation
- Fundamental aspects of air, water and land pollution.
- Environmental pollutants and its significance.
- Various technologies and techniques in removal of toxic substances.

LEARNING OUTCOMES:

By the end of the course students should

- Understand the concept of xenobiotics, interaction between xenobiotic and living organisms.
- Understand the metabolism of xenobiotics: phase I and phase II reactions.
- Be familiar with bioremediation techniques in removing pollutants from soil and water.
- Understand biofuels and its types, production of biofuels from plants.
- Understand air, water and soil pollution and its effects in living organisms.
- Understand the techniques in monitoring pollution including solid waste management.
- Be familiar with green chemistry and its twelve principles, green chemistry metrics.

UNIT I

Chapter 1.1 AIR POLLUTION **02 HRS**

Types, sources (natural and anthropogenic sources) and consequences in living organisms.Air borne diseases.Diseases of the upper respiratory tract diseases (pharyngitis, laryngitis and diphtheria) and lower respiratory tract (whooping cough, pneumonia and tuberculosis).

Chapter 1.2 AIR SAMPLING **03 HRS**

Sampling considerations, sampling systems of air pollutants. Air pollution monitoring :Surveillance, surveys and investigation, Resource management. Air quality standards and its criteria [National Ambient Air Quality Standards (NAAQS), Pollution standard index and indoor air quality, KSPC].

UNIT II

Chapter 2.1 WATER POLLUTION **02 HRS**

Types and sources (municipal, industrial and agricultural sources). Types of water pollutants (Physical, Chemical and Biological).Eutrophication.Consequences of Water pollution-water borne diseases (diarrheoa, dysentry, cholera, typhoid).

Chapter 2.2 WATER QUALITY **03 HRS**

Classification of water sources based on their use and quality, water quality standards and parameters of drinking water. Water quality assessment: Chemical and bacteriological

analysis. Steps involved in the water quality assessment: Identification of water resource, selection of environmental indicators, search of existing source of information, sample collection, laboratory analysis, statistical analysis and interpretation of data. Effluent Analysis: Measurement of metal pollutant using Atomic absorption spectrophotometer (AAS) and measurement of common anions (cyanide, sulphide, sulphite and chlorides).

Chapter 2.3 PURIFICATION OF WATER 02 HRS

Boiling process, filtration process, radiation technologies-UV and IR.Membrane filtration-micro filtration, ultrafiltration, nanofiltration, reverse osmosis.

UNIT III

Chapter 3.1 SOIL POLLUTION 02 HRS

Types (Agricultural soil pollution, soil pollution by industrial effluents and solid waste, soil pollution due to urban activities), sources and consequences of soil pollution – Effects on human health and growth of plants. Electronic waste (E-waste) and its components.

Chapter 3.2 SOLID WASTE MANAGEMENT 03 HRS

Introduction, types sources and causes of solid wastes. Effects of solid waste pollution-health hazards and environmental impacts.Solid waste management – Collection of solid wastes, disposal of solid wastes, recycling of solid waste. Examples of recycling and waste utilization: as a source of energy, production of oils and fuels from solid waste, methanol production from organic waste, byproducts from sugar industries. Membrane bioreactor (MBR).

UNIT IV

MONITORING POLLUTION 03 HRS

Bioindicators, Biomarkers, biochemical indicators, Immunochemistry, Genetic indicators. Toxicity testing using biological material- Using plants and algae, luminescent organisms, Ames test and molecular biology markers, biosensors.

UNIT V

Chapter 5.1 BIOREMEDIATION 03 HRS

Definition, scope and advantages. Bioremediation strategies. Indigenous micro-organisms, Stimulation of indigenous microbial growth, bioaugmentation, genetically manipulated organisms.

Chapter 5.2 BIOCHEMICAL PATHWAYS OF BIODEGRADATION 03 HRS

The initial steps in the degradation of polycyclic aromatic hydrocarbons (toluene, anthracene, phenanthrene, naphthalene) surfactants (alkyl benzene sulphonates and alkyl phenol ethoxylates). Enzymatic degradation of bacterial biofilms using *Aspergillus clavatus*.Biodegradation of Atrazine by *Pseudomonas sp.*

Chapter 5.3 BIOREMEDIATION TECHNIQUES 05 HRS

In situ – land farming, bioventing, biosparging and *ex situ* – composting (Vermicomposting), biopile process, bioreactors (fluidized bed reactors, rotating disc bioreactors, single blanket reactors, sequential reactors). Phytoremediation :Phytoextraction, phytodegradation, phytovolatalization, phytostabilisation. Removal of pollutants from the atmosphere: Rhizofiltration, Rhizostimulation. Applications of genetic engineering to Phytoremediation.

