University of Engineering and Management

Institute of Engineering & Management, Salt Lake Campus

Institute of Engineering & Management, New Town Campus

University of Engineering & Management, Jaipur

4th Semester Syllabus for B.Tech Admission Batch 2023

Index:

Syllabus Structure:

Sl. No.	Type	Subject Code	Subject Name	L	T	P	Total	Credit
1	CC	PCCBT401	Bioprocess Engineering	2	1	0	3	3
2	CC	PCCBT402	Green Biotechnology and Pollution Abetment	2	0	0	2	2
3	CC	PCCBT403	Immunology & Immuno- technology	2	0	0	2	2
4	CC	PCCBT404	Structural Biology	2	1	0	3	3
5	CC	PCCBT405	rDNA Technology	2	1	0	3	3
6	CC	PCCBT406	Bioinformatics & Computational Biology	2	1	0	3	3
7	HS	HSMC401	Engineering Economics	2	0	0	2	2
8	AU	AUBT401	Environmental Science	1	0	0	1	0
9	GSC	ESP401	Essential Studies for Professionals – IV	2	0	0	2	0.5
10	CC	PCCBT491	Bioprocess Engineering Lab	0	0	2	2	1
11	CC	PCCBT 493	Immunology & Immuno- technology Lab	0	0	4	4	2
12	CC	PCCBT495	rDNA Technology Lab	0	0	4	4	2
13	CC	PCCBT 496	Bioinformatics & Computational Biology Lab	0	0	4	4	2
14	GSC	SDP481	Skill Development for Professionals – IV	0	0	0	0	0.5
15	PS	PSBT481	Comprehensive viva voice	0	0	0	0	1
16	IFC	IFC	Industry and Foreign Certification	0	0	0	0	0
17	Mandatory course	MAR481	Mandatory Additional Requirements	0	0	0	0	0
							Total Credit points	27

Syllabus for B.Tech Admission Batch 2023

Subject Name: **Bioprocess Engineering** **Credit: 3** **Lecture Hours: 36**

Subject Code: PCCBT401

Pre-requisite: Basic concepts of biochemistry, molecular biology, microbiology, biology and mathematics

Relevant Links:

Study Material Coursera NPTEL MITopencourseware

COURSE OBJECTIVES:

1. To acquire learning on optimization of various parameters for the production of desired products.
2. To understand various quantitative and qualitative assessment of various conditions and product formation

COURSE OUTCOMES:

CO1	The students would be able to learn engineering principles that can be applied to processes involving cell or enzyme catalysts with applications in the industry
CO2	The students will learn the basics of bioreactor design and operation control that have been applied to a variety of bioprocess industries and also conduct related experiments for better understanding
CO3	To be able to understand various optimization conditions required for the development of products
CO4	To have a detailed understanding of the mechanism of metabolic pathways for the development of product.
CO5	To students would be able to understand the concept of upscaling of the products
CO6	The students would be able perform qualitative and quantitative assessment of the product

Subject Code: PCCBT401

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	**Microbial Growth Kinetics**	Media formulation and optimization; Kinetics of microbial growth, substrate utilization and product formation; Sterilization of air and media; Batch, fed-batch and continuous processes; Microbial Culture systems; Media for Industria fermentations; Media Optimization; Sterilization of Industrial Media; The development of Inocula for Industrial fermentations; Starter Cultures; Downstream Processing and fermentation economics. Oxygen uptake rate in mass transfer correlation, experimental determination of KLa values, factors affecting KLa value,	**International standard** Bioseparations science and engineering in SearchWorks catalog (stanford.edu) Bioprocess engineering : basic concepts in SearchWorks catalog (stanford.edu) ***AICTE prescribed syllabus*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***IndustryMapping:*** Importance of Enzyme Immobilization (agscientific.com) Principals of various protein precipitation methods - BQC - Bioquochem	**5**	1. Lactic Acid Fermentation.

		scale- up principles and its difficulties, scale down			
2	**Commercial Strain Development & Microbial Processes**	Cellular control regulating production of microbial metabolites – Primary and Secondary metabolite – Induced mutation technique – Analogue resistant mutant – Catabolic derepressed mutants – Genetically engineered strain – Protoplast fusion technique. Basic idea on fermentation process, submerged, stationary, solid and semi-solid – with their merits and demerits, Outlines of all microbial processes like productions of organic acids, solvent, antibiotic, polysaccharide, enzymes, vitamins, lipids, pigments, aroma, Classical process may be discussed in details: Wine and spirits; Acetone butanol; Penicillin/Tetracycline/Strepto mycin fermentation; Alkaline protease/lipase/amylase; Citric acid; Dextran, xanthan gum.	**International standard** Bioseparations science and engineering in SearchWorks catalog (stanford.edu) Bioprocess engineering : basic concepts in SearchWorks catalog (stanford.edu) ***AICTE prescribed syllabus*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***Industry Mapping:*** Importance of Enzyme Immobilization (agscientific.com) Applications of Chromatography - Chrom Tech, Inc. List of Solvent extraction /Sectors with Industry Classification (finology.in) Green Dot Bioplastics - A Bioplastic Material Science Company	**5**	1. Ethanol Fermentation efficacy by varying substrate
3	**Unconventional bioreactors & Recombinant cell culture processes**:	Hollow fiber reactor, membrane reactor, perfusion reactor for animal and plant cell culture. Advanced Concepts: Scale up concepts, Growth and product formation by recombinant cells. Guidelines for choosing host-vector systems, plasmid stability and instability model, limits to over expression, Bioreactor configurations for Secondary metabolites from plant and animal cell cultures.	**International standard** Bioseparations science and engineering in SearchWorks catalog (stanford.edu) Bioprocess engineering : basic concepts in SearchWorks catalog (stanford.edu) ***AICTE prescribed syllabus*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***Industry Mapping:*** PharSol - F0-BABY	**10**	1. Production of L-Asparaginase by varying substrate 2. Production of L-Glutaminase by varying temperature

