ERA UNIVERSITY, LUCKNOW
STUDY & EVALUATION SCHEME (Effective from Session 2024-25)
M.Sc. BIOTECHNOLOGY
YEAR II, SEMESTER – III

S. No.	Course category	Course code	Course title	Hours/week			EVALUATION SCHEME				CT	C	Attributes						
				L	T	P	Mid Sem Exam	TA	Total	End Sem Exam			Employability	Entrepreneurship	Skill Development	Gender	Environment Sustainability	Human values	Professional Ethics
THEORY																			
1.	Major Own Faculty	MBT0301T	Genetic Engineering	3	1	0	20	20	40	60	100	4	√	√	√		√		
2.	Major Own Faculty	MBT0302T	Plant & Animal Biotechnology	3	1	0	20	20	40	60	100	4	√		√		√		
3.	Major Own Faculty	MBT0303T	Industrial Biotechnology	3	1	0	20	20	40	60	100	4	√	√	√				√
4.	Major Own Faculty	MBT0304T	Ecology & Environmental Biotechnology	3	1	0	20	20	40	60	100	4	√		√		√		
5.	Major Own Faculty	MBT0305T	Bioentrepreneurship	3	1	0	20	20	40	60	100	4	√	√	√		√		
PRACTICALS																			
6.	Major Own Faculty	MBT0306P	Laboratory Course III (Genetic Engineering + Plant & Animal Biotechnology + Environmental Biotechnology)	0	0	6	20	20	40	60	100	3	√	√	√		√		
7.	Major Own Faculty	MBT0307R	Educational Visit + Seminars	2	0	2	0	0	0	100	100	3	√	√	√		√		
Total											**700**	**26**							

L- Lecture T- Tutorial P- Practical C- Credit TA- Teacher Assessment CT- Course Total

Era University
Department of Biotechnology
Course Outline
Academic Year: 2024-2025

Course Name: *Genetic Engineering*		**Course Code:** *MBT0301T*	**Year:** II	**Semester:** III
Core Course				
Credits: 4	**Total No. of Lectures: 60**	**Lecture-Tutorial-Practical (In hours/week) L-T-P:** 3-1-0		
Evaluation Spread	**Internal Continuous**	40	**End Term Exam**	60
Course Objective	The objective of this course is to make students aware about the scope and applications of genetic engineering and teach them with various approaches of conducting genetic engineering, and their applications in biological, research as well as biotechnology industries. To introduce students to basic concepts of human genetics and provide information about the role of genetics in medicine.			
Course Outcome	CO1: Know the role of the molecular tools applied in gene cloning for construction of recombinant molecules. CO2: know several techniques involved in production of cDNA and Genomic library and primer synthesis. CO3: Know different types of screening and selection procedure of identifying recombinants. CO4: Know the basic concepts of human genetics.			
Pedagogy	Interactive, Discussion Based Sessions, Presentations, Seminars			
Internal Evaluation Mode	Sessional Test: 20 Quiz: 5 Assignments: 5 Attendance: 5 Presentations: 5			

Unit	**Topic**	**No. of Lectures Total = 60**
I	**Introduction to Genetic Engineering:** Early development of Genetic Engineering, Overview of Recombinant DNA Technology, Restriction Enzymes, Class I, II & III Restriction Enzymes, Naming Nomenclature, Restriction Digestion: Partial and complete Digestion, Restriction Mapping, Nucleases (DNases, RNases, S1), Linkers, Adaptor, Homopolymer Tailing, Significance of DNA & RNA polymerase, reverse transcriptase, terminal transferase; T4 polynucleotide kinase, Alkaline Phosphatase and ligase (*E. Coli*& T4).	**12**
II	**Vectors:** General characteristics of vectors, Vectors based on E. Coli. (Brief account of plasmids. pBR 322, pBR325, pUC 18 and 19 vectors; Expression Vectors, Bacteriophage Vectors; Lambda Based Vectors, Insertion and Replacement Vectors; M 13 Derived Vectors, Cosmids, Phagemids, Shuttle vectors, BACs) YEps, YIps, YRps, Agrobacterium based vectors, plant virus as cloning vectors, cloning vectors for animals pET-based vectors; Protein purification; Protein tagging; Intein-based vectors; Inclusion bodies; Methodologies to reduce formation of inclusion bodies.	**12**
III	**Gene transfer methods:** The uptake of DNA by bacterial cells, Identification of recombinants, Introduction of phage DNA into bacterial cells, Identification of recombinant phages, Introduction of DNA into non-bacterial cells	**12**
IV	**Gene Cloning Strategies:** Cloning from mRNA: Cloning from genomic DNA. Construction of Gene Libraries, cDNA library, Advanced cloning strategies, Selection, Screening and Analysis of Recombinants, Radioative and non-radioactive Labelling of DNA: nick translation, random priming, radioactive	**12**

