Name of the Programme : M.Sc. Part-II (Biochemistry)
Course Code : CHB-624
Title of the Course : Bioprospecting and Bioremediation
Number of Credits : 4
Effective from AY : 2022-23

Pre-requisites for the Course:	Students should have studied natural and life sciences at M.Sc Part I Level	
Course Objectives:	1. To introduce the concept of bioprospecting of bioactive compounds from plant and microbial sources. 2. To impart knowledge on purification and characterization of novel metabolites from biological sources using analytical techniques. 3. To develop concepts in environmental pollution and role of microorganisms in biogeochemical cycles and bioremediation of pollutants	
Content:		**No of hours**
	1. Sources and Sampling of potential microbes and plants sources **a. Sources: microbes and plants** i. Marine and other coastal ecosystems: Water and sediment samples, microorganisms from mangroves, sand dunes and salterns. ii. Terrestrial: Forest/Ghats iii. Microbes in Extreme environments: thermophilic, psychrophilic, halophilic, alkaliphilic, barophilic **b. Sampling microorganisms** i. Niskin water sampler ii. Van Veen Grab sediment sampler **c. Aseptic collection of samples** i. Sampling of plants: Selection criteria: Type, physical condition, stage of growth, plant part. Sample treatment: surface sterilization, excision of desired plant component, extraction.	**6**
	2. Industrially and medically important biomolecules from plants and microorganisms: Screening, detection, purification and characterization using analytical tools a. Enzymes: extremozymes; food additives/ quality enhancers, medicine, antioxidants and antitumor agents b. Pigments: food colorants, fabric dyes c. Biocontrol agents:herbicides, pesticides d. Nanoparticles: medicine, drug carriers. e. Biofuels: microbially produced; plant based f. Optical and electronic devices: archaeal metabolites (bacteriorhodopsin and cell wall S-layer as membrane for ultrafiltration) g. Biopolymers – biodegradable plastics: PHAs, blended plastic polymers, EPS, biosurfactants and bioemulsifiers	**24**

	h. Plant growth promoters- gibberellins, auxins, cytokinins i. Pharmaceuticals: Antimicrobials, Antitumour agents, drug carriers. j. Nutraceuticals: PUFAs, β-carotenes, antioxidants k. Cosmeceuticals: humectants (polyols). l. Drugs from Sea	
	3. Pollutants in the environment and their impact: **a. Environment and pollutants** i. Classification of pollutants ii. Toxicity, synergistic or antagonistic action. iii. Eco-toxicology: concept of permissible limits, ED50 & LD50 iv. Acute and chronic exposures; biochemical effects and genotoxicity. **b. Significant environmental pollutants: source, effect and impact** i. Soil Xenobiotics ii. Agricultural chemicals iii. Pesticides iv. lead and other heavy metals v. Marine pollutants **c. Monitoring of pollution** i. Using indicator microorganisms ii. Biosensors: genetically modified organisms and enzymes **d. Significant environmental monitoring parameters** i. Dissolved oxygen ii. Biochemical Oxygen Demand iii. Chemical Oxygen demand. iv. Environment protection regulations, impact assessment and standards. v. Environmental pollutants , improper waste disposal	**10**
	4. Remediation of waste a. Treatment of waste: Concepts of Reuse, Recycle, Recovery. b. Introduction to waste treatment i. Wastewater/sewage treatment ii. Solid waste management iii. Hospital waste management. c. Biological systems for remediation: plants, bacteria and fungi d. Microbial consortia and related microbial processes i. Enzymatic transformations ii. Co-metabolism iii. Microbial adhesion iv. Biofilms v. Production of extracellular polymers and emulsifiers. e. Other pollutant removal techniques i. Sedimentation ii. Sorption	**10**

	iii. Precipitation iv. Speciation conversion f. Emerging eco-friendly alternatives for chemical industry – Green chemistry and Green Technology	
	5. Biotechnological methods to control pollution a. Bioremediation i. In situ and Ex-situ bioremediation ii. Factors affecting process of bioremediation iii. Methods in determining Biodegradability iv. Use of microbes (bacteria and fungi) bioremediation v. Bioremediation of common environmental pollutant vi. Evaluating Bioremediation b. Biofilters c. Biotransformation d. Phytoremediation e. Biodegradation	**10**
Pedagogy:	Mainly lectures and tutorials. Seminars / term papers /assignments / presentations / self-study or a combination of some of these can also be used. ICT mode should be preferred. Sessions should be interactive in nature to enable peer group learning.	
References/ Readings:	1. S. E. Manahan, Environmental Chemistry. Lewis Publishers, 2000. 2. A. V. Salker, Environmental Chemistry. Narosa Nublishing, 2017. 3. A. De, Environmental Chemistry. New Age International Publishers, 2005. 4. S.M. Khopkar, Environmental Pollution Analysis. New Age International Pvt. Ltd., 2005. 5. S.N. Jogdand, Gene Biotechnology. Himalaya publishing house, 2016. 6. S.N. Jogdand, Advances in Biotechnology. Himalaya publishing house, 2007. 7. A. Verma and A. Singh, Animal Biotechnology Models in Discovery and Translation. Academic press, 2020. 8. S.S.Dara, D.D.Mishra, A text book of Environmental Chemistry and Pollution Control. S. Chand Publishers, 2004. 9. R. Mitchell and J.D. Cu, Environmental Microbiology. Wiley-Blackwell Publication, 2009. 10. J. W. Moore and E. A. Moore, Environmental Chemistry. Academic Press, 1976. 11. E. D. Enger, B.E. Smith, Environmental Science: A study of Interrelationships. WCB Publication-McGraw-Hill Higher Education, 2019. 12. U. Satyanarayana and U. Chakrapani, Biotechnology, Books & Allied (P) Ltd, 2020. 13. A. Altman and P Hasegawa, Plant Biotechnology and Agriculture. Elsevier 2011. 14. D. Clark and N.Pazdernik, Biotechnology. Academic Press cell, 2015. 15. J. Pongracz and M.Keen, Medical Biotechnology. Churchill Livingstone, 2009	

	16. G. L. Fletcher, and M. L. Rise, Aquaculture Biotechnology. Wiley, 2011. 17. I. Ravi, M. Baunthiyal, and J. Saxena, Advances in Biotechnology. Springer, 2014. 18. S. Bielecki, J.Tramper and J.Polak, Food Biotechnology. Elsevier, 2000. 19. R. Maier, I. Pepper, C. Gerba and T. Gentry, Environmental Microbiology. Academic Press, 2008.
Course Outcomes:	1. Students will be able to explain the basic pathways of drug distribution, metabolism and excretion in the body. 2. Students will be able to 3. Students will be able to categorize different types of drug formulations and their contents. 4. They will be able to implement quality assurance and quality control procedures for drug formulations.

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