

**JAYPEE INSTITUTE OF INFORMATION
AND TECHNOLOGY**

M.Sc Environmental

3rd Semester

Detailed Syllabus

Lecture-wise Breakup

Subject Code	19M21BT212	Semester: Odd	Semester: III Session : 2022 -2023 Month from: July to December
Subject Name	Recombinant DNA Technology		
Credits	3	Contact Hours	3
Faculty (Names)	Coordinator(s)	1. Dr. Pooja Choudhary	
	Teacher(s) (Alphabetically)	1. Dr. Pooja Choudhary 2. Dr. Sonam Chawla	
COURSE OUTCOMES			COGNITIVE LEVELS
C230. 1	Summarize the fundamental concepts of RDT, cloning vectors, prokaryotic vs. eukaryotic hosts and expression systems		Understand Level, C2
C230. 2	Illustrate different methods of gene transfer, cloning, genomic libraries and molecular tools for microbes, plants and animals		Apply level, C3
C230. 3	Analyse RDT tools, techniques and its applications in environment, Medicine and agriculture		Analyze level, C4
C230. 4	Identify importance as well as ethical and biosafety issues related to transgenics		Understand Level, C2

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Introduction	Basic Concepts of Recombinant DNA technology, origin of RDT, pioneering discoveries and significance of tailoring microbes, model plants and animals in present context	4
2.	Enzymes, Vectors and Hosts for Cloning	Restriction enzymes and other DNA modifying enzymes; Cloning vectors, expression vectors, prokaryotic and eukaryotic expression systems, bacterial, fungal and plant hosts for cloning, methods of gene transfer	6
3.	Recombinant DNA	Basic techniques of gene manipulation, - Gel electrophoresis, DNA transformation techniques, Cloning	6
	Technology	of PCR products, Construction of Genomic and cDNA libraries, Screening Libraries with Gene Probes, Screening Expression Libraries, Positional Gene Cloning, Subtractive cloning, Functional cloning	
4.	Molecular tools supporting RDT	PCR, RT-PCR, Blotting techniques, Sequencing methods, NGS, Gene editing, Mutagenesis, Gene expression techniques, Regulation of gene expression, microRNAs, Microarrays	4
5.	Methods & Applications of Plant Genetic engineering	Molecular Biology of DNA transfer in Plant through <i>Agrobacterium tumefaciens</i> , methods for artificial gene transfer, Applications in agriculture such as golden rice, BT Cotton, Nif and Nod gene clusters and Nitrogen fixing, etc.	5
6.	RDT for Environmental Biotechnology	Environmental Applications: biodegradation and bioremediation Energy based applications: Biogas, biodiesel and bioethanol production by microorganisms. Biotechnological applications. Biotechnological applications.	5
7.	RDT in Medicine & Therapeutics	Production of recombinant vaccines and antibiotics, phytopharming, microbes as cell factories for production of therapeutic molecules, insulin and other major discoveries, gene therapy	6

8.	Animal cloning & Issues	Transferring gene in animal oocytes, eggs embryos and specific animals tissues, Application of rDNA technology in animal cell lines, tailoring model animals, Controlling the expression of transgene in time and space, case studies exposing risks of animal cloning	4
9.	Ethics & Biosafety in RDT	Ethical issues, Biosafety guidelines and regulations	2
Total number of Lectures			42

PBL Component: Students assigned topics in group of 2 to 3 members. A review of literature based project on latest advancements in Recombinant DNA Technology and genetic engineering. PBL involves real-time learning based on published scientific papers, involves constructive analytical thinking and peer learning. Students submit their report/e-poster/PowerPoint presentation of their review work.

