आईएफटीएम विश्वविद्यालय, मुरादाबाद, उत्तर प्रदेश
IFTM University, Moradabad, Uttar Pradesh
NAAC ACCREDITED

SCHOOL OF BIOTECHNOLOGY
IFTM UNIVERSITY
www.iftmuniveristy.ac.in

Study & Evaluation Scheme of Master of Technology (Biotechnology) Session 2021-2022

Programme:	Master of Technology (Biotechnology)
Course Level:	PG Degree
Duration:	Two Years (Four semesters) Full Time
Medium of Instruction:	English
Maximum required attendance:	75%
Maximum Credits:	93

Programme Outcomes (POs)

The student will be able to:

- Acquire necessary knowledge and skills in the frontier areas of Biotechnology and will think critically and creatively about the use of biotechnology to address local and global problems.
- Apply the knowledge of mathematics, science, engineering fundamentals, engineering concepts like mass transfer heat, transfer and fluid flow to the solution of complex engineering problems.
- Students will be able to implement the engineering principles to biological systems for development of industrial applications, as well as entrepreneurship skills to start biotech industries.
- Apply their knowledge on Bioprocess engineering techniques like Upstream process involving medium optimization and downstream process involving product recovery and purification in fermentation industries.
- Analyze the problem related with bioreactor designing and its component parts and can conduct experiments, to analyze and interpret data.
- Independently carry out research /investigation and development work to solve practical problems, write and present a substantial technical report/document.
- Recognize the need for continuous learning and will prepare oneself to create, select, learn and apply appropriate techniques, resources, and modern instrumentation to solve complex biotechnological activities with an understanding of the limitations.
- Demonstrate knowledge of biotechnology and management principles and apply to manage projects efficiently and economically with intellectual integrity and ethics for sustainable development of society.

IFTM UNIVERSITY, MORADABAD
M.TECH. BIOTECHNOLOGY
COURSE STRUCUTRE
(Effective from 2021-22)

First Semester

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
			L	T	P	Mid Sem Exam	AS +AT	Total	End Sem Exam		
THEORY											
1.	MTB-101	Advanced Bioseperation Engineering	3	1	0	20	10	30	70	100	4
2.	MTB-102	Advanced Bioprocess Engineering	3	1	0	20	10	30	70	100	4
3.	MTB-103	Bioinformatics	3	1	0	20	10	30	70	100	4
4.	MTB-104	Biochemistry, Biophysics & Molecular dynamics	3	1	0	20	10	30	70	100	4
5.	MTB-105	Advanced Biochemical Engineering	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT											
6.	MTB-151	Advanced Bioseperation Engineering; Advanced Bioprocess Engineering	0	0	4	20	10	30	70	100	2
7.	MTB-152	Biochemistry, Biophysics & Molecular dynamics; Advanced Biochemical Engineering	0	0	4	20	10	30	70	100	2
8.	MTB-153	Bioinformatics	0	0	4	20	10	30	70	100	2
		Total Credit	15	5	12			240	560	800	**26**

IFTM University, Moradabad
Master of Technology (M.Tech.), Programme
M.Tech. Biotechnology I Year (I Semester)
(Effective from 2021-22)

MTB-101: ADVANCED BIOSEPARATION ENGINEERING

Objective: The main objective of this course:

- Is designed to introduce the principles of bioseparation engineering that makes the student able to quantitatively and systematically design an integrated bioseparation process for the recovery and purification of biosynthetic products like pharmaceuticals, secondary metabolites form fermentation broth and the recycling of salvageable components and the proper treatment and disposal of waste.

UNIT I: **(8 Sessions)**

An introduction to Bioseparation: Role of Downstream Processing in Biotechnology, Different sectors in biotechnology, Recovery in modern versus classical biotechnology, Characteristics of fermentation broth.