			Types of Industrial Filtration and Their Benefits | Interfil		
4	**Application of Bioprocess Technology**	Biofuels, Bioplastics, industrial enzymes, antibiotics; Large scale production and purification of recombinant proteins; Industrial application of chromatographic and membrane based bioseparation methods; Immobilization of biocatalysts (enzymes and cells) for bioconversion processes; Bioremediation-Aerobic and anaerobic processes for stabilization of solid / liquid wastes	***International Standards:*** Bioseparations science and engineering in SearchWorks catalog (stanford.edu) Bioprocess engineering : basic concepts in SearchWorks catalog (stanford.edu) ***AICTE prescribed syllabus*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***IndustryMapping:*** Importance of Enzyme Immobilization (agscientific.com) Kemin Bio Solutions | Enzyme & Antioxidant Solutions | Kemin USA BIOplastics Home Green Dot Bioplastics - A Bioplastic Material Science Company	**4**	1. Biosurfactant production

Text Book
Bioprocess Engineering by Shuler and Kargi

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Institute of Engineering & Management, New Town
Biotechnology Department
Syllabus for B.Tech Admission Batch 2023

Course Name: Green Biotechnology and Pollution Abetment **Credit: 2** **Lecture Hours: 24**

Course Code: PCCBT402 **Semester IV**

Study material link.

https://docs.google.com/document/d/1Nx1CARaGSM7b1T7qkJaV67C1dJ2laMbE/edit?usp=drive_link&ouid=117367197800556919374&rtpof=true&sd=true

Coursera link.

Renewable energy
https://www.coursera.org/specializations/renewable-energy
Municipal solid waste management in developing countries
https://www.coursera.org/learn/solid-waste-management?skipBrowseRedirect=true
Algal Biotechnology
https://www.coursera.org/learn/algae-biotechnology
Sustainable Agricultural land management
https://www.coursera.org/learn/sustainable-agriculture

Module number	Topic	Sub-topics	Mapping with Industryand International Academia	Lecture Hours

1	Biological Waste Treatment	Biological wastewater treatment: Principles and design aspects of various waste treatment methods with advanced bioreactor configuration: Solid waste management: landfills, recycling and processing of organic residues, minimal national standards for waste disposal	***International Academia:*** **https://ocw.mit.edu/courses/1-85-water-and-wastewater-treatment-engineering-spring-2006/** AICTE – prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model%20Curriculum%20for%20UG%20Degree%20Course%20in%20Biotechnology.pdf **Industrial Mapping** This concept is important for Wastewater treatment plants, Any manufacturing industries to convert its waste to resource by indigenous method.	4
2	Biodegradation of Xenobiotic Compounds	Xenobiotic compounds–Definition, examples and sources. Biodegradation- Introduction, effect of chemical structure on biodegradation, recalcitrance, co metabolism and biotransformation. Factors affecting biodegradation, microbial degradation of hydrocarbons	**International Standards** https://ocw.mit.edu/courses/20-104j-chemicals-in-the-environment-toxicology-and-public-health-be-104j-spring-2005/	4

			AICTE – prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model%20Curriculum%20for%20UG%20Degree%20Course%20in%20Biotechnology.pdf ***Industry Mapping:*** Many research institutes are working on this	
3	Biotransformations and Biocatalysts	Basic organic reaction mechanism- Common prejudices against enzymes, advantages & disadvantages of biocatalysts, isolated enzymes versus whole cell systems, biocatalytic application, catalytic antibodies; stoichiometry	***International Standards***: **https://ocw.mit.edu/courses/10-492-2-integrated-chemical-engineering-topics-i-introduction-to-biocatalysis-fall-2004/** AICTE – prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model%20Curriculum%20for%20UG%20Degree%20Course%20in%20Biotechnology.pdf ***Industry Mapping:*** This concept is an important component of chemical industry and textile industry	4

4	Bioremediation and Biorestoration	Introduction and types of bioremediation, bioremediation of surface soil and sludge, bioremediation of subsurface material, In situ and Ex-situ technologies, phytoremediation- restoration of coal mines a case study. biorestoration: reforestation through micropropagation, use of mycorrhizaein reforestation, use of microbes for improving soil fertility, reforestation ofsoils contaminated with heavy metals.	***International Standards:*** (https://web.stanford.edu/class/archive/ee/ee108a/ee108a.1082/schedule.html) **https://ocw.mit.edu/courses/1-34-waste-containment-and-remediation-technology-spring-2004/** AICTE – prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model%20Curriculum%20for%20UG%20Degree%20Course%20in%20Biotechnology.pdf ***Industry Mapping:*** This is of high priority in Agricultural research, in many other Research institutes working on environment friendly products	4
5	Eco-Friendly Bioproducts from Renewable Sources	Fundamentals of composting process: scientific aspects and prospects of biofuel production: bioethanol, biohydrogen and biodiesel; biofertilizers and biopesticides.	AICTE – prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model%20Curriculum%20for%20UG%20Degree%20Course%20in%20Biotechnology.pdf ***International standard:*** https://ocw.mit.edu/courses/22-033-nuclear-systems-design-project-fall-2011/resources/lecture-3-hydrogen-and-biofuel-production-design-process/	4