Chapter 5.4BIOFUELS 02 HRS

Types of biofuels – solid, liquid (biodiesel and bioalcohol). Biodiesel production from *Jatropha sp., Pongamia sp*., and Castor and gaseous (biogas and gobar gas)

UNIT VI

Chapter6.1METABOLISM OF POLLUTANTS 02 HRS

Definition and scope of environmental biochemistry, concept of xenobiotics (XB) with examples, types - biodegradable and non- biodegradable (recalcitrant compounds), classification.Hazards from Xenobiotics in living organisms.

Chapter 6.2 XENOBIOTICS **03 HRS**

Behavior of Xenobiotics in living organisms- absorption, distribution, biotransformation, toxic effects and elimination. Metabolism of xenobiotics: Phase I reactions - oxidation, hydrolysis, sulphation, Phase II reactions- conjugation reactions. Role of cytochrome P450.

UNIT VII

METAL TOXICITY AND DETOXIFICATION **04 HRS**

Introduction.Biosorption and extra cellular precipitation. Biochemical toxicology and detoxification of Cyanide, Chromium, lead, Cadmium, Mercury and Arsenic. Use of nanomaterials in detoxification.

UNIT VIII

GREEN CHEMISTRY **03 HRS**

Introduction, Twelve principles of green chemistry, examples-production of 1,3-propanediol using genetically modified strain of E.coli, Synthesis of tryptanthrin using β-cyclodextrin as catalyst and polylactic acid polymerization process.

Green chemistry metrics- concepts like effective mass yield, carbon efficiency, atom economy,reaction mass efficiency, environmental factor and eco scale. Carbon credit. Water audits – Water Efficiency Products India (WEPI)

REFERENCES:

1. Applied Bioremediation and Phytoremediation,Edited by Singh,Ajay Ward Owen.P Springer Verlag 2004.
2. Scragg . Allan, Environmental Biotechnology,second edition ,Oxford University Press.
3. Alexander. Martin Biodegradation and Bioremediation, second edition, ,Academic Press 2001
4. E. Hodgson and R. Smart Introduction to Biochemical Toxicology,.Appleton and Lange. Third edition, 2001.
5. Mukhopadhyay S.N. Process Biotechnology: Theory and Practice.Vol 1 The Energy and Resources Institute TERI 2012.
6. RajvaidyaNeelima and MarkandeyDilip Kumar. Environmental Biochemistry. APH Publishing Corporation 2005.
7. Maheshwari D.K. and Dubey R.C. Bioremediation of Pollutants.Vol 1.I.K.International Publishing House.2012.
8. InduShekhar Thakur . Environmental Biotechnology -Basic concepts and Applications. I.K International Publishing house PvT LTD., Second Edition 2012.
9. Pandey.S.N and Misra. S.P. Environment and Ecology.Ane Books Pvt LTD., Ane's Student Edition 2011

VI SEMESTER BIOCHEMISTRY PRACTICAL PAPER VIII

DURATION: 3 HRS / WEEK **NO. OF UNITS:15**

1. Determination of total hardness of water by EDTA method.
2. Estimation of residual chlorine by iodometric method.
3. Determination of dissolved oxygen by Winkler's method.
4. Determination of organic matter in the given water sample.
5. Determination of water alkalinity by titrimetric method.
6. Determination of iron in polluted water by phenanthroline method.
7. Determination of total dissolved solids by gravimetric method.
8. Estimation of Chemical Oxygen Demand in water.
9. Quantification of chloride in water by silver nitrate method.
10. Estimation of phosphorus in soil by Fiske –Subbarow method.

Repetition and Tests.

REFERENCES:

1. InduShekhar Thakur . Environmental Biotechnology -Basic concepts and Applications. I.K International Publishing house Pvt LTD., Second Edition 2012.
2. Pandey.S.N and Misra. S.P. Environment and Ecology.Ane Books Pvt LTD., Ane's Student Edition 2011.