University of Engineering & Management, Kolkata

Syllabus for B.Tech Admission Batch 2022

5th Semester, Department of Biotechnology

Subject Name: Metabolic Engineering

Credit: 2+1 **Lecture Hours: 36**

Subject Code: PCCBT505

Study material: metabolic engineering Study material.docx

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	Introduction	Introduction to metabolic engineering and its importance	**International standard** https://ocw.mit.edu/courses/7-344-cellular-metabolism-and-cancer-nature-or-nurture-fall-2018/ ***AICTE prescribed syllabus*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***IndustryMapping:*** https://nthrys.com/bioinformatics-training.html	**5**	1. Understanding the metabolite estimation

2	**Metabolic Control**	Metabolic pathways, genetic control of metabolic pathways, Michaelis Menten Model, Monod's Model, Metabolic control in eukaryotes and prokaryotes	**International standard** **https://ocw.mit.edu/courses/5-07sc-biological-chemistry-i-fall-2013/** ***AICTE prescribed syllabus*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***Industry Mapping:*** https://nthrys.com/bioinformatics-training.html	**5**	1. Determination of metabolic regulation by KEGG pathway
3	Metabolites	Transport mechanism of various types of metabolites. Thermodynamic and metabolic flux analysis, Instruments in metabolic detection, MATLAB in metabolic engineering	**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:***	**8**	Total Flavonoid estimation

			https://nthrys.com/bioinformatics-training.html		
4	**Applications of Metabolic Engineering**	Application of metabolic engineering in pharmaceuticals, chemical bioprocess, food technology, agriculture, environmental bioremediation and biomass conversion. Case studies of Metabolic engineering: engineering of Saccharomyces crevices for production of secondary metabolites. Enhancement of product yield e.g. ethanol and amino acid; Extension of substrate range e.g. metabolic engineering of pentose metabolism for ethanol production, and lactose and whey utilization; Extension of product spectrum and novel products e.g. antibiotics and biopolymer.	***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:*** https://nthrys.com/bioinformatics-training.html	**6**	1. Antimicrobial efficacy of metabolites

Submitted by Dr. Moupriya Nag (Module1 and Module 2); Dr.Dibyajit Lahiri (Module 3 and Module4)

Subject Name: Analytical Techniques

Credit: 2+1 **Lecture Hours: 36**

Subject Code: PCCBT504

Study Material: ANALYTICAL TECHNIQUES Study material.docx

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	Spectroscopy	Methods for study of biomolecule structure: X-ray diffraction and X-ray crystallography, optical, UV/visible,IR luminescence, fluorescence and circular dichroism spectroscopy, Nuclear magnetic resonance spectroscopy, Raman spectroscopy and electron microscopy (SEM and TEM), Mass Spectroscopy Two dimensional electrophoresis (2-D PAGE): Protein pre-fractionation and sample preparation, IEF, SDS-PAGE, visualization of protein spot. Protein identification by mass spectrometry: ESI-TOF, MALDI-TOF	**International standard** https://ocw.mit.edu/courses/5-80-small-molecule-spectroscopy-and-dynamics-fall-2008/ ***AICTE prescribed syllabus*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***IndustryMapping:*** https://nthrys.com/bioinformatics-training.html	**5**	1. Protein concentration determination using spectroscopy 2. Nucleic Acid Denaturation

2	**Protein Chemistry**	Differential thermal analysis: Principle, Instrumentation and applications, differences between DSC and ITC. Applications of DSC (Inorganic and Polymer samples). Introduction to steps of Protein design and Engineering, protein splicing and its application; Solid phase peptide synthesis. Folding Rate, Molten globule; Techniques for studying of protein folding , Protein folding errors: Alzheimer's, prions and Mad Cow (BSE, CJD), Cystic Fibrosis and cancer;application of protein folding to design new drug	**International standard** **https://ocw.mit.edu/courses/7-88j-protein-folding-and-human-disease-spring-2015/** ***AICTE prescribed syllabus*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***Industry Mapping:*** https://nthrys.com/bioinformatics-training.html	**5**	Determination of protein mis-folding by bioinformatics tool
3	**Techniques Involved in Separation Processes**	Foam-fractionation; Solvent extraction of bio-processes, aqueous two-phase extraction, adsorption-desorption process; Salt precipitation; Chromatographic separation based on size, charge hydrophobic interactions and metal ion affinity. HPLC, Affinity chromatography, inhibitors: their preparation and uses, method of linkages, Protein Precipitation.	**International standard** https://ocw.mit.edu/courses/res-5-0001-digital-lab-techniques-manual-spring-2007/resources/column-chromatography/ ***AICTE prescribed syllabus*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/***	**8**	Chromatographic separation of plant compounds