Evaluation Criteria	
Components Maximum Marks	
T1 20 T2 20 End Semester Examination 35 TA 25 Total 100	
Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Genes XII: Benjamin Lewin, 2016
2.	Molecular Biology of the Gene, Seventh Edition: James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick, 2004 Microbial Biotechnology: Progress and Trends, Farshad Darvishi Harzevili, Hongzhang Chen, First edition CRC Press/Taylor & Francis Group, 2017
3	Molecular biotechnology: principles and applications of recombinant DNA / Bernard R. Glick and Jack J. Pasternak, Cheryl L. Patten. ASM Press
4.	Gene Cloning and DNA Analysis: An Introduction, Seventh Edition-T. A. Brown, John Wiley & Sons Ltd. 2016

Detailed Syllabus

Lecture-wise Breakup

Course Code	16B1NBT733	Semester ODD (specify Odd/Even)	Semester III Session 2022-23 Month from July-December
Course Name	Waste Management		
Credits	4	Contact Hours	3-1

Faculty (Names)	Coordinator(s)	Dr. Garima Mathur
	Teacher(s) (Alphabetically)	Dr. Garima Mathur

COURSE OUTCOMES		COGNITIVE LEVELS
C432-3.1	Explain the fundamental concepts related to waste management	Understand level (C2)
C432-3.2	Apply basic environmental legislation and Environmental Management System for effective waste management	Apply level (C3)
C432-3.3	Analyze the emerging waste management technologies for sustainable solution	Analyze level (C4)
C432-3.4	Assess the environmental, social and economic aspects in integrated waste management	Evaluate level (C5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	An introduction to Waste management	Definition of waste, sources, general categories of waste in context of Indian legislations, waste generation aspects, waste collection, storage and transport	4
2.	Biological and chemical waste treatment technologies	Waste incineration and waste to energy (WTE), fundamentals of thermal processing – combustion, pyrolysis, gasification, energy recovery system, aerobic and anaerobic digestion, composting, biogasification and mechanical biological treatment of wastes.	7
3.	Waste handling and disposal	Health considerations in the context of operation of facilities, handling of materials and impact of outputs on the environment, Landfills: Design and operation including: site	7

		selection, Geo-environmental investigations, engineered sites, liners and covers, management of landfill leachate and the mining of old landfills, gas recovery and control, including utilization of recovered gas (energy), and landfill monitoring and reclamation, Natural attenuation process and its mechanisms, integrated waste management	
4.	Source Reduction and waste Recycling	Unit operations for separation and processing, size reduction, separation, density separation.	8
5.	Product recovery and biorefinery	Recovery of Biological Conversion Products: Composts and Biogas, recovery technologies to deliver added-value products	5
6.	Hazardous Waste: Management and Treatment	Specific waste streams including healthcare (biomedical wastes), food wastes, mineral and mining wastes, electronic waste, hazardous wastes and producer responsibility wastes.	6
7.	Legal aspects and policy guidelines	Regulatory requirements for identification, characterization and disposal of hazardous, nonhazardous and domestic wastes, International treaties addressing waste issues	3
8	Environmental and Economic considerations of waste management	Economics of the on-site v/s off site waste management options	2
Total number of Lectures			42

Evaluation Criteria	
Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment 1. Assignment 2)
Total	100

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Waste from wealth- Banwari Lal, Priyangshu M Sarma, The Energy and Resources Institute, 3 rd Edition, 2017.
2.	Textbook of solid waste management, Khan, Iqbal H, Ahsan, Naved, CBS Publishers & Distributor 2014

3.

Environmental Waste Management, Ram Chandra, CRC Press, 1st Edition, 2015

Course Code	20M31BT211	Semester Odd (specify Odd/Even)	Semester III Session 2022 -2023 Month from July to December
Course Name	Environmental Policy, Ethics & Legislation		
Credits	3	Contact Hours	3

Faculty (Names)	Coordinator(s)	Dr. Indira P. Sarethy
	Teacher(s) (Alphabetically)	Dr. Indira P. Sarethy Dr. Ankisha Vijay

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Explain and interpret ethics	Understand (C2)
CO2	Correlate ethics with respect to environment	Apply (C3)
CO3	Evaluate environmental policy and legislation as applied in different countries	Evaluate (C5)
CO4	Analyze commercialization with respect to environment and policy	Analyze (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction	What is ethics? What is the environment? Ethics and the Environment	2 [CO1]
2.	Environment vs ethics	Environmental problems as ethical problems, environmental ethics approaches and world views; A brief history of environmental ethics	3 [CO1]
3.	Environmental Justice	Equal and fair treatment for all people, with respect to development, implementation; enforcement of environmental laws, regulations, and policies.	5 [CO2]
4.	Anthropocentric environmental ethics	Population growth, pollution, and resource overexploitation as tragedies of the (unregulated) commons. : Humans, other animals, and speciesism, diets, Biocentrism and biocentric individualism. Biodiversity, species preservation, and ecological tradeoffs.	4 [CO2]