	and non-radioactive probes.	
V	**Applications of recombinant DNA technology** in the field of medicine, agriculture and Forensic Science.	**12**

Text Books

1. Terence A Brown. Gene Cloning and DNA Analysis: An Introduction. (7th Edition), Wiley Blackwell S. B. Primrose, Richard M. Twyman. Principles of gene Manipulation & Genomics (7 th Ed.) Blackwell Publishing
2. J Sambrook & D W Russel, Molecular Cloning: A laboratory manual, 3rd Edition, Cold Spring Harbor Laboratory press, U.S.A
3. Nicholl D.S.T. Introduction to Genetic Engineering Cambridge (3rdEd.) University press.UK. 2008 5. Bernard R. R. Glick, Jack J. Pasternak, Molecular Biotechnology: Principles and Applications of recombinant DNA, ASM Press, U.S.A
4. Snustad & Simmons, Principles of genetics, 6th Edition, Wiley Publications, 8th edition.
5. Strachan T and Read A P; Human molecular genetics; 4th Edition Garland Science, Taylor & Francis Group, LLC.

UNIT	MAPPED CO
I	CO1, CO3, CO4
II	CO1, CO2, CO3, CO4
III	CO1, CO2, CO3, CO4
IV	CO1, CO3, CO4
V	CO1, CO2, CO3

MAPPED CO's WITH PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	√	√	√		√		√		
CO2	√	√	√				√		
CO3	√	√	√				√		
CO4	√	√	√				√		

Course Created by:

Approved by:

Era University
Department of Biotechnology
Course Outline
Academic Year: 2024-2025

Course Name: Plant & Animal Biotechnology		**Course Code:** *MBT0302T*	**Year:** II	**Semester:** III
Core Course				
Credits: 4	**Total No. of Lectures: 60**	**Lecture-Tutorial-Practical (In hours/week) L-T-P:** 3-1-0		
Evaluation Spread	**Internal Continuous**	40	**End Term Exam**	60
Course Objective	The course aims to introduce the students to understand the basic principles of animal tissue culture, primary culture techniques, organ and tissue culture methods and, the application of animal biotechnology covers major areas related to commercial applications.			
Course Outcome	CO1: Students will learn basic concepts of animal and organ culture. CO2: Students will learn the various applications of animal cells and tissue culture CO3: Students will learn methods of cell cloning, transformation, transfection, micro-manipulation, nuclear transplantation and applied methods such as Artificial breeding, methods of knock-out and knock-in mice and applied animal biotechnology.			
Pedagogy	Interactive, Discussion Based Sessions, Presentations, Seminars			
Internal Evaluation Mode	Sessional Test: 20 Quiz: 5 Assignments: 5 Attendance: 5 Presentations: 5			

Unit	**Topic**	**No. of Lectures Total = 60**
I	**Plant Tissue culture Techniques and application -:** Introduction and basic procedure of plant tissue culture; General requirements for plant tissue culture-washing room, media room, glassware/plasticware, transfer room, growth room, cold storage and green house; Various sterilization techniques; Tissue culture media- composition and preparation. Initiation and maintenance of callus culture and suspension culture, Protoplast isolation, culture and viability test, Somatic hybridization- methods and hybrids selection, Cybridization. Cellular totipotency-Organogenesis and somatic embryogenesis- methods and application. Production of haploid plants- Androgenesis and Gynogenesis- application and limitation, In vitro production of secondary metabolites- classification, techniques and application. Virus free plants through meristem culture; shoot tip culture, Plant micropropagation, Somaclonal variation.	**12**
II	**Transgenic Plants and application:** Agrobacterium-plant interaction; virulence; screenable and selectable markers; Ti and Ri plasmids; opines and their significance; T-DNA transfer; disarmed Ti plasmid; Genetic transformation - Agrobacterium-mediated gene delivery; cointegrate and binary vectors and their utility; direct gene transfer - PEG-mediated, electroporation, particle bombardment and alternative methods. Applications of tissue culture engineering- pathogen resistance (*Bt* gene), herbicide tolerance, Edible vaccine and golden rice development.	**12**
III	**Introduction to Animal tissue culture:** Tissue culture- concept and application, Minimal requirement for cell culture, Various types of contamination, Aseptic conditions and methods of sterilization, Natural and synthetic media, physicochemical properties of culture media, balance salt solutions, complete culture media, Serum and serum-free media- advantages and disadvantages. Biology	**12**