			Industry Mapping: https://nthrys.com/bioinformatics-training.html		
4	**Membrane based separation**	Micro-filtration, Reverse osmosis, Ultrafiltration and affinity ultrafiltration, concentration polarization, rejection, flux expression, membrane modules, dead-ended and cross-flow mode, material balances and numerical problems, biological applications.	***International Standards:*** https://ocw.mit.edu/courses/res.ll-004-ll-educate-introduction-to-engineering-concepts-spring-2022/pages/filtration-lab-step-3-design/ ***AICTE prescribed syllabus*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***IndustryMapping:*** https://nthrys.com/bioinformatics-training.html	**6**	Determination of filtration coefficient

Submitted by Dr. Moupriya Nag (Module1 and Module 2);

Dr. Dibyajit Lahiri (Module 3 and Module 4)

Subject Name: Cheminformatics & Medicinal Chemistry

Credit: 2+1 **Lecture Hours: 36**

Subject Code: PCCBT506

Study Material : Cheminformatics & Medicinal Chemistry Study materiasl.docx

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	Introduction	Introduction Introduction to drug designing, drug design to discovery and development, drug metabolism, toxicity and pharmacokinetics, toxicology considerations, problems and drawbacks on drug discovery and development.	**International standard** https://ocw.mit.edu/courses/15-136j-principles-and-practice-of-drug-development-fall-2013/ ***AICTE prescribed syllabus*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***IndustryMapping:*** https://nthrys.com/bioinformatics-training.html	**5**	3. Identification of Drug like compounds

2	**Steps of Drug Discovery**	Identification and validation strategies Drug Target classification, identification and validation strategies, Design and development of combinatorial libraries for new lead generation. Structure-based design – 'de novo' design methodologies 3D-database searching techniques, docking.	**International standard** **https://ocw.mit.edu/courses/15-136j-principles-and-practice-of-drug-development-fall-2013/** ***AICTE prescribed syllabus*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***Industry Mapping:*** https://nthrys.com/bioinformatics-training.html	**5**	Detection of Drug like properties
3	**Drug Designing**	Rational basis of drug designing, criteria for synthesizing drugs, Drug designing approaches- Phamacophore based drug design- lead and target tissues, lead finding and lead optimization, action and reaction, Structure based drug design process of Structure based design, Receptor based design-drug designing using known receptor structure, design of energy inhibitors.	**International standard** https://ocw.mit.edu/courses/15-136j-principles-and-practice-of-drug-development-fall-2013/ ***AICTE prescribed syllabus*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***Industry Mapping:*** https://nthrys.com/bioinformatics-training.html	**8**	Molecular docking interaction

4	**QSAR**	QSAR: Statistical techniques behind QSAR, classical QSAR, molecular descriptors 3D QSAR and COMFA. Basic principles of molecular modeling, molecular dynamics simulation techniques.	***International Standards:*** https://ocw.mit.edu/courses/15-136j-principles-and-practice-of-drug-development-fall-2013/ ***AICTE prescribed syllabus*** ***https://www.aicte-india.org/flipbook/p&ap/biotechnology/*** ***IndustryMapping:*** https://nthrys.com/bioinformatics-training.html	**6**	Not Applicable

Submitted by Dr. Moupriya Nag (Module1 and Module 2);

Dr.Dibyajit Lahiri (Module 3 and Module 4)

Subject Name: Biomaterials **Credit: 4**

Subject Code: OECBT501 **Lecture Hours: 48**

COURSE OBJECTIVES:

1. Understand biomaterials' common use and the chemical structure, properties, and morphology.
2. Understand and account for methods for the categorization of biomaterials.
3. Explain methods to modify surfaces of biomaterials and choose material for the desired biological response.
4. Describe interactions between biomaterials, proteins, and cells.
5. Understand the interaction between biomaterial and tissue for short-term and long-term implantations, and distinguish between blood and tissue reactions.
6. Explain the types of material used to replace different organs & tissues of the human body.