UNIT II: **(8 Sessions)**

Cell disruption methods: (Physical, chemical and Enzymatic) & Kinetics for release of intracellular product. Scale up of bead mill and homogenizer. Solid Liquid separation techniques including flocculation, Sedimentation - Mechanism and importance; Centrifugation types- Mechanism; Selection and Filtration theory, Types and Pretreatment.

UNIT III: **(8 Sessions)**

Methods of concentration of Product: Extraction Processes and its fundamental relation between distribution coefficient and separation factors, kremser equation, Extraction of high molecular weight compounds. Precipitation methods of separation, Aqueous two-phase extraction- Phase Diagram, Principles Membrane based separation basic principle and types of membrane processes characteristics of different modes of operations.

UNIT IV: **(8 Sessions)**

Sorption mechanism: Materials and fundamentals of adsorption and chromatography principles with special reference to gel permeation chromatography, Different electrophoresis technique.

UNIT V: **(8 Sessions)**

Product polishing: Crystallization & Drying theory and equipments, importance of formulation of baker's yeast and enzymes, Downstream processing steps for citric acid, antibiotic extracellular enzymes, Intracellular enzymes.

Course Outcomes:

At the end of the course students will able to:

- Understand that how to isolate and purify biological products.
- Work on the scale-up process of bioprocess plant.

Suggested Readings:

1.Comprehensive Biotechnology- Murray Moo- Young, Vol II latest ed., Pergan Publishers, 2nd edition, 2011.

2.H.J. Rehm and G. Reed, Biotechnology- Volume 3,4,5, Verlag Publishers, 1985.
3.Stanbury and Whitakker, Principles of Fermentation Technology, Pergamon Press, 2013.
4.A Biologist's guide to principles & techniques of practical biochemistry- Wilson and Walker, 6th edition, 2010.

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books

IFTM University, Moradabad
Master of Technology (M.Tech.), Programme
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MTB-102: ADVANCED BIOPROCESS ENGINEERING

Objective(s): The objectives of the course:

- Is to introduce the concept of bioprocess engineering, design and optimization method of media, importance of medium preparation its kinetic behavior, perform material and energy balances for any biochemical process decide upon control strategies for process control.
- To apply engineering principles to address issues in bioprocesses, analyze and identify limiting factors in a bioprocess scale-up and propose solutions to address biological and engineering problems.

UNIT I: **(8 Sessions)**

Methods of inoculation: Medium preparation, Media design-Plackett Burman and Response Surface Method, Sterilization of medium & fermenter, Kinetics of thermal death of microorganisms, Batch sterilization, Continuous sterilization of air: Methods, filters and deign of depth filters.

UNIT II: **(8 Sessions)**

Microbial growth kinetics: In closed, semi-open and open cultivation systems. Kinetics of substrate uptake in cell culture, kinetics of product formation, Maintenance energy and yield concepts, analysis of growth data and estimation of biomass.

UNIT III: **(8 Sessions)**

Steady state and unsteady state: Material and energy balance, Growth stoichiometry-element and electron balance, Product stoichiometry, molecular diffusion-liquid-solid, liquid-liquid and gas-liquid mass transfer, measurement of K_La-sulphite oxidation method, oxygen transfer method, Dynamic method, oxygen transfer in bioreactor.

UNIT IV: **(8 Sessions)**

Bioreactor: Types of Bioreactors for animal, plant and microbial system, Design and operation of various bioreactors, viz Batch, CSTR, fed batch systems, air-lift bioreactors, fluidized bed bioreactors & plug flow reactor, Scale up of bioreactor-mixing, aeration, mass transfer.

UNIT V: **(8 Sessions)**

Monitoring and control of bioreactor: Temperature, pressure, mixing and foam control, measurement and control of dissolve oxygen, inlet and exit gas analysis, manual and advance controlled system-Fuzzy logic, ANN and PID control.

Course Outcomes:

At the end of the course students will able to:

- Understand design media, sterilization procedure for the growth of micro-organisms for industrial applications.
- Apply mass and energy balances to calculate the concentration of different gases in the fermenter off-gas, amount of reactant used, amount of oxygen etc.
- Work on the scale-up process of the bioprocess plant/industry.
- Control of physical, chemical and biological environment of the bioreactor.