	and characterization of cultured cells- cell adhesion, proliferation, differentiation and metabolism.	
IV	**Tissue culture characteristics:** Initiation of cell culture and cell lines development, Methods of specific cell lines identification, growth curve of cultured cells, Cell synchronization, Cell separation techniques-. Primary cell culture- various isolation techniques, establishment of cell lines- finite and continuous cell lines, immortalization of cell lines, maintenance of cell culture, Stem cell culture- Embryonic and epithelial stem cell culture. 3-D culture: Organ explants and techniques of organ culture, utility and limitations of organ culture, histotypic and organotypic cultures.	**12**
V	**Experimental application and applied animal biotechnology:** Cell viability and cytotoxicity assays, clonogenic survival assays, soft agar assay, Invasion assay; Transformed cells- characteristics and methods of development, In vitro drug testing in cultured cell- Genotoxicity, Cytotoxicity and Tumorigenicity test; Cell transfection- methods and application. General Biology of Rat and Mice, their behavior, biological, physiological and reproductive differences in rat and mice. Mouse model for human disease- characteristics and utility. Production of gene knockout mice- techniques and application. Transgenic animals- sheep, calves, mice, fish- methods of production and their application. Drug delivery systems- Various routes of drug delivery; their types and application.	**12**

Suggested Readings

1. Introduction to Pharmaceutical Biotechnology (Animal tissue culture and biopharmaceuticals) Volume 3; Saurabh Bhatia, Tanveer Naved and Satish Sardana
2. Practical Biotechnology: Methods and Protocols; S Janarthanan
3. Biotechnology; Dr. U. Satyanarayana& Dr. U. Chakrapani
4. Textbook of Animal Biotechnology" by B Singh and S K Gautam, TERI publishers.
5. Animal Biotechnology, MJP Publishers.
6. Animal Biotechnology: Comprehensive Biotechnology, Pergamon publishers
7. Biotechnology And Safety Assessment, publishers CRC Press.
8. Biotechnology Theory and Techniques CBS publishers.

UNIT	MAPPED CO
I	CO1
II	CO1
III	CO1
IV	CO2
V	CO2, CO3

MAPPED CO's WITH PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	√						√		
CO2	√	√	√				√	√	
CO3	√	√	√				√	√	

Course Created by:

Approved by:

Era University
Department of Biotechnology
Course Outline
Academic Year: 2024-2025

Course Name: *Industrial Biotechnology*	**Course Code:** *MBT0303T*	**Year:** II	**Semester:** III
Core Course			

Credits: 4	**Total No. of Lectures: 60**	**Lecture-Tutorial-Practical (In hours/week) L-T-P:** 3-1-0		
Evaluation Spread	**Internal Continuous**	40	**End Term Exam**	60

Course Objective	• To impart information and knowledge on fundamental principles of bioprocess engineering • To enlighten students mind on the upstream bioprocess infrastructure, knowhow and considerations • To enable the students downstream process, unit operations and product recovery. • To educate students about fundamental concepts of bioprocess technology and its related applications, thus, preparing them to meet challenges of new and emerging areas of biotechnology industry. • Students will be able to understand fermentative productions of representative biomolecules like enzymes, antibodies, vitamins etc.
Course Outcome	CO1: To introduce students to bioprocess instrumentation, measurement, control and automation. CO2: Gain of detailed knowledge on downstream processing: a multi stage operation, unit operations: solid liquid separation: filtration, centrifugation. Methods for disruption of cells for product recovery, concentration of biological products, purification of product: chromatography methods, monitoring of downstream process and process integration. CO3: Present unit operations along with fundamental principles for basic methods in production techniques for biologically based pdts. CO4: Select and design a bioreactor CO5: Undertake bioprocess monitoring/control. CO6: Describe equipment, materials and methods related to biotechnological processes CO7: To gain ability to investigate, design and conduct experiments. CO8: To analyse and interpret data to solve complex bioprocess engineering problems.
Pedagogy	Interactive, Discussion Based Sessions, Presentations, Seminars
Internal Evaluation Mode	Sessional Test: 20 Quiz: 5 Assignments: 5 Attendance: 5 Presentations: 5