			https://ocw.mit.edu/courses/ec-701j-d-lab-i-development-fall-2009/resources/mitec_701jf09_lec12/ **Industry Mapping**: Many industries like Reliance are into generating biofertilizers and biopesticides All mainstream petroleum companies are generating alternative fuel	
6	Biotechnology in Environment Protection	Current status of biotechnology in environment protection and its future, release of genetically engineered organisms in the environment.	***International standard:*** https://ocw.mit.edu/courses/1-74-land-water-food-and-climate-fall-2020/pages/reconciling-demand-and-supply-i/adoption-of-genetically-engineered-crops-in-the-usa/ https://ocw.mit.edu/courses/24-03-good-food-ethics-and-politics-of-food-spring-2017/94047b7ea208b16cf7e0cd76357ec181_MIT24_03S17_lec24.pdf AICTE – prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model%20Curriculum%20for%20UG%20Degree%20Course%20in%20Biotechnology.pdf ***Industry Mapping:*** **https://www.isaaa.org/gmapprovaldatabase/developerlist/default.asp#:~:text=Agrivida%2C%20Inc.&text=Bioceres%20S.A.&text=Dow%20AgroSciences%20LLC%20and%20DuPont,Hi%2DBred%20International%20Inc.)** Many industries are working and research is going on genetically modified organisms in many research institutes	3

Syllabus for B.Tech Admission Batch 2023

Subject Name: **Immunology & Immuno- technology** **Credit: 2**
Subject Code: **PCCBT403** **Lecture Hours: 24**

Pre- requisite: Cell and molecular biology
Relevant links:
immunology.pdf
https://nptel.ac.in/courses/102105083
https://www.linkedin.com/learning/the-data-science-of-healthcare-medicine-and-public-health?trk=learning-serp_learning-search-card_search-card&upsellOrderOrigin=default_guest_learning
https://www.coursera.org/specializations/immunology
Course objective:

1. To understand the basics of immune system
2. To understand the various immune disorders

Course Outcomes

CO1	define the basic components of our immune system
CO2	describe the structure of antibody molecule
CO3	illustrate the concepts of various immunological processes that give protection to human body
CO4	analyse the basic mechanism of antigen reaction
CO5	evaluate the detailed understanding of cytokines

CO6	To design the mechanisms of immune-regulation and various immunological disorders

Module Number	Topic	Sub Topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	Introduction to Immunology	The origin of Immunology: History and evolution of immune system; Innate immunity; Acquired immunity; Humoral and cell-mediated immunity; Passive transfer of immunity; Primary and secondary lymphoid organs; Structure and function of Antigen; Concept of Epitope, B cell and T cell: Biogenesis or Maturation; Macrophage and other Antigen Presenting Cells (APCs)	International academia: https://ocw.mit.edu/courses/hst-176-cellular-and-molecular-immunology-fall-2005/ AICTE – prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model%20Curriculum%20for%20UG%20Degree%20Course%20in%20Biotechnology.pdf Industry mapping: https://chemometec.com/industry/immunology/	6	1. Understanding the humoral and cell based immune system through preparation and observation of blood smear 2. Study of total count of white blood cells 3. Study of differential count of white blood cells
2	Molecular basis of Immunology	Structure and function of Antibody; Concept of Isotype, Allotype and Idiotype; Molecular basis of antibody diversity: DNA rearrangements; variations arising out of V,D,J joining; somatic	International academia: https://ocw.mit.edu/courses/hst-176-cellular-and-molecular-immunology-fall-2005/ AICTE – prescribed syllabus:	6	1. Understanding antigen antibody interaction through single radial immunodiffusion assay 2. Understanding antigen antibody interaction through double radial immunodiffusion assay 3. Understanding antigen antibody interaction through rocket immunoelectrophoresis assay 4. Understanding antigen antibody interaction through Sandwich ELISA assay

		hypermutation; Class switching; Primary and secondary immune response; Polyclonal and monoclonal antibody; Complement; Antigenantibody reaction, Basic concepts of Immunodiffusion, RIA and ELISA	https://www.aicte-india.org/sites/default/files/Model%20Curriculum%20for%20UG%20Degree%20Course%20in%20Biotechnology.pdf Industry mapping: https://www.sigmaaldrich.com/IN/en/products/protein-biology/immunoassay-platform-solutions/elisa-kits Preparation of diagnostic kits		
3	Major Histocompatibility Complex	Antigen processing and presentation; synthesis of antibody and secretion; HLA; laws of graft rejection; graft versus host reaction; Development of Inbred mouse strain; Blood group classification and Rh factor, Cytokines and other co-stimulatory molecules	International academia: https://ocw.mit.edu/courses/hst-176-cellular-and-molecular-immunology-fall-2005/ AICTE – prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model%20Curriculum%20for%20UG%20Degree%20Course%20in%20Biotechnology.pdf Industry mapping: https://www.biolabdiagnostics.net/blood-group-test-kit.html Blood grouping tests; Organ donation	6	1. Understanding blood group classification and Rh factor through analysis of blood group
4	Immune response and tolerance	Regulation of immune response; Immune tolerance; T cell anergy and T cell elimination; Hypersensitivity;	International academia: https://ocw.mit.edu/courses/hst-176-cellular-and-molecular-immunology-fall-2005/	6	1. Understanding immune response by conducting Widal Test 2. Understanding the spectrum of antibodies raised due to antigen action during immune response through Western Blotting