Suggested Readings:

1. Michael L. Shuler, FikretKargi, Bioprocess Engineering – Basic Concepts, 2nd Ed., Pearson Education India, 2015.
2. James Bailey, David Ollis, Biochemical Engineering Fundamentals, 2nd Ed., McGraw Hill Education, 2017.
3. Roger G. Harrison, Paul W. Todd, Scott R. Rudge, Demetri P. Petrides, Bioseparations Science and Engineering, 2nd Ed., Oxford University Press, 2003.
4. Pauline M. Doran, Bioprocess Engineering Principles, 2nd Ed., Academic Press, 2012**.**
5. Stanbury, Peter F., Allan Whitaker, and Stephen J. Hall. Principles of fermentation technology. Elsevier, 2013.

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books
- https://www.masterclass.com

IFTM University, Moradabad
Master of Technology (M. Tech.), Programme
M. Tech. Biotechnology I Year (I Semester)
(Effective from 2021-22)

MTB-103: BIOINFORMATICS

Objective(s): The objectives of this course:

- Offers advanced level training on gene expression and gene therapy by covering topics such as genome mapping, proteomic techniques and new targets for drug discovery.
- To deal with sequence alignment algorithm and matrices are introduced to solve the complex biological problems.

UNIT I: **(8 Sessions)**

Introduction and applications of Bioinformatics: Biological databases in Bioinformatics, Classification of biological databases, biological database retrieval system. Sequence and molecular file formats

UNIT II: **(8 Sessions)**

Sequence Alignment: Dot matrix analysis, dynamic programming algorithm (Needleman-Wunsch algorithm and Smith Waterman algorithm), heuristic methods (BLAST, FASTA). Iterative methods of multiple sequence alignment (Genetic Algorithm, HMM).

UNIT III: **(8 Sessions)**

Protein structure prediction: Protein identification and characterization, primary structure analysis and prediction, secondary structure analysis and prediction. Microarray Data Analysis.

UNIT IV: **(8 Sessions)**

Protein modeling: Methods of protein modeling, homology modeling, fold recognition, *Ab-initio* modeling. Protein classification and protein structure visualization: Protein structure database, Protein structure visualization databases and tools, Protein classification approaches.

UNIT V: **(8 Sessions)**

Introduction to drug discovery: Target discovery strategies, Target validation, Computer aided Drug Designing: Introduction, drug-design approaches, ADME- Tox property prediction. Introduction to QSAR.

Course Outcomes:

Students will be able to understand

- Bioinformatics tools for sequence alignment and gene prediction.
- Algorithm and Matrices to solve the biological problem.
- Able to visualize the 3D structure of protein molecules.
- Designing of new drug molecules.

Suggested Readings:

1. Bioinformatics: Sequence and Genome Analysis by David W. Mount.
2. Bioinformatics and Functional Genomics by Jonathan Pevsner.
3. Developing Bioinformatics Computer skills by Gibas and Jambeck.
4. Bioinformatics: Principles and Applications by Zhumur Ghosh and Mallick.
5. Bioinformatics: Genomics, Proteomics and drug discovery by S.C. Rastogi.
6. A text book of Bioinformatics by Singhal and Singhal

Websites Sources:

- www.ncbi.nlm.nih.gov
- http://www.bic.nus.edu.sg/
- http://bioinfo.ernet.in/
- http://www.bioinform.com/index

IFTM University, Moradabad
Master of Technology (M.Tech.), Programme
M.Tech. Biotechnology I Year (I Semester)
(Effective from 2021-22)

MTB-104: BIOCHEMISTRY, BIOPHYSICS & MOLECULAR DYNAMICS

Objective(s): The objectives of this course:

- Provides a degree path centered on the chemistry and physics of life processes with training that integrates the principles of chemistry, physics, mathematics, biochemistry, molecular genetics, and computer science.
- Explore the chemical structure of living matter and the chemical reactions occurring in living cells.
- To use the methods of physical science to study the structure and functions of macromolecules and solve problems at the intersection of biological and physical sciences.