Unit	**Topic**	**No. of Lectures Total = 60**
I	**Introduction:** Introduction to industrial biotechnology: history and scope, Principles of fermentation. Microbial Strain Improvement: Isolation, selection and improvement of microbial cultures; Primary and secondary screening of industrially important microbes, screening, enrichment, specific screening for the desired product. Strain improvement for the selected organism -random and strategic screening methods; Media for Industrial Fermentation: Natural and synthetic media; Media formulations- Carbon sources, Nitrogen sources, minerals, vitamin sources, nutrient recycle; Buffers; Precursors and metabolic regulators and Oxygen requirement.	**12**
II	**Design of Fermenter**: Basic functions of a fermenter, Bioreactor configurations: Design features, culture vessel, cooling and heating devices. Mass transfer in	**12**

	reactors: Transport phenomena in fermentation Gas- liquid exchange and mass transfer, oxygen transfer, critical oxygen concentration, determination of Kla; Heat transfer, aeration/agitation. Sterilization of Bioreactors, nutrients, air supply, products and effluents, process variables; Measurement and control of Bio-process - probes for online monitoring and computer control of fermentation process. Fermentation Process Batch, fed batch and continuous cultivation; Solid state cultivation; Growth of cultures in the fermenter; Kinetics of growth in batch culture, continuous culture with respect to substrate utilization.	
III	**Down Stream Processing:** Cell disintegration- Physical, chemical and enzymatic methods. Biomass separation by centrifugation, filtration and flocculation. Extraction- solvent, two phase, liquid extraction, whole broth and aqueous multiphase extraction. Purification – Chromatography, Concentration, ultra-filtration, reverse osmosis, drying and crystallization.	**12**
IV	**Microbial Products**: Microbial technology for alcoholic beverages production (wine), Dairy fermentation (Cheese), Single cell protein, Industrial biotechnology in chemical, pharmaceutical, food and allied sectors, Citric acid, Amino acids – Glutamic acid and Vitamin – B_{12}. Microbial Production of Therapeutic Compounds: Antibiotics- production of Penicillin, Streptomycin.	**12**
V	**Principle of food preservation**, Method of food preservation (Thermal processing, cold preservation, pascalisation, irradiation, chemical and natural food preservatives). Operational units in food industry, Food safety and standards (FSSAI), HACCP.	**12**

Suggested Readings

1. Biotechnology: A Text Book of Industrial Microbiology, Wulf Crueger and Anneliese Crueger. Science Tech Publishers. USA
2. Wulf Crueger & Anneliese Crueger (2000). Biotechnology. 2nd Edition, Panima Publications.
3. Gautam, N. C., Food Biotechnology in Comprehensive Biotechnology, Vol. 6., Shree Publishers, New Delhi, 2007
4. Gutierrez – Lopez, G. F. et. al., Food Science and Food Biotechnology. CRC Publishers, Washington, 2003
5. Maheshwari, D. K. et. al., Biotechnological applications of microorganisms, IK. International, New Delhi, 2006
6. Waites, M. J. et. al., Industrial Biotechnology: An Introduction, Blackwell publishing, UK, 2007.
7. Biochemical Engineering, S Aiba, AE Humphrey and NF Millis, Academic Press. New York 1973
8. Frazier,W.C. and Westhoff, D. C. 2004. Food Microbiology. 4th ed. McGraw-Hill, New Delhi.
9. Biochemical Reactors, B Atkinson, Pion Ltd., London. 1974
10. Biochemical Engineering Fundamentals (2nd edition), JE Baily and DF Ollis, McGraw Hill Book Co. New York. 1986
11. Bioprocess Technology: Fundamentals and Applications, KTH, Stockholm. 2000
12. Process Engineering in Biotechnology, A T Jackson, Prentice Hall, Engelwood Cliffs. 1991