		Autoimmunity with respect to Myasthenia gravis and Rheumatoid arthritis; AIDS and immunodeficiency; Tumour immunology; vaccines	AICTE – prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model%20Curriculum%20for%20UG%20Degree%20Course%20in%20Biotechnology.pdf Industry mapping: https://microsidd.com/products/4th-generation-hiv-test-kit		

Text books:

1. Kuby Immunology by Jenni Punt, Sharon Stranford, Patricia Jones, Judith A. Owen, WH Freeman Publication (Chapters 1, 2, 3, 4, 5, 6, 7, 8, 12, 16, 19, 20, 21)

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Subject Name: **Structural Biology** **Credit: 3** **Lecture Hours: 36**

Subject Code: PCCBT404

Pre-requisite: Basic concepts of biochemistry, molecular biology, microbiology, biology and mathematics

Relevant Links:

Study Material NPTEL MITopencourseware

COURSE OBJECTIVES:

1. To acquire learning on structure and functionality of various types of biomolecules
2. To understand various techniques and instrumentations those can be used to analyse the biomolecules

COURSE OUTCOMES:

CO1	Students will gain an understanding of the basic science of protein and Nucleic Acid (DNA and RNA) structure, including first principles of physical interactions that maintain proteins and the mechanisms that make them intact.
CO2	The students will also learn about the different techniques and experimental approaches that represent the state-of-the-art and are widely used in the study of proteins.
CO3	The students will be able deal with different applications of protein structure.
CO4	The students will be offered a learning environment that should make the understanding of protein structure and its dynamics interesting, reachable and relevant to their future careers
CO5	The students will be able to perform isolation and identification of metabolites from various sources.
CO6	The students will have solid foundation of understanding structural biology that will facilitate application to current and future research problems

Subject Code: PCCBT404

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	**Protein structural biology**	Principles of soluble and membrane protein purification, Phase diagram and separation, crystallization, Use of robotics in crystallization, Space groups and symmetry, structure determination; NMR sample preparation, Sample preparation for Cryo EM, Structure validation and best practices on the use of protein structures from protein data bank; Protein fold-function relationships, Protein Data Bank (PDB) and EM Data Bank, BioMagResBank (BMRB).	**International standard** https://web.stanford.edu/class/cs279/lectures/lecture1.pdf https://ocw.mit.edu/courses/20-442-molecular-structure-of-biological-materials-be-442-fall-2005/pages/lecture-notes/ ***AICTE prescribed syllabus*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***IndustryMapping:*** https://www.jbei.org/research/technology/structural-biology/	**5**	1. Detection of crystalline structure of proteins through online servers 2. Finding of Protein Primary and Secondary Structure

2	**Protein structure and analysis**	Principles of soluble and membrane protein purification, Phase diagram and separation, crystallization, Use of robotics in crystallization, Space groups and symmetry, structure determination; NMR sample preparation, Sample preparation for Cryo EM, Structure validation and best practices on the use of protein structures from protein data bank; Protein fold-function relationships, Protein Data Bank (PDB) and EM Data Bank, BioMagResBank (BMRB).	**International standard** https://ocw.mit.edu/courses/20-442-molecular-structure-of-biological-materials-be-442-fall-2005/pages/lecture-notes/ https://web.stanford.edu/class/cs279/lectures/lecture2.pdf ***AICTE prescribed syllabus*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***Industry Mapping:*** https://www.jbei.org/research/technology/structural-biology/	**5**	1. Determination of protein quaternary structure using online server
3	**Methods for atomic-resolution structure determination**	X-ray crystallography, solution- and solid-state NMR spectroscopy, Single particle Cryo Electron Microscopy, X- Ray Free-Electron Laser (XFEL). Anisotropy? Use of Circular Dichroism, Steady-state and time-resolved fluorescence spectroscopy, FRET, Single molecule fluorescence, Electron Paramagnetic Resonance spectroscopy.	**International standard** https://ocw.mit.edu/courses/20-442-molecular-structure-of-biological-materials-be-442-fall-2005/pages/lecture-notes/ https://web.stanford.edu/class/cs279/lectures/lecture2.pdf ***AICTE prescribed syllabus*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***Industry Mapping:*** OmicsLogic Learn - Our Courses How Can Synthetic Biology Be Applied to Plants? - Hudson Robotics, Inc.	**8**	1. Image analysis of various samples of bacteria using X-Ray Crystallography, FT-IR
4	**DNA and RNA structures**	DNA and RNA secondary structures (duplex, triplex, quadruplexes and aptamers), RNA secondary structure prediction.	***International Standards:*** https://ocw.mit.edu/courses/7-01sc-fundamentals-of-biology-fall-2011/pages/molecular-biology/dna-structure-classic-experiments/	**4**	1. Prediction of nucleotide sequence and gene expression of various

			AICTE prescribed syllabus ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***IndustryMapping:*** OmicsLogic Learn - Our Courses iGEM Technology How Can Synthetic Biology Be Applied to Plants? - Hudson Robotics, Inc.		organisms using online servers
5	**Structure of Sugars and lipids**	Saturated and Unsaturated Fatyy acids Structure of various types of carbohydrates, Reactions	***International Standards:*** https://ocw.mit.edu/courses/7-01sc-fundamentals-of-biology-fall-2011/pages/biochemistry/macromolecules-lipids-carbohydrates-nucleic-acid/ ***AICTE prescribed syllabus*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***Industry Mapping:*** How Can Synthetic Biology Be Applied to Plants? - Hudson Robotics, Inc.	**2**	No laboratory based experiments

Text Books/References:

1. Principles of Biochemistry, Lehninger, 4t Edition

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Subject Name:	**rDNA Technology**	**Credit: 2**	
Subject Code:	**PCCBT405**	**Lecture Hours: 24**	

Prerequisite: Knowledge of genetics, molecular biology and biochemistry

Relevant Links:
Study material- rDNA technology.pdf
https://www.coursera.org/learn/dna-decoded

https://archive.nptel.ac.in/courses/102/103/102103013/

https://www.linkedin.com/products/biotech-primer-inc.-genetic-engineering-primer/

Course Objective

1. The course acquaints the students with concepts of Recombinant DNA technology and is so designed as to make students aware about the materials and methods being used in the transfer of DNA and its expression in the target organisms.
2. Also students will learn about the vast scope of the subject and will acquaint with applications of Recombinant technology

Course Outcomes

On completion of this course, the students will be able to:

CO1. Understand the concept of restriction enzyme and cloning vectors

CO2. Understand the concept of different techniques of rDNA technology- various labeling techniques, blotting techniques

CO3. Understand different techniques of DNA, RNA, protein sequencing, DNA fingerprinting

CO4. Understand the various methods of gene cloning, different types of PCR

CO5. Understand various mechanisms of gene transfer technologies, concept of biosafety

CO6. Students will have the foundational and applied knowledge of the fields of molecular genetics and molecular biology and will understand the role of recombinant DNA technology in field of applied biotechnology.

Module Number	Topic	Sub Topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	Tools of Recombinant DNA technology	●**Restriction & modification enzymes** (Restriction enzymes, DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase)	***International academia***: https://ocw.mit.edu/courses/7-01sc-fundamentals-of-biology-fall-2011/pages/recombinant-dna/development-of-recombinant-dna/ https://online.stanford.edu/courses/chemeng355-advanced-biochemical-engineering https://ocw.mit.edu/courses/7-012-introduction-to-biology-fall-2004/resources/lecture-15-recombinant-dna-1/ ***AICTE prescribed syllabus:*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***Industry mapping*** : The most popular application of restriction endonucleases is as a tool for genetic engineering. The endonuclease activity enables manipulation of the genome as well as introduction of sequences of interest in the host organism. https://www.promega.in/resources/guides/nucleic-acid-	8	Isolation of Plasmid DNA from *E.coli* XL1Blue (pUC18) and its agarose gel Electrophoresis Restriction Mapping of Plasmid DNA pBR322 Extraction of DNA fragments from agarose gels Ligation between insert DNA and vector DNA

			analysis/restriction-enzyme-resource/ ***International academia***: https://ocw.mit.edu/courses/7-016-introductory-biology-fall-2018/resources/lecture-16-recombinant-dna-and-cloning/ https://ocw.mit.edu/courses/7-01sc-fundamentals-of-biology-fall-2011/pages/recombinant-dna/basic-mechanics-of-cloning/ ***AICTE prescribed syllabus:*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***Industry mapping*** : Proteins, vaccines, and antibiotics are all produced by the process of cloning. This can include DNA copies, cells, organs, or even the complete animal aid using cloning. In agriculture, cloning is employed to create pest-resistant plants. Cloning is also utilized to create transgenic animals and for gene therapy. https://intactgenomics.com/product/quick10-cloning-kit		
		● **Cloning Vectors:** plasmid, M13 vectors, cosmids, Phagemids,YAC,			

		BAC and MAC; Expression vectors**:** pET vectors, Baculovirus vectors.			
2	Techniques used in Recombinant DNA technology	●DNA labelling (radioactive and non-radioactive method)	***International academia***: https://ocw.mit.edu/courses/7-01sc-fundamentals-of-biology-fall-2011/pages/molecular-biology/dna-replication/ ***AICTE prescribed syllabus:*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***Industry mapping***: The labeled DNA probes have a myriad of applications in lab procedures, such as DNA sequencing, microarray analysis, in situ hybridization, southern blotting, and northern blotting. https://www.ogt.com/ca/resources/array-resources-support/array-scientific-literature/evaluation-of-dna-labelling-kits-for-enhanced-microarray-results/ ***International academia***: https://ocw.mit.edu/courses/7-016-introductory-biology-fall-2018/resources/lecture-17-genomes-and-dna-sequencing/ https://ocw.mit.edu/courses/7-01sc-fundamentals-of-biology-fall-2011/resources/agarose-gel-electrophoresis-dna-sequencing-pcr-excerpt-1/ ***AICTE prescribed syllabus:*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/***	8	Southern Blotting Hybridization for Identification of target DNA from mixture of DNA by using Biotin labelled probe DNA

		● DNA sequencing (Maxum & Gilbert, Sangers, pyro-sequencing, shotgun sequencing method)	***Industry mapping***: Sequencing is utilized to determine the order of nucleotides in small targeted genomic regions or entire genomes. Sequencing enables a wide variety of applications, allowing researchers to ask virtually any question related to the genome, transcriptome, or epigenome of any organism. https://www.sigmaaldrich.com/IN/en/technical-documents/protocol/genomics/sequencing/sanger-sequencing https://sapac.illumina.com/science/technology/next-generation-sequencing/beginners.html ***International academia***: https://ocw.mit.edu/courses/20-109-laboratory-fundamentals-in-biological-engineering-fall-2007/pages/labs/mod1_7/ https://ocw.mit.edu/courses/7-91j-foundations-of-computational-and-systems-biology-spring-2014/resources/lecture-13-predicting-protein-structure/ https://ocw.mit.edu/courses/20-109-laboratory-fundamentals-in-biological-engineering-spring-2010/pages/labs/module-2-day-2-site-directed-mutagenesis/ https://ocw.mit.edu/courses/7-016-introductory-biology-fall-2018/resources/lecture-16-recombinant-dna-and-cloning/		

		● Protein sequencing; RNA sequencing; Southern and northern and western blotting;	***AICTE prescribed syllabus:*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***Industry mapping***: Invaluable tool to modify genes and study the structural and functional properties of a protein https://www.sigmaaldrich.com/IN/en/technical-documents/protocol/protein-biology/western-blotting/western-blotting-sample-preparation?gclid=Cj0KCQiA35urBhDCARIsAOU7QwkI3BSpf7G2H9GVMuDQZLyT2i2ZATAQGG4OABdbSJq-y8Chm0zfi6gaAudgEALw_wcB		

		In-situ hybridization; Site-directed mutagenesis; DNA fingerprinting (RAPD; RFLP, AFLP).			
3	Gene Cloning Methods	● Isolation of DNA, mRNA and total RNA; Polymerase chain reactions (PCR) and modified PCR. Genomic and cDNA libraryies; Gene isolation; Gene cloning; screening & Expression of cloned gene	***International academia***: https://ocw.mit.edu/courses/7-01sc-fundamentals-of-biology-fall-2011/resources/polymerase-chain-reaction-pcr/ https://ocw.mit.edu/courses/7-01sc-fundamentals-of-biology-fall-2011/pages/recombinant-dna/agarose-gel-electrophoresis-dna-sequencing-pcr/ https://ocw.mit.edu/courses/7-01sc-fundamentals-of-biology-fall-2011/resources/cdna-libraries-and-expression-libraries/ https://ocw.mit.edu/courses/7-012-introduction-to-biology-fall-2004/resources/lecture-13-gene-regulation/ ***AICTE prescribed syllabus:*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***Industry Mapping***: It can generate several copies of a DNA sequence in a very short time period. It is also important in forensic science as a tool for genetic engineering. It helps in analyzing the gene expression https://www.takarabio.com/products/mrna-and-cdna-synthesis/cdna-synthesis-kits/library-construction-kits	8	Isolation of plasmid DNA Isolation of genomic DNA Isolation of RNA Designing of forward and reverse primers Amplification of DNA by standard Polymerase Chain Reaction (PCR) and analysis by Agarose Gel Electrophoresis

		● Transposons and gene targeting;	***International academia***: https://ocw.mit.edu/courses/7-03-genetics-fall-2004/fa17fc58c50767e1bbea53da44cdb662_lecture12.pdf ***AICTE prescribed syllabus:*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***Industry Mapping***: Transposons can be used in genetic research and recombinant genetic engineering for insertional mutagenesis https://www.sigmaaldrich.com/IN/en/product/sigma/na2110?gclid=Cj0KCQiA35urBhDCARIsAOU7QwnGwJ_ZgAAHQOjw7An7JLETB4Vl6DihqxPCligkrUKcQSuMLLkGb7saAsxrEALw_wcB		
4	Application	● Gene transfer technologies,	***International academia***:	8	*In Silico* Designing And Docking Analysis On

	of rDNA technology	production of insulin, human growth factor; gene therapy (antisense and ribozyme technology)	https://live.ocw.mit.edu/courses/7-014-introductory-biology-spring-2005/resources/mediaresource-2010-10-26/ https://ocw.mit.edu/courses/20-109-laboratory-fundamentals-in-biological-engineering-fall-2007/pages/labs/sirna_design/ ***AICTE prescribed syllabus:*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***Industry mapping***: It is used to improve the production of proteins by cleaving RNA at specific sites. Antiviral therapy https://sg.idtdna.com/pages/products/functional-genomics/antisense-oligos ***International academia***: https://ocw.mit.edu/courses/20-109-laboratory-fundamentals-in-biological-engineering-fall-2007/pages/labs/mod2_5/ ***AICTE prescribed syllabus:*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***Industry Mapping***: Microarray helps in the identification of new genes, as well as in studying their function and expressions in different conditions. It includes the determination of the genetic sequence of all types of organisms such as human beings, mice, as well as microbes		Insulin-Like Growth Factor 1 Receptor

		● Large scale Gene expression analysis (Microarray for DNA and protein). Biosafety.	https://www.fullmoonbio.com/products/antibody-array/?gad_source=1&gclid=Cj0KCQiA35urBhDCARIsAOU7QwlbinI12miC2qhXIUjBKCWJnYJLuzbOqP7HS4acHaqQqouHt4jBk5EaAsr9EALw_wcB		

Text Books:
Molecular Cloning- Sambrook Russel, Chapter no- 1-8, 10-14, 17-19

University of Engineering and Management
Institute of Engineering & Management, Salt Lake Campus
Institute of Engineering & Management, New Town Campus
University of Engineering & Management, Jaipur

Syllabus for B.Tech Admission Batch 2023

Subject Name: **Bioinformatics & Computational Biology** **Credit: 3** **Lecture Hours: 36**

Subject Code: PCCBT406

Pre-requisite: Basic concepts of biochemistry, molecular biology, microbiology, biology and mathematics

Relevant Links:

Study material Coursera NPTEL

COURSE OBJECTIVES:

1. To understand the principles of analyzing biological data, building models and testing hypotheses using computer science algorithms.

2. To survey of algorithms and tools in biological sequence analysis, genome-wide disease association, and precision medicine

COURSE OUTCOMES:

CO1	The students would be able to understand the principles of analyzing biological data, building models and testing hypotheses using computer science algorithms
CO2	The students will learn surveying of algorithms and tools in biological sequence analysis, genome-wide disease association, and precision medicine
CO3	The students will be able to understand information technology practices in the field of biotechnology

CO4	The students will acquire information on various repositories widely used in biological sciences; and tools for searching or querying those databases.
CO5	The students would be able to design drugs and analyse its drug like properties
CO6	To students students can browse or retrieve gene, protein sequences and related information from biological databases; learn to align sequences using dot matrices, dynamic programming and heuristic approach; understand the notion of similarity, identity and gaps in the context of sequence alignment and deduce evolutionary relationships among sequences; analyze microarray and RNA-seq gene expression data

Subject Code: PCCBT406

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	General Introduction to Bioinformatics and Computational Biology	Biological databases and tools: Nucleotide sequence databases, Protein sequence, structural and functional databases, Patent database, in silico tools for rDNA technology. Database searching: BLAST and its types, Entrez, Ensembl-Biomart.	**International standard** https://ocw.mit.edu/courses/6-092-bioinformatics-and-proteomics-january-iap-2005/pages/lecture-notes/ https://ocw.mit.edu/ans7870/6/6.047/f15/MIT6_047F15_Compiled.pdf ***AICTE prescribed syllabus*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***IndustryMapping:*** https://nthrys.com/bioinformatics-training.html	**5**	3. Understanding the various types of Databases 4. Finding the functionalities of Primary and Secondary Databses
2	**Sequence Alignment**	Pairwise Sequence alignment: Pairwise alignment, Dynamic\ programing, Scoring Matrices, Gaps. Multiple sequence alignment:	**International standard** \ https://ocw.mit.edu/courses/7-91j-foundations-of-computational-and-systems-biology-spring-2014/pages/readings/	**5**	2. Dot Matrix analysis of two sequences 3. Determining Pair-wise

		Dynamic and heuristic methods, Relevance to inferences about evolution, introduction to molecular phylogeny.	https://ocw.mit.edu/courses/6-047-computational-biology-fall-2015/2eddab6441d8092607e1259aafceb280_MIT6_047F15_Lecture02.pdf ***AICTE prescribed syllabus*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***Industry Mapping:*** https://nthrys.com/bioinformatics-training.html		alignment of two sequences 4. Determining Multiple sequence alignment
3	Phylogenetic analysis	Introduction, Types of Phylogenetic Trees, Methods and Applications. Bootstrap. Genome informatics: Genome sequencing technologies and analysis methods; transcription factor regulation and motif finding	**International standard** https://ocw.mit.edu/courses/6-047-computational-biology-fall-2015/07bfcb2cbf5320a271925b8ff7c5646a_MIT6_047F15_Lecture18.pdf ***AICTE prescribed syllabus*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***Industry Mapping:*** https://nthrys.com/bioinformatics-training.html	**8**	Determining phylogenetic relationship among various types of sequences uding cladogram and dendogram
4	**Drug Designing**	Molecular modeling (Homology and Ab initio) and validation (Procheck, verify 3D etc), Docking, Molecular dynamics, Energy calculations, Classical and semi-classical calculations, Quantum mechanical approaches	***International Standards:*** https://ocw.mit.edu/courses/20-320-analysis-of-biomolecular-and-cellular-systems-fall-2012/pages/modeling-and-manipulating-biomolecular-interactions/ ***AICTE prescribed syllabus*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***IndustryMapping:***	**6**	1. Prediction of protein-protein interaction 2. Prediction of protein-ligand interaction

			https://nthrys.com/bioinformatics-training.html		

TEXT BOOK:

1. Essentials of Bioinformatics by Xiong

University of Engineering & Management
Department of Biotechnology

Syllabus for B. Tech (Biotechnology) for Environmental Science

Subject Name: Environmental Science | Credit: 0
Subject Code: AUBT401 | Lecture Hours: 32

COURSE OBJECTIVES:

1. To study about environment and ecosystems.
2. Knowledge and concept of biodiversity and its conservation.
3. Basic knowledge and concept of causes, effect and control of different type of environmental pollution.
4. To study about different waste disposal techniques and environmental management.

COURSE OUTCOMES:

CO 1: Students will gain knowledge about environment and ecosystem.
CO 2: Students will learn about natural resource, biodiversity and importance of its conservation
CO 3: Aware students about problems of environmental pollution, its impact on human and ecosystem and control measures.
CO 4: At the end of the course students will learn about waste disposal measures and environmental management.