UNIT I: **(8 Sessions)**

Carbohydrates, Proteins and Lipids: Classification and Structure of Carbohydrate; Mechanism of major metabolic pathways: Glycolysis, TCA Cycle, Gluconeogenesis, Galactose Metabolism, HMP Pathway. Classification and structure of Protein; Biochemical mechanism of protein synthesis and degradation. Classification and Structure of Lipid; Catabolism of Lipids; Fatty acid synthesis

UNIT II: **(8 Sessions)**

Coenzymes and Enzymes: Introduction; Vitamins: Types, structures and functions; Coenzymes; Classification of Enzymes; Distinction between coenzymes and cofactors; Factors affecting rate of enzyme reaction; Kinetics of normal enzymatic reaction; Enzyme inhibition and activation, Isozymes and their Biochemical and clinical significance.

UNIT III: **(8 Sessions)**

Nucleic acids: Introduction; General Structure and function of purines; pyrimidines, nucleic acids and nucleotides; Hydrolysis of Nucleic acids; Biosynthesis of purines, pyrimidines, Nucleosides and Nucleotides; Degradation of nucleic acids and nucleosides; Mechanism of Salvage Pathway.

UNIT IV: **(8 Sessions)**

X-Ray and NMR: Crystals and symmetries, crystal systems point groups and space groups, growth of crystals of biological molecules, X-ray diffraction, X-ray data collection, structure solutions, refinement of structure. Basic principle, NMR theory, classical description of NMR, NMR parameters, the Nuclear Oberhausen effect.

UNIT V: **(8 Sessions)**

Biomechanics: Striated muscles and contractile proteins, mechanical properties of muscles, biomechanics of cardiovascular system. Electrical activity during the heartbeats.

Course Outcomes:

At the end of the course students will able to:

- Demonstrate proficiency in the foundational topics of biochemistry and biophysics
- Disciplinary knowledge and understanding of biochemistry, structure and function of biological molecules.
- Explain biological mechanisms, such as the processes and control of bioenergetics and metabolism, as chemical reactions.
- Analyze biochemical data (e.g. in enzyme kinetics, molecular structure analysis and biological databases).
- Identify, analyze, and solve various biomechanical problems

- Explain centers of the brain that control heart rate and describe their function.
- Knowledge about the effects of exercise on cardiac output and heart rate.

Suggested Readings:

1. Lehninger principles of Biochemistry-Fourth edition, Published by W.H. Freeman 2004.
2. Fundamentals of Biochemistry: Life at the molecular level- By Donald Voet, Judith G. Voet and Charlotte W. Pratt, 2012.
3. Nicholls & Ferguson, Bioenergetics, 4th Edition. Elsevier publication.

Website Sources:

- https://www.britannica.com/science/biochemistry
- https://www.sanfoundry.com/1000-biochemistry-questions-answers/
- https://science.rpi.edu/biology/programs/undergrad/bs-biochem-biophysics
- http://www.cryst.bbk.ac.uk/pps97/assignments/projects/ambrus/html.htm
- https://www.sanfoundry.com/analytical-instrumentation-questions-answers-instrumentation-xray-spectroscopy/

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MTB-105: ADVANCED BIOCHEMICAL ENGINEERING

Objective(s): The objectives of the course:

- To introduce the role and application of engineering in biotechnology, aspects of chemical reaction engineering is described to study the transport phenomenon in biological system.
- Chemical reaction and kinetics are explained to study the homogeneous and heterogeneous reactions. Reactor data analysis and enzyme kinetics is also explained.

UNIT I: **(8 Sessions)**

Concept of ideal reactors: Based on flow characteristics, design of ideal reactors using material and energy balance equations, Single reactors with ideal flow condition, comparison of volumes of plug flow reactor and chemostat. Multiple reactors- methods to show how total volume is affected in multiple reactors.