UNIT	MAPPED CO
I	CO1, CO4, CO5
II	CO1, CO4, CO5, CO6, CO7, CO8
III	CO1, CO2, CO5, CO6, CO7, CO8
IV	CO1, CO3, CO6, CO7, CO8
V	CO1, CO7, CO8

MAPPED CO's WITH PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	√	√	√		√		√		
CO2	√	√	√				√		
CO3	√	√	√				√		
CO4	√	√	√				√		
CO5	√	√	√				√		
CO6	√	√					√		
CO7	√	√	√				√		
CO8	√	√	√				√		√

Course Created by: **Approved by:**

Era University
Department of Biotechnology
Course Outline
Academic Year: 2024-2025

Course Name: Ecology and Environmental Biotechnology		**Course Code:** MBT0304T	**Year:** II	**Semester:** III
Core Course				
Credits: 4	**Total No. of Lectures: 60**	**Lecture-Tutorial-Practical (In hours/week) L-T-P:** 3-1-0		
Evaluation Spread	**Internal Continuous**	40	**End Term Exam**	60
Course Objective	• This course is an introduction to biodiversity and its conservation strategies, environment and types of pollution present in the universe. • It focuses on the utilization of microbial processes in waste and water treatment, biodegradation of petroleum products and bioremediation. • On successful completion of the course the student will be know the importance of microbial diversity in environmental systems, processes and biotechnology as well as the importance of molecular approaches in environmental microbiology and biotechnology.			
Course Outcome	After completion of the course the learners will: CO1: Understand the importance of Biodiversity and its conservation strategies. CO2: Have the concept and importance of ecology. CO3: Know the biotechnological techniques involved in biodiversity conservation. CO4: Gain the knowledge about management of environmental issues.			
Pedagogy	Interactive, Discussion Based Sessions, Presentations, Seminars			
Internal Evaluation Mode	Sessional Test: 20 Quiz: 5 Assignments: 5 Attendance: 5 Presentations: 5			
Unit	**Topic**			**No. of Lectures Total = 60**
I	**The Environment**: Physical environment; biotic environment; biotic and abiotic interactions. Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (R and K selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations.			**12**
II	**Species Interactions**: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.			**12**
III	**Ecosystem Ecology**: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C, N, P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine). Biogeography: Major terrestrial biomes; theory of island biogeography; bio			**12**

	geographical zones of India. **Applied Ecology**: Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches. Conservation Biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).	
IV	Response of microbes, plant and animals to environmental stresses; Environmental problems- ozone depletion, greenhouse effect, water, air and soil pollution, land degradation. Role of environmental biotechnology in management of environmental problems, Bioremediation, advantages and disadvantages; In situ and ex-situ bioremediation; slurry bioremediation; Bioremediation of contaminated ground water and phytoremediation of soil metals; microbiology of degradation of xenobiotics.	**12**
V	Sewage and waste water treatment and solid waste management, chemical measure of water pollution, role of microphyte in water treatment; recent approaches to biological waste water treatment, composting process and techniques. Biofuels and biological control of air pollution, plant derived fuels, biogas, landfill gas, bioethanol, biohydrogen; use of biological techniques in controlling air pollution; Removal of chlorinated hydrocarbons from air.	**12**

Suggested Readings

1. Basic ecology - E. P. Odum
2. Ecology and field biology - R.L. Smith
3. Ecology - P.D. Sharma
4. Fundamentals of ecology -E.P. Odum
5. Principles of ecology – Rickleff
6. Environmental Science (5th Edition) by WP Cunninghum & BW Saigo., McGraw Hill. 1999.
7. Biotechnology for Wastewater Treatment. P Nicholas Cheremisinoff. Prentice Hall Of India. 2001
8. Biotechnological Methods of Pollution Control. SA Abbasi and E Ramaswami. Universities Press 1999
9. Environmental Biotechnology, Concepts and Applications. Hans-Joachin Jordening and Josef Winter. Winter-VCH. 2005
10. Biology of wastewater Treatment. N F Gray. McGraw Hill. 2004.
11. An Introduction to Environmental Biotechnology by Milton Wain Wright. KluwarAcad Publ. Group, Springer, 1999.