CO-PO mapping													
Sl. No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Students will gain knowledge about environment and ecosystem	2	1	2	1	1	3	3	3	3	3	2	3
CO2	Students will learn about natural resource, biodiversity and importance of its conservation	2	1	2	1	1	3	3	3	3	3	2	3
CO3	Students will learn about natural resource, biodiversity and importance of its conservation	2	1	2	1	1	3	3	3	3	3	2	3
CO4	At the end of the course students will learn about waste disposal measures and environmental management.	2	1	2	1	1	3	3	3	3	3	2	3

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
I	**Overview**	Basic ideas of environment, basic concepts, man, society & environment, their interrelationship Mathematics of population growth and associated problems, Importance of population study in environmental engineering, the definition of resource, types of resource, renewable, non-renewable, potentially renewable, effect of excessive use vis-à-vis population growth, Sustainable Development. Materials balance: Steady state conservation system, steady state system with non-conservative pollutants, step function. Importance, scope and principles of EIA.	***International Academia:*** https://online.stanford.edu/courses/xeiet100-clean-renewable-energy-storage-sustainable-future ***AICTE-prescribed syllabus:*** ***https://old.aicte-india.org/downloads/Environmental_Studies_curriculum.pdf*** ***Industry Mapping:*** https://cbs.umn.edu/populus/downloadplant(WWTP) .	4	There are no corresponding labs
II	**Ecology**	Elements of ecology: System, open system, closed system, the definition of ecology, species, population, community, definition of ecosystem-components types and function. (1L) Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundar ban); Food chain [definition and one example of each food chain], Food web.(2L) Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphate, Sulphur]. (1L) Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity.(2L)	***International Academia:*** ***https://ocw.mit.edu/courses/1-020-ecology-ii-engineering-for-sustainability-spring-2008/*** ***AICTE-prescribed syllabus:*** ***https://old.aicte-india.org/downloads/Environmental_Studies_curriculum.pdf*** ***Industry Mapping:*** ***https://vsni.co.uk/solutions/ecology*** ***https://www.helsinki.fi/en/researchgroups/statistical-***	6	There are no corresponding labs

			ecology/software		
III	**Air Pollution**	Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause. (1L) Energy balance: Conductive and Convective heat transfer, radiation heat transfer, simple global temperature model [Earth as a black body, earth as albedo], Problems.(1L) Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Earth's heat budget.(1L) Lapse rate: Ambient lapse rate Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion).(2L) Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes and Gaussian plume model.(2L) Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN. (2L) Smog, Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone	***International Academia:*** https://ocw.mit.edu/courses/1-84j-atmospheric-chemistry-fall-2013/pages/lecture-notes/ ***AICTE-prescribed syllabus:*** ***https://old.aicte-india.org/downloads/Environmental_Studies_curriculum.pdf*** ***Industry Mapping:*** https://www.who.int/europe/tools-and-toolkits/airq---software-tool-for-health-risk-assessment-of-air-pollution	10	There are no corresponding labs

		layer by CFC, impact of other green-house gases, effect of ozone modification. (1L) Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP. cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference). (1L)			
IV	**Water Pollution**	Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds.DO, 5-day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river [deoxygenating, reaeration], COD, Oil, Greases, pH. Lake: Eutrophication [Definition, source and effect]. Waste water standard [BOD, COD], Water Treatment system,primary and secondary treatments, tertiary treatment definition.Water pollution due to the toxic elements. USEPA and WHO guidelines for drinking water.	***International Academia:*** ***https://online.stanford.edu/courses/cee270m-aquatic-and-organic-chemistry-environmental-engineering*** ***AICTE-prescribed syllabus:*** ***https://old.aicte-india.org/downloads/Environmental_Studies_curriculum.pdf*** ***Industry Mapping:*** *Activated Sludge Simulation (ASIM), Sewage Treatment Operation and Analysis Over Time (STOAT), and GPS-X are the common softwares used for waste water treatment plant(WWTP).*	4	There are no corresponding labs
V	**Lithosphere**	Lithosphere; Internal structure of earth, rock and soil (1L). Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes; Recovery and disposal method-	***International Academia:*** ***https://ocw.mit.edu/courses/1-34-waste-containment-and-***	3	There are no corresponding labs

		Open dumping, Land filling, incineration, composting, recycling. Solid waste management and control (hazardous and biomedical waste).(2L)	***remediation-technology-spring-2004/*** ***AICTE-prescribed syllabus:*** ***https://old.aicte-india.org/downloads/Environmental_Studies_curriculum.pdf*** ***Industry Mapping:*** ***https://www.wasteworksonline.com/***		
VI	**Noise pollution**	Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighbourhood noise] (1L) Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, L10 (18hr Index) ,n Ld.Noise pollution control. (1L)	***International Academia:*** ***No link found*** ***AICTE-prescribed syllabus:*** ***https://old.aicte-india.org/downloads/Environmental_Studies_curriculum.pdf*** ***Industry Mapping:*** No software found	3	There are no corresponding labs
VII	**Environmental Management**	Environmental impact assessment, Environmental Audit, Environmental laws and protection act of India, Different international environmental treaty/ agreement/ protocol. (2L)	***International Academia:*** ***https://ocw.mit.edu/courses/11-601-introduction-to-environmental-policy-and-planning-fall-2016/*** ***AICTE-prescribed syllabus:*** ***https://old.aicte-india.org/downloads/Envi***	2	There are no corresponding labs

			ronmental_Studies_curriculum.pdf ***Industry Mapping:*** ***https://www.intelex.com/products/environment/***		