Course Outcome:

CO 1- Explain the importance of Bioimplants testing

CO2- Define the basic technology of cell-biomaterials interactions

CO 3- Explain the importance of animal model testing

CO 4- Analyze the significance of surface modification and cellular compatibility

CO 5- Define cellular adhesion and surface compatibility

CO 6- Evaluate in-vivo (oxidation) and in-vitro (microbial infections) toxicity of biomaterial

Module number	Topic	Sub-topics	Mapping with Industryand International Academia	Lecture Hours	Corresponding Lab Assignment
I	**Overview**	Definition of biomaterials – biologically derived materials or materials compatible with biology. Common biomaterials: some proteins, many carbohydrates, and some specialized polymers. Collagen (protein in bone and connective tissues): Structure production and its use. Fibroin (protein in silk): Production and its use. Production of these proteins by conventional cloning methods.	***International Academia:*** https://ocw.mit.edu/courses/3-051j-materials-for-biomedical-applications-spring-2006/resources/lecture6/ ***AICTE-prescribed syllabus:*** https://www.aicte-india.org//sites/default/files/Model_Curriculum/Biotechnology/biotechnology.pdf ***Industry Mapping: NA***	8	There is a corresponding lab: • Preparation of Simulated Body Fluid (SBF)
II	**Carbohydrates**	Carbohydrates: Modified carbohydrates acting as lubricants for biomedical applications; Polydextrose made from bacteria; Carbohydrates modified from enzymes; artificial wood.	***International Academia:*** https://ocw.mit.edu/courses/7-341-biomaterials-and-devices-for-disease-diagnosis-and-therapy-fall-2018/ ***AICTE-prescribed syllabus:*** https://www.aicte-india.org//sites/default/files/Model_Curriculum/Biotechnology/biotechnology.pdf ***Industry Mapping: NA***	14	There is a corresponding lab: • Development of 2-D Scaffold

• III	**Biopolymers**	**Biopolymers**: Synthesis from a simple biological monomer (e.g. hyaluronate polymers); Dextrans (used in chromatography columns); Rubberlike materials produced by bacteria and fungi (Polyhydroxy-butyrate PHB), Polycaprolactone (PCL); Production of a copolymer of PHB and PHV (poly-hydro-valeric acid), sold as Biopol by fermentation on Alcaligenes eutrophus; Biodegradable polymers	***International Academia:*** https://ocw.mit.edu/courses/20-441j-biomaterials-tissue-interactions-fall-2009/ ***AICTE-prescribed syllabus:*** https://www.aicte-india.org//sites/default/files/Model_Curriculum/Biotechnology/biotechnology.pdf ***Industry Mapping:*** *https://rtec-instruments.com/solutions/biomaterials/*	14	There is a corresponding lab. • Development of 3-D Porous and Non-Porous Scaffold • Interconnectivity Test
IV	**Industrial Biopolymers**	**Industrial biopolymers**: Production of polyphenol resins by the enzyme soybean peroxidase; Evaluation of the properties of biopolymers to make good biomaterials; Tensile strength (both elasticity and breaking strength); Hydration, visco-elastic properties; viscosity.	***International Academia:*** https://ocw.mit.edu/courses/3-051j-materials-for-biomedical-applications-spring-2006/resources/lecture7/ ***AICTE-prescribed syllabus:*** https://www.aicte-india.org//sites/default/files/Model_Curriculum/Biotechnology/biotechnology.pdf ***Industry Mapping:*** *https://boydbiomedical.com/articles/common-applications-of-biomaterials-in-life-sciences#:~:text=Biomaterials%20are%20used%20in%20tissue,adhesion%2C%20prolife*	12	There is a corresponding lab. • Biodegradation Assay • Microscopic Analysis of Scaffold https://ocw.mit.edu/courses/10-467-polymer-science-laboratory-fall-2005/

			ration%2C%20and%20differentiation.		