5.	International Environmental Policies	Introducing laws to protect the environment; major environmental laws globally and in India; Nature of Environmental Policies; Stockholm Conference(1972); Rio Conference (UNCED)(1992); Merits of the Conference (Agenda 21); Failures of the Conference.	4 [CO3]
6.	International Agreements and Treaties	Concept of agreement and treaty; Need of international agreements and treaties; Johanesburg treaty; GAAT and Environment; CITES; Montreal Protocol	5 [CO3]
7.	National Policy on Environment	National Committee on Environment and Planning (NCEP); Tiwari committee; Establishment of MoEF; National Forest Policy; National Water Policy and National Energy Policy; CPCB and SPCBs.	4 [CO3]
8.	Constitutional provisions for Environmental Protection	Historical Background of constitutional provisions; Article 14, 15, 19, 21, 32, 39, 47, Article 48(A), 49, 51A(g) as fundamental duties of citizen and directive principles of state policy, Article 243, 243(G) and (W); Art. 246, 248 and other articles related to Environment; Writ provisions for the protection of environment.	5 [CO3, CO4]
9.	National Environmental Legislation	The Water(Prevention and Control of Pollution) Act, 1974; The Air (Prevention and Control of Pollution), Act, 1981; The Environment (Protection) Act, 1986; Aims, objectives and major contents and Sec. 12 of Mining Act, 1952. The Forest (conservation) Act, 1980; The Wildlife (Protection) Act, 1972; The Biodiversity (Protection) Act, 2002; Aims, objectives and major contents with ammendments.	5 [CO3, CO4]
10.	Environmental Legislation related to CRZ & PIL	Concept and need of public interest litigation; Jurisdiction of High Courts and Supreme Court; Need of CRZ rules for regulation the activities in coastal zone; Statutory provisions in IPC and CrPC; Common law remedies for environmental safeguard; Environment related provisions in Public Liability Insurance Act.	5 [CO3, CO4]
Total number of Lectures			42
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20	
End Semester Examination		35	
TA		25 (Assignments 1, 2. Presentation 1)	
Total		100	

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Declaration of: The Stockholm Conference, Rio, Rio+5 and Rio+10: https://www.ipcc.ch/apps/nj-lite/srex/nj-lite_download.php?id=6471 ; https://www.un.org/en/development/devagenda/sustainable.shtml

2.	Anti-Pollution Acts http://www.lawsindia.com/Industrial%20Law/list%20of%20Acts/Pollutioin%20act%20list/POLLUTION%20ACTS%20%20LIST.htm
3.	Constitution of India (referred articles from Part-III, Part-IV and Part-IV-A) https://www.mea.gov.in/Images/pdf1/Part3.pdf ; https://www.mea.gov.in/Images/pdf1/Part4.pdf
4.	P. Leelakrishnan, Environmental Law in India, Lexis Nexis; 4th edition (26 July 2016)

Course Code	20M32BT212	Semester: Odd	Semester: III Session : 2020-21 Month from: July to December
Course Name	Bioformulations		
Credits	3	Contact Hours	3

COURSE OUTCOMES: Upon completion of the course, students will be able to		COGNITIVE LEVELS
CO1	Understand different categories and components of Bioformulations, factors impacting their stability	Understanding Level (C2)
CO2	Apply different bioformulation technologies to prepare high quality liquid and solid bioformulations	Apply Level (C3)
CO3	Procedures for quality control, Laws & Regulations governing Bioformulations	Understanding Level (C2)
CO4	Understand current methods of production, consumer acceptance, market potential and future prospects of bioformulatives Industry	Understanding Level (C2)

Faculty (Names)	Coordinator(s)	Prof. Krishna Sundari
	Teacher(s) (Alphabetically)	1. Prof. Krishna Sundari