UNIT	MAPPED CO
I	CO1, CO2, CO3, CO4
II	CO2, CO3
III	CO2, CO3
IV	CO4
V	CO4

MAPPED CO's WITH PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	√	√			√		√	√	
CO2	√	√			√		√	√	
CO3	√	√			√		√	√	
CO4	√	√	√		√		√	√	

Course Created by: **Approved by:**

Era University

Department of Biotechnology
Course Outline
Academic Year: 2024-2025

Course Name: Bio-Entrepreneurship	**Course Code:** *MBT0305T*	**Year:** II	**Semester:** III
Core Course			
Credits: 4	**Total No. of Lectures: 60**	**Lecture-Tutorial-Practical (In hours/week) L-T-P:** 3-1-0	
Evaluation Spread	**Internal Continuous** 40	**End Term Exam**	60

Course Objective	• The course aims to give the learner an insight into the field of bio entrepreneurship, i.e., business within the life sciences. • It will equip students with the necessary knowledge on how to bridge science and business and hence translate biotech concepts into commercial terms and will develop a general understanding of the central role that business development plays for the biomedical industry regarding skills and ability. • It also enables students to understand the differences in issues and challenges in science-based industries related to entrepreneurship and innovation. Finally, students will develop the skills to successfully work in interdisciplinary teams and jointly produce business plans that are ready for submission to a business plan competition or presented to potential venture capitalists.
Course Outcome	CO1: To identify business opportunities in the life science sector. CO2: Identify potentially significant scientific advances which open up valuable opportunities. Create a team to take advantage of such an opportunity. CO3: Obtain the resources necessary to create an entrepreneurial organization. Seek to grow the business into a sustainable enterprise. CO4: Understand and gain a piece of knowledge about the entrepreneurial aspects and their essence. Formulate a business plan and financial plan. Run a business successfully. CO5: Students increase their awareness and deliberately practice the skills and disciplines necessary to increase confidence and agency; foster self-efficacy and self-advocacy; improve communication and problem-solving skills, manage strong impulses and feelings; and identify their personal purpose.
Pedagogy	Interactive, Discussion Based Sessions, Presentations, Seminars
Internal Evaluation Mode	Sessional Test: 20 Quiz: 5 Assignments: 5 Attendance: 5 Presentations: 5

Unit	**Topic**	**No. of Lectures Total = 60**
I	**Introduction to Bio-entrepreneurship:** Introduction and scope in Bio-entrepreneurship. Types of Bio-industries and competitive dynamics between the sub-industries. Entrepreneur skills, Difference between entrepreneurship and intrapreneurship. The Global Bio business. Entrepreneurship development programs of public and private agencies.	**10**
II	**Business Strategy and Marketing:** Challenges in marketing in bio business & assessment of market demand for potential products. (Market conditions & segments; developing distribution channels, the nature, analysis & management of customer needs). Marketing Strategies: 7P's of marketing.	**10**

III	**Business accounting & Technology Management:** Collaborations and partnerships, Record preparation: bookkeeping and accountancy. Technology: assessment, development & upgradation. Technology Transfer, and dispute resolution skills. Quality control & Crisis Management.	**10**
IV	**Human Resource Development (HRD):** Different Organizational Structures: Leadership and Managerial Skills, teamwork, and team building. HRD in global perspective, HRD interventions, Intellectual Capital (IC) its measurement and management, HRD Ethics.	**15**
V	**R&D Knowledge Centers/ IPR** Role and significance of R&D centers. Knowledge management in R&D. Intellectual Property and Entrepreneurship, Types of IPR and its importance, IPR for startups. IPR in India.	**15**

Suggested Readings

1. Bioentrepreneurship Development: A Resource Book -Ms. Shreya Sanghvi Malik, Deputy Manager Dr. Shiv Kant Shukla, Deputy General Manager [https://www.biotech.co.in/sites/default/files/2020-01/Bioentrepreneurship-Development.pdf]
2. https://birac.nic.in/webcontent/jk.pdf
3. https://www.researchgate.net/publication/352413541_Introduction_to_Bioentrepreneurship
4. http://biotechjournal.in/images/paper_pdffiles/Bio-60fd9e8898187.pdf

UNIT	MAPPED CO
I	CO1
II	CO1, CO2, CO3, CO4, CO5
III	CO3, CO4, CO5
IV	CO2, CO3, CO4, CO5
V	CO3, CO4, CO5

MAPPED CO's WITH PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1							√		√
CO2	√	√	√	√	√		√		√
CO3	√	√	√		√		√		√
CO4	√	√	√	√	√		√		√
CO5	√	√	√	√	√		√		√