Submitted by Dr. Keya De Mukhopadhyay and Dr. Pratik Talukder

Subject Name: Biosimilars Technology **Credit: 2**

Subject Code: PECBT507 **Lecture Hours: 24**

Pre-requisite: Chemistry and Biochemistry

Relevant Links: https://uemeduin-my.sharepoint.com/:b:/g/personal/sonali_paul_uem_edu_in/Eaiji_BL0r1Cu0nbarsu3gcButSNykMVpEFwtEMJVI-4yw?e=IuszoM

https://nptel.ac.in/courses/104102113

https://www.linkedin.com/learning/the-data-science-of-healthcare-medicine-and-public-health/drug-re-discovery?trk=learning-serp_learning-search-card_search-card&upsellOrderOrigin=sem-ga_campid.9764329640_asid.102279866120_crid.428931010987_kw.linkedin%2Blearning_d.c_tid.kwd-310582843911_n.g_mt.e_geo.9298520

https://www.coursera.org/learn/drugs

Course Objective:

1. To understand the basis of drug action
2. To study the structure and production of drugs

Course outcome:

CO1	To define the concepts of pharmacokinetics and pharmacodynamics
CO2	To describe the mechanism of antibiotics
CO3	To illustrate a detailed knowledge of hybridoma technology
CO4	To analyse the significance of biomarkers
CO5	To evaluate the idea of tablet preparation
CO6	To design the use of enzymes in clinical diagnosis and kit development

Module Number	Topic	Sub Topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	Introduction	Introduction, Pharmacokinetics – Absorption, Distribution, Metabolism, Excretion and Toxicology. Pharmacodynamics Pre-clinical and clinical models employed in the screening of new drugs belonging to following categories: Analgesic - antipyretics, anti-inflammatory, anti-anxiety agents, anti-depressant drugs, anti-convulsants, anti-diabetics, local anesthetics and anti-histamine	International academia: https://ocw.mit.edu/courses/15-136j-principles-and-practice-of-drug-development-fall-2013/ AICTE – prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model%20Curriculum%20for%20UG%20Degree%20Course%20in%20Biotechnology.pdf Industry mapping: https://www.fda.gov/patients/learn-about-drug-and-device-approvals/drug-development-process	6	1. Assay of Ascorbic Acid Tablets 2. Assay of Paracetamol tablets
2	Antibiotics	Structure, Mechanism of	International academia: https://ocw.mit.edu/course	6	1. Assay Of Promethazine Hydrochloride tablets

		Action and production of antibiotics – Penicillin and Cephalosporins (beta lactam antibiotics), Griseofulvin, Streptomycin, Rifampicin, Amphotericin B and Mitomycin C. Hybridoma technology – selection, screening and fusion methods for myeloma cells and B lymphocytes. Production, purification and application of monoclonal antibodies. Introduction to second generation antibodies and lymphokines.	s/15-136j-principles-and-practice-of-drug-development-fall-2013/ AICTE – prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model%20Curriculum%20for%20UG%20Degree%20Course%20in%20Biotechnology.pdf Industry mapping: https://medlineplus.gov/antibiotics.html		2. pH dependent stability studies
3	Biomarker	Biomarkers in disease diagnostics: FDA definition of disease markers, Role of markers in	International academia: https://ocw.mit.edu/courses/15-136j-principles-and-practice-of-drug-	6	1. Temperature dependent stability studies 2. Synthesis of Phenytoin

		Disease diagnosis. Approaches and methods in the identification of disease markers, predictive value, diagnostic value, emerging blood markers for sepsis, tumour& cancer markers, markers in inflammation and diagnosis of cytoskeletal disorders. Industrial production of (A) interferon, interleukins (regulatory proteins) (B) Erythropoietin (blood products) (C) Hepatitis B vaccine (D) insulin hormone. Various routes of administration, controlled and targeted drug delivery oftherapeutic proteins and peptides	development-fall-2013/ AICTE – prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model%20Curriculum%20for%20UG%20Degree%20Course%20in%20Biotechnology.pdf Industry mapping: https://www.fda.gov/drugs/biomarker-qualification-program/what-are-biomarkers-and-why-are-they-important-transcript		

4	Tablet production	Compressed tablets; dry and wet granulation; slugging or direct compression; tablet presses; coating of tablets; capsule preparation; oval liquids – vegetable drugs – topical applications; preservation of drugs; analytical methods and other tests used in drug manufacture; packing techniques; quality management; gmp. Use of enzymes in clinical diagnosis and kit development: Principle of diagnostic enzymology, determination/use of enzyme/enzyme activities for clinical diagnosis (Liver, cardiac and Kidney enzyme, Digestive enzyme,	International academia: https://ocw.mit.edu/courses/15-136j-principles-and-practice-of-drug-development-fall-2013/ AICTE – prescribed syllabus: 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/technical-documents/technical-article/pharmaceutical-and-biopharmaceutical-manufacturing/solid-formulation-strategies/tablet-manufacturing-technologies-solid-drug-formulation	6	1. Synthesis of Benzimidazole

		Miscellaneous enzymes and their general function tests)			

Text Books/References:

1. LaszloEndrenyi,PaulDeclerckandShein-ChungChow,BiosimilarDrugDevelopment, DrugsandPharmaceuticalSciences,Vol216,CRCPress.
2. ChengLiuandK.JohnMorrowJr.,BiosimilarsofMonoclonalAntibodies:APractical GuidetoManufacturing,PreclinicalandClinicalDevelopment,Wiley,Dec2016.
3. https://www.drugs.com/medical-answers/many-biosimilars-approved-united-states-3463281/

Submitted by Dr. Sonali Paul, Dr. Pratik Talukder, Dr. Keya De Mukhopadhyay

Subject Name: Good Manufacturing and Laboratory Practice **Credit: 3**
Subject Code: PCCBT506 **Lecture Hours: 36**

COURSE OBJECTIVES:

1. To understand the principles that form GMP and GLP and why it was necessary.
2. Develop the ability to establish GMP and GLP-compliance in the Biotech sector.
3. To learn how to recognize GMP and GLP deficiencies using scenarios.
4. To gain an in-depth knowledge of the regulations themselves.

COURSE OUTCOME:

CO1. List the various types of manufacturing methods

CO2. Explain the quality of a product mainly for human consumption

CO3. Explain the ideal laboratory conditions/necessaries for GLP in bio-pharmaceuticals and food safety

CO4: Explain the limitations of GLP

CO5: Explain public safety with GLP

CO6: GLP limitations, guidelines, and assessment

Module number	Topic	Sub-topics	Mapping with Industryand International Academia	Lecture Hours	Corresponding Lab Assignment
I	**Overview**	Introduction to Good Manufacturing and Laboratory Practice, Requirement of GLP and GMP compliance for regulatory approval, Ethics in manufacturing and control,	***International Academia:*** https://manufacturing.mit.edu/academics/courses ***AICTE-prescribed syllabus:*** https://www.aicte-india.org//sites/default/files/Model_Curriculum/Biotechnology/biotechnology.pdf ***Industry Mapping: NA***	8	There is no corresponding lab
II	**Principles of Quality and Design**	Principles of Quality by design (QBD) Introduction to the concept of Design of Experiment (DOE)	***International Academia:*** https://ocw.mit.edu/courses/15-783j-product-design-and-development-spring-2006/pages/lecture-notes/ ***AICTE-prescribed syllabus:*** https://www.aicte-india.org//sites/default/files/Model_Curriculum/Biotechnology/biotechnology.pdf	14	There is no corresponding lab

			Industry Mapping: NA		
• III	**Application of Quality Principles in Biotech**	Application of QBD principles in Biotech product development. Case studies: Example of QBD and DOE in Process Development, Example of DOE in analytical development, Introduction to ICH guidelines and their usage, National and international regulatory authorities, and their function, Pharmaceutical	***International Academia:*** https://searchworks.stanford.edu/view/8641438 ***AICTE-prescribed syllabus:*** https://www.aicte-india.org//sites/default/files/Model_Curriculum/Biotechnology/biotechnology.pdf ***Industry Mapping: NA***	14	There is no corresponding lab
IV	**Jurisprudence and Laws related to Product design, Drug Development & Approval**	Jurisprudence and Laws related to Product design, Drug Development & Approval Process, Regulation of Clinical and Preclinical Studies, Good Manufacturing Practices, Formulation Production Management, Authorization and marketing of drugs. Computer simulation on process design.	***International Academia:*** https://searchworks.stanford.edu/view/8641438 ***AICTE-prescribed syllabus:*** https://www.aicte-india.org//sites/default/files/Model_Curriculum/Biotechnology/biotechnology.pdf ***Industry Mapping: NA***	12	There is no corresponding lab

Submitted by Dr. Keya De Mukhopadhyay