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Introduction to Bioformulations , types & stability	Fundamental characters of Bioformulations, types of Bioformulations, factors impacting the stability of Bioformulations (Physical, Chemical, biological), bioformulations vs bioinoculants	5
2.	Different categories of Bioformulations	Beneficial Microorganisms, Biofertilizers, Biopesticides, Biofungicides, Antiviral agents, Bio supplements, Biostimulants, plant growth supplements, Concentrated nutrient formulations, Phytohormones	4
3.	Constituents of Bioformulations	Additives, spreaders, stickers and adjuvants,color agents, stabilizers, emulsifiers, surfactants and other substances used in bioformulations, role of each of such components	5
4.	Nanoformulations	Microemulsions, nanoemulsions and other nanoformulations of synthetic biocidal agents, phytocompounds for pest control	4

5.	Microbes in formulations	Different classes of Bacteria used as Bioinoculants, Fungi in Bioformulations, Cyanobacteria, Advantages of Bioformulations over chemical counterparts, Use of pure culture vs. consortia as Bioformulations, Current Challenge to Increase Crop Performance, Bioformulations of Novel Indigenous Rhizobacterial Strains for Managing Soilborne Pathogens	4
6.	Bioformulation technologies	Methods of preparing Bioformulations, Encapsulation Techniques, Testing the efficacy of Bioformulations, various mechanisms of application, Formulation Technologies for Biocontrol Agents	4
7.	Quality control in Bioinoculant formulations	Factors affecting the quality of bioformulations, procedures for quality control, Shelf life of Bioformulations, Bio-Based and Reduced-Risk Strategies for sustainable crop Management	4
8.	Bioformulations Market	An Overview of Globally Available Bio-Formulations, Market availability of Bioformulations products, market preparedness, SWOT analysis for Bioformulations, Present Status and Future Prospects	4
9.	Laws & Regulations governing Bioformulations	Regulations related to Bioformulations, Government ministry / State agency for certifying Bioformulations, Patents in Bioformulations (Indian and International) Regulation of Biopesticides: Global Concerns and Policies	8
Total number of Lectures			42
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20	
End Semester Examination		35	
TA		25	
Total		100	

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Prescott's Microbiology, 10 th Edition, Eds. Joanne Willey, Linda Sherwood and Christopher J. Woolverton, 2017
2.	Environmental Microbiology, 3rd Edition, Eds: Ian Pepper, Charles Gerba, Terry Gentry, Academic Press, 2014
3.	Bioformulations: for Sustainable Agriculture (2016). Eds. Arora N., Mehnaz S., Balestrini R. Springer, New Delhi. https://doi.org/10.1007/978-81-322-2779-3_1
4.	Research articles from refereed journals.

Course Code	17M12BT118	Semester Odd	Semester. III. Session 2022-2023 Month from July – Dec
Course Name	Product Development in Biotechnology		
Credits	3	Contact Hours	3

Faculty (Names)	Coordinator(s)	Prof. Neeraj Wadhwa
	Teacher(s) (Alphabetically)	Prof. Neeraj Wadhwa, Dr. Manisha Singh

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Outline various processes relevant for Bio business	Understand Level (C2)
CO2	Compare marketing techniques and related ethics	Apply Level (C2)
CO3	Select appropriate technology for the production of biological products	Understand Level (C3)
CO4	Explain financial, regulatory, health policy aspects for biobased industries	Understand Level (C2)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Biotechnology Industries overview	Biotech industries in India and abroad, Biotechnology as a function of science and business, Company structures versus other non-biotech companies, Functional units Company structure and functions Emerging technology and technical convergences issues	5
2.	Business in the context of biotechnology Entrepreneurship-	Science/development, the idea and its development, Plant tissue culture lab-equipment- glassware's chemical requirement-- construction, techniques in culturing and export abroad, Vermitechnology, Mushroom cultivation, single cell protein, Biofertilizer technology-production, Textile processing, leather treatment, leather industry set up Detergent industry, bakery, diary, Technology product development Other biotech product development, such as biofuels, bioengineered foods, etc.- commercialization of Bakery and dairy products relevant case studies	14
3.	Product development	a. Production of commercially important primary metabolites like organic acids, amino acids and alcohol & Production processes for various classes of secondary metabolites: Antibiotics, Vitamins and Steroids. production of Industrial Enzymes, Biopesticides, Biofertilizers, Bio preservatives, Biopolymers, Pulp and Paper, SINGLE CELL PROTEIN & Mushroom culture, Bioremediation.	12

		Bioprocess strategies in Plant Cell organ culture and Animal Cell culture.	
4.	Bio business plans	Concerns and opportunities, Environmental clearances requirement from government, Quality checks and validation certificates, Branding, Marketing and Packaging concerns Bank loan and finance strategy, Budget planning, Policy and regulatory concerns,	6
5.	Bioremediation Bioethics and legal issues	Business Development public perception in product development, Sustainability, Environmental concerns of product and their waste as well of genetically modified products and organism-	5
Total number of Lectures			42
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20	
End Semester Examination		35	
TA		25 (Assignment)	
Total		100	
Project Based Learning (PBL): Students will be skilled, prepared and oriented towards understanding the insight of various bio-based business development ideas. They will be made aware of various planning and policy systems existing in the global market to start and run a business. Students will also be trained to develop entrepreneurial skills.			

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Satyanarayana, U. "Biotechnology" Books & Allied (P) Ltd., 2005.
2.	Kumar, H.D. "A Textbook on Biotechnology" 2nd Edition. Affiliated East West Press Pvt. Ltd., 1998.
3.	Balasubramanian, D. et al., "Concepts in Biotechnology" Universities Press Pvt. Ltd., 2004.
4.	Ratledge, Colin and Bjorn Kristiansen "Basic Biotechnology" 2nd Edition Cambridge University Press, 2001
5.	Faber K, Biotransformation's in Organic Chemistry, IV edition, Springer
6.	Dubey, R.C. "A Textbook of Biotechnology" S. Chand & Co. Ltd., 2006. Trevor Palmer, Enzymes II ed Horwood Publishing Ltd
7.	Cruger, Wulf and Anneliese Crueger, "Biotechnology: A Textbook of Industrial Microbiology", 2 nd Edition, Panima Publishing, 2000
8.	Moo-Young, Murrey, "Comprehensive Biotechnology", 4 Vols. Pergamon Press, (An Imprint of Elsevier) 2004.
9.	Richard Oliver "The coming Biotech Age; the business of Biomaterials "Mc Graw Hill Publication, New York USA2000

10 .	Karthikeyan, S and Arthur Ruf.” Bio business” MJP Publication Chennai India 2009
11 .	Cynthia Robins,” The business of Biotechnology”. UK Harper Collins 2001

Course Code	20M35BT211	Semester Odd	Semester III Session 2022-23 Month from July to December
Course Name	Environmental Biotechnology Lab-III		
Credits	0-0-4	Contact Hours	8
Course Coordinators: Prof Neeraj Wadhwa			
Faculty: Prof Vibha Rani, Dr. Ekta Bhatt, Dr Smriti Gaur, Prof Neeraj Wadhwa, Dr. Ashwani Mathur			

COURSE OUTCOMES Students will be able to		COGNITIVE LEVELS
CO1	Analyze bacterial transformation techniques	Level IV (Analyze)
CO2	Evaluate cloning techniques	Level V (Evaluate)
CO3	Evaluate biological treatment of waste and kinetics involved	Level V (Evaluate)
CO4	Apply informatics tools for environmental studies	Level III (Apply)

Module No.	Title of the Module	List of Experiments
1.	Bacterial Transformation	Competent cells preparation and Transformation of plasmid DNA of into <i>E. coli</i> , calculation of transformation efficiency
2.	Cloning and screening of recombinants	Restriction digestion of vector and insert; ligation of gene of interest in standard plasmid vectors; Transformation; Screening of recombinants
3.	Waste Management	Field visit to ETP: Primary, chemical and biological treatment; calculation of kinetics of microbial degradation of waste; bioreactors; pollution control case study
4.	Bioinformatics	Application of bioinformatics tools and resources in environmental biotechnology

Evaluation Criteria

Components	Maximum Marks
Mid Term Exam	20
End Term Exam	20
Day to Day	60
Total	100

PBL:**Recommended Reading**