Course Created by:

Approved by:

Era University
Department of Biotechnology
Course Outline
Academic Year: 2023-2024

Course Name: Laboratory Course III (Genetic Engineering + Plant & Animal Biotechnology + Environmental Biotechnology)	**Course Code:** *MBT0306P*	**Year:** II	**Semester:** III
Core Course			
Credits: 3	**Total No. of Lectures: NIL**	**Lecture-Tutorial-Practical (In hours/week) L-T-P:** 0-0-6	
Evaluation Spread	**Internal Continuous** 40	**End Term Exam**	60
Course Objective	The objective of this laboratory course is to introduce students to experiments in Animal Biotechnology, and Environmental Biotechnology. The course is designed to teach students the utility of set of experimental methods in biotechnology.		
Course Outcome	CO1: Student should be able to understand fundamental aspects of basic tools and techniques in Genetic Engineering, Plant & Animal Biotechnology and Environmental Biotechnology. CO2: Students will gain the ability to apply these practical knowledge and experience in different industries. CO3: Students will gain knowledge about fundamental and applied research in the field of biology		
Pedagogy	Interactive, Discussion Based Sessions, Practical's		
Internal Evaluation Mode	Sessional Test: 20 Viva: 10 Attendance: 5 Lab Record: 5		

Topic

GENETIC ENGINEERING ***(30HRS)***

1. Blue White Screening
2. Restriction Mapping
3. Yeast Transformation
4. Plasmid Isolation
5. Restriction Digestion
6. Ligation of DNA and analysis by electrophoresis

PLANT & ANIMAL BIOTECHNOLOGY: ***(30HRS)***

1. Preparation of phosphate-buffered saline (PBS) solution at pH= 7.4
2. Preparation of animal cell culture media and filter sterilization
3. Subculture and maintenance of mammalian cell lines (adherent cells)
4. Freezing and thawing of mammalian cell line
5. Measurement of live and dead cells density by trypan blue dye exclusion assay
6. Evaluation of cell viability by MTT dye assay
7. Cell lysis from cultured animal cells and protein extract preparation
8. Determination of protein concentration by Bradford method
9. Analysis of Protein Extraction in SDS-PAGE and determination of molecular weight of unknown protein
10. Rat/Mice handling and restraining technique
11. Routes of drug administration and injection technique

ENVIRONMENTAL BIOTECHNOLOGY: ***(30HRS)***

1. Determination of B.O.D and C.O.D.
2. Alcoholic fermentation.
3. Determination of coliforms in water.
4. Determination of residual chlorine
5. Determination of available chlorine in bleaching powder
6. Estimation of sulphates
7. Determination of fluorides
8. Determination of ammonical nitrogen

MAPPED CO's WITH PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	√	√	√			√	√	√	
CO2	√	√	√			√	√	√	
CO3	√	√	√			√	√	√	

Course Created by:

Approved by:

Era University
Department of Biotechnology
Course Outline
Academic Year: 2024-2025

Course Name: Educational Visit (1) + Seminars (2)	**Course Code:** *MBT0307R*	**Year:** II	**Semester:** III
Core Course			
Credits: 3	**Total No. of Lectures -Tutorial-Practical (In hours/week) L-T-P:** 2-0-2		
Evaluation Spread	**Internal Continuous** 100	**End Term Exam**	0
Course Objective	The main objective of this course is to provide the students an exposure to various research activities and acquaint the student with state-of-the-art technique/instruments used in various research institutions and industries of national repute. The student needs to submit a report after completion of the tour.		
Course Outcome	CO1: Develop understanding of techniques/instruments used in various reputed institutes/industries. CO2: Enhance communication and social skills by communication with peers.		
Pedagogy	Interactive, Discussion Based Sessions, Presentation		
Internal Evaluation Mode	Content: 40 Subject Knowledge: 20 Presentation: 20 Discussion: 20		

MAPPED CO's WITH PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	√	√	√	√	√	√	√	√	√
CO2	√	√	√	√	√	√	√	√	√
CO3	√	√	√	√	√	√	√	√	√
CO4	√	√	√	√	√	√	√	√	√

Course Created by:

Approved by: