Department of Liberal Education
Era University, Lucknow
Course Outline
Effective From: 2023-24

Name of the Program	**B.A. / B.Sc. (LIBERAL EDUCATION)**			**Year/ Semester:**	**3rd / 5th**
Course Name	**Environmental Microbiology & Biotechnology**	**Course Code:**	**EVA302**	**Type:**	**Theory**
Credits	**04**			**Total Sessions Hours:**	**60 Hours**
Evaluation Spread	**Internal Continuous Assessment:**	**50 Marks**		**End Term Exam:**	**50 Marks**
Type of Course	○ Compulsory	◉ Core		○ Creative	○ Life Skill
Course Objectives	1. Apply microbiological and biotechnological know-hows in tackling environmental problems. 2. Learn about the Intellectual Property Right and their applications. 3. Understand need for bioethics and concept of biosafety.				

Course Outcomes(CO): *After the successful course completion, learners will develop following attributes:*

Course Outcome (CO)	**Attributes**
CO1	Gain knowledge about different types of microbes and their environmental applications.
CO2	Learn role and application of beneficial microbes in industries.
CO3	Learn about various biotechnological tools and their application for environment management.
CO4	Students learn relevance of bioethics in life, need for biosafety approaches to promote human safety and importance of IPR in R&D as well as corporate sector.
Pedagogy	Interactive, discussion-based, student-centered, presentation.
Internal Evaluation Mode	Mid-term Examination: 20 Marks Activity: 10 Marks Class test: 05 Marks Online Test/Objective Test: 05 Marks Assignments/Presentation: 05 Marks Attendance: 05 Marks

Session Details	**Topic**	**Hours**	**Mapped CO**
Unit 1	**Environmental Microbiology** ● Microbes: Types, cultivation & application ● Extremophilic microbes: Thermophiles, halophiles, acidophiles & psychrophiles ● Microbial indicators: air, water and soil- ● Biological treatment of wastewater; ● Bioremediation: Concept and approaches **Activity**: Read research articles, collect data and prepare list of microorganisms exhibiting ability to remove various pollutants from the environment.	16	CO1

Unit 2	**Food and Industrial Microbiology** • Food and microbes: Food spoilage and preservation; fermentation food, microbiology of milk • Industrial uses: biogas production, vaccine production, etc. • Role of microbes: biopolymers production & plastic biodegradation • Microbes & Agriculture: Biofertilizers, biopesticides **Activity**: Collect and compile information (organisms used, mechanisms of action, composition of product) regarding commercially available biofertilizers and biopesticides.	15	CO2
Unit 3	**Biotechnology** • Scope and Importance of Biotechnology • Development of genetically engineered microorganisms (GEMs) • Biotechnology & agriculture- Composting, vermicomposting • Crude oil management: Microbial enhanced oil recovery (MEOR), Superbug-oil eating bug Biomining & Biosensors: Concept & application **Activity**: Prepare an infographic poster on role of biotechnology in management of environmental issues.	14	CO3
Unit 4	**Bioethics, Biosafety and IPR** • Ethics of Genetically modified (GM) plants, animals, microbes • GM food and Biowarfare • Biosafety guidelines in India Intellectual Property Right **Activity**: To review any one IPR related case study and discuss its various aspects in class.	15	CO4

CO-PO and PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1		3	3	3		2	2		3	2	3		3	
CO2		3	3	3		2	2		3	2	3		3	
CO3		3	3	3		2	2		3	2	3		3	
CO4		3	3	3		3	3		3	2	3		3	

Strongcontribution-3,Averagecontribution-2, Lowcontribution-1,

Suggested Readings:

Text- Books	1. Mohapatra, P. K., Textbook of Environmental Microbiology, I.K. International (P) Ltd. 2. Jordening, H. J. & Winter J. 2005. *Environmental Biotechnology: Concepts and Applications*. John Wiley & Sons. 3. Sree Krishna. V., Bioethics and Biosafety in Biotechnology, New Age International Publishers.
Reference Books	1. Environmental Microbiology, Pepper, I. L., Gerba, C. P. and Gentry, T. J., 3rd edition, Academia Press, Elsevier. 2. Evans, G. G. & Furlong, J. 2010. Environmental Biotechnology: Theory and Application (2nd edition). Wiley-Blackwell Publications. 3. Wainwright, M. 1999. An Introduction to Environmental Biotechnology. Springer.
Para Text	**Unit 1:** 1. Wastewater treatment- https://www.youtube.com/watch?v=s8IVjQg7yno; https://www.youtube.com/watch?v=ciPFC3Y2rkg

	Unit 2: 1. Biopolymers- https://www.youtube.com/watch?v=Xc1G5uulW6U&ab_channel=RheaMae **Unit 3:** 1. Genetic engineering- https://study.com/academy/lesson/what-is-genetic-engineering-definition-benefits-issues.html; **Unit4:** 1. IPR- https://www.youtube.com/watch?v=I0onf2CKyzA&ab_channel=Kopiraittila

Recapitulation & Examination Pattern

Internal Continuous Assessment:

Component	**Marks**	**Pattern**
Mid-term Exam	20	**Section A:** Contains **10** MCQs/Fill in the blanks/One Word Answer/ True-False type of questions. Each question carries **0.5 marks.** **Section B:** Contains **07** descriptive questions out of which **05** questions are to be attempted. Each question carries **03 marks**.
Activity	10	Will be decided by subject teacher
Class Test	05	Contains **05 descriptive questions.** Each question carries **01** marks.
Online Test/ Objective Test	05	Contains **10 multiple choice questions.** Each question carries **0.5** marks.
Assignment/ Presentation	05	Assignment to be made on topics and instruction given by subject teacher
Attendance	05	As per policy
Total Marks	**50**	

Course created by: Dr. Swati Sachdev **Signature:**	**Approved by: Prof. Venkatesh Dutta** **Signature:**