UNIT II: **(8 Sessions)**

Searching for mechanism: Arrhenius equation, Batch reactor analysis for kinetics (synchronous growth and its application in product production), Growth Kinetics: Batch growth quantifying cell concentration, growth profiles and kinetics in batch culture, fed batch growth, continuous growth and their growth kinetic quantification, chemostat growth, semi-continuous / exponential feeding strategy.

UNIT III: **(8 Sessions)**

Maximizing the yield of intermediate product in series reactions: Design principles–Non isothermal reactions and pressure effects, non-ideal flow in bioreactors-reasons for non-ideality, concept of RTD studies, characterization of non-ideality using RTD studies, various distribution functions, conversions using tracer studies.

UNIT IV: **(8 Sessions)**

Diagnosing the ills of non-ideal bioreactors: Various models of non-ideal flow, Design and analysis of bioreactors-stability and analysis of bioreactors, biomass production and effect of dilution rate, Design and operation of various bioreactors, *viz* CSTF, fed batch systems, air-lift bioreactors, fluidized bed bioreactors.

UNIT V: **(8 Sessions)**

Mass transfer in biological reactors: Scale up of bioreactors, Instrumentation and control, Criteria for selection of bioreactors.

Course Outcomes:

At the end of the course students will able to:

- Different modes of reactor operation and their kinetics.
- Designing of Ideal and Non-ideal reactor based on reaction kinetics.
- Selection of criterion for scale-up of the reactor for large volume production.

Suggested Readings:

1. M.L. Shuler and F.Kargi: Bioprocess Engineering: Basic Concepts, Prentice Hall, 2001.
2. P M Doran: Bioprocess Engineering Principles, Academic Press 2005.
3. Octave Levenspiel: Chemical Reaction Engineering, John Wiley & Sons, 1999.
4. J.E. Bailey and D.F. Ollis:Biochemical Engineering Fundamentals, McGraw Hill Higher Education, 2nd edition, 1986.

Website Sources:

- https://www.youtube.com/watch?v=OGWwdT6UGVM&feature=emb_logo
- http://www.ric.edu/faculty/ptiskus/reactions/
- https://www.khanacademy.org/science/biology/chemistry--of-life/chemical-bonds-and-reactions/a/chemical-reactions-article

IFTM University, Moradabad
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MTB-151: Advance Bioprocess & Bioseperation Engineering

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipment and Accessories and Working	
5.	To plot Microbial growth curve for shake flask culturing using turbidity method.	Experiment 1
6.	To prepare a standard curve of reducing sugar by 3, 5-Dinitrosalicylic acid method.	Experiment 2
7.	To Estimate the Monod Parameters for microbial growth kinetics.	Experiment 3
8.	Demonstration of lab scale fermenter (bench top fermenter).	Experiment 4
9.	Preparation of standard curve of Ethanol.	Experiment 5
10.	Disruption of yeast cells by mechanical method.	Experiment 6
11.	To study the effect of: i) Increasing speeds of centrifugation on the settling of the yeast cell particles. ii) Increasing centrifugal times on the settling of yeast cell particles.	Experiment 7
12.	To estimate citric acid from fermentation broth by calorimetric method.	Experiment 8
13.	To identify the unknown pigments by comparing its R_f value with R_f value of the standards.	Experiment 9

IFTM University, Moradabad
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MTB-152: Biochemistry, Biophysics & Molecular dynamics & Advanced Biochemical Engineering

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipment and Accessories and Working	
5.	To study of the properties of carbohydrates. (i) Molish Test (ii) Benedict's Test	Experiment 1
6.	To estimate given amount of protein by Folin-Lowry method. To estimate the protein content in the given sample by Biurret methods	Experiment 2
7.	Qualitative test for the presence of fatty acid by titrametric methods. Estimation of cholesterol by Liebermann-Buchard reaction.	Experiment 3
8.	To learn technique SDS-PAGE and to separate protein according to their molecular size	Experiment 4
9.	Identification of amino acids in a given solution sample by ascending paper chromatography.	Experiment 5
10.	To separate & identify lipid by Thin Layer Chromatography.	Experiment 6
11.	Determination of extinction coefficient of standard BSA solution. Determination of concentration of unknown protein by taking molar extinction coefficient value and by using standard plot.	Experiment 7
12.	Determination of the thermodynamic parameters; ΔH, ΔG, ΔS and Cp of protein lysozyme.	Experiment 8

IFTM University, Moradabad
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MTB-153: Bioinformatics

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipment and Accessories and Working	
5.	To learn how to retrieve structural data of a protein using PDB database.	Experiment 1
6.	To compute the various physical and chemical parameters of a protein.	Experiment 2
7.	To predict the secondary structure of a protein using SOPMA.	Experiment 3
8.	Identifying fold of Proteins: Use of Threading Servers-Phyre2.	Experiment 4
9.	To identify the 10-homologues sequences of P68871 of various origins. Find the conserved region existing between them comment on the same.	Experiment 5
10.	Comment on the evolutionary relationship between the sequences.	Experiment 6
11.	To model a protein using SWISS-MODEL	Experiment 7
12.	To retrieve more information about the drug molecules, drug targets, enzymes and pathways related to drugs.	Experiment 8

IFTM UNIVERSITY, MORADABAD
M.TECH. BIOTECHNOLOGY
COURSE STRUCUTRE
(Effective from 2021-22)

Second Semester

S.N.	Module Code	Module Name	Periods			EVALUATION SCHEME				Course Total	Credits
			L	T	P	Mid Sem Exam	AS +AT	Total	End Sem Exam		
THEORY											
1.	MTB-201	Recombinant DNA Technology	3	1	0	20	10	30	70	100	4
2.	MTB-202	Microbiological Engineering	3	1	0	20	10	30	70	100	4
3.	MTB-203	Enzyme & Protein Engineering	3	1	0	20	10	30	70	100	4
4.	MTB-204-208	Department Elective – I	3	1	0	20	10	30	70	100	4
5.	MTB-209-213	Department Elective – II	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT											
6.	MTB-251	Recombinant DNA Technology; Microbiological Engineering	0	0	4	20	10	30	70	100	2
7.	MTB-252	Enzyme & Protein Engineering	0	0	4	20	10	30	70	100	2
8.	MTB-253	Design Problem	0	0	4	20	10	30	70	100	2
		Total Credit	15	5	12			240	560	800	**26**

List of Department Electives

Department Elective-I

S. N.	Course Code	Course Name
1.	MTB-204	Biophysical & Biochemical techniques
2.	MTB-205	Food Biotechnology
3.	MTB-206	Non conventional Energy Resources
4.	MTB-207	Biosensors: Design and Application
5.	MTB-208	Process Control & Instrumentation

Department Elective-II

S. N.	Course Code	Course Name
1.	MTB-209	Bio entrepreneurship
2.	MTB-210	Programming in C Language
3.	MTB-211	Waste Water Engineering
4.	MTB-212	Cell & Tissue Culture Technology
5.	MTB-213	Biostatistics

IFTM University, Moradabad
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MTB-201: RECOMBINANT DNA TECHNOLOGY

Objective(s): The objectives of this course:

- Recombinant DNA technology which came into existence in the middle of the twentieth century, allow for genetic manipulation of organisms by which incorporating DNA sequences from different sources into a single recombinant molecules.
- Is to technology has unfastened several applications in animal and plant genomics; basic, applied and clinical research.

UNIT I: **(8 Sessions)**

Tools of Genetic Engineering: Restriction enzymes, Modifying enzymes, DNA ligase, Polymerase etc. Cloning Vectors: Plasmids, Lambda phage, Phagemids,Cosmids, Artificial chromosomes (BACs, YACs), Shuttle vectors.

UNIT II: **(8 Sessions)**

Molecular probes and Gene Transfer: Agrobacterium mediated gene transfer, Transformation, transduction, Particle gun, Electroporation, microinjection, Preparation and application of molecular probes: DNA probes, RNA probes, Radioactive labeling, Non radioactive labeling, use of molecular probes, DNA fingerprinting.

UNIT III: **(8 Sessions)**

Polymerase Chain reaction (PCR): Basic principles, modifications, applications. Modifying Genes: Site-directed mutagenesis, Insertion & Deletion Mutagenesis.

UNIT IV: **(8 Sessions)**

Analysis and expression of cloned gene in host cells: Expression vectors, Restriction enzyme mapping, Southern blotting, Northern blotting, Western blotting, In-situ hybridization. Colony and plaque hybridization, Factors affecting expression of cloned genes, Reporter genes, Fusion proteins.

UNIT V: **(8 Sessions)**

Different methods of gene isolation: Gene libraries- cDNA synthesis, Genomic DNA libraries, Amplification of gene libraries.

Course Outcomes:

At the end of the course students will able to:

- Utilized of both the principles and the applications of molecular biology methods/techniques with an emphasis on the application of recombinant DNA technology to animals, plants, and microbial organisms.
- Make use of conceptualize properties and applications of versatile DNA modifying enzymes, cloning strategies, vector types, host genotype specificities for selection and screening of recombinants and/or recombinant clones.
- Describes the use of genetically engineering techniques, strategizing research methodologies for biotechnological research and genetically engineered products to solve environmental problems and cure human disease.

Suggested Readings:

1. Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten. Molecular Biotechnology: Principles and Applications of Recombinant DNA 4th Edition.ASM Press; 4 edition (2009).
2. S. B. Primrose and R. M. Twyman, John Wiley & Sons. Principles of Gene Manipulation and 3. Genomics 7th Edn. Oxford Publisher USA (2009).
3. Julia Lodge, Pete Lund and Steve Minchin, Gene Cloning Taylor and Francis, NY (2006).
4. T. A. Brown, Gene Cloning and DNA Analysis. An Introduction, 7th Edn (2016).
5. Blackwell Scientific Publications. India.
6. Sambrook, J., Russell, D.W., Molecular cloning: A Laboratory Manual 3th Edn. Cold Spring Harbor, New York (2001).

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books/NBK21988/

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MTB-202: MICROBIOLOGICAL ENGINEERING

Objective(s): The objectives of the course:

- Is to introduce the concept of biochemical engineering and its application in bioprocess.
- Substrate required for the microbial growth and product yield calculation are explained by stoichiometry equation.
- Importance of medium components and sterilization techniques are also described.

UNIT I: **(8 Sessions)**

Introduction to biotechnology and biochemical engineering: bioprocess techniques, biotechnology products. Raw materials used for Industrial fermentation and its processing. Chemical, physical and physiochemical treatment.

UNIT II: **(8 Sessions)**

Microbial growth: Aerobic and anaerobic growth phenomena; Synchronous culture; Mathematical modeling of microbial growth; product synthesis kinetics: Batch, fed-batch and continuous culture cultivation techniques; Growth and non-growth associated product formation.

UNIT III: **(8 Sessions)**

Medium optimization and Sterilization: principles and mechanism of media sterilization using thermal and membrane filtration; Medium optimization techniques with special emphasize on statistical techniques, Placket-Burman design. Sterilization: Batch and continuous sterilization of media; Air sterilization – Principle and design; Media sterilization: kinetics of thermal death of cells & spores, design of batch and continuous thermal sterilization, coupling of Arrhenius equation and cell death kinetics, Radiation and chemical sterilization.

UNIT IV: **(8 Sessions)**

Stoichiometry of bioreaction and energetic of microbial growth: ATP and redox potential balance, Yield coefficients, Growth stoichiometry and elemental balances, electron balances, productivity and their correlation with the stoichiometry. The limitation of Monod model Kinetics based on molecular mechanism.

UNIT V: **(8 Sessions)**

Engineering and social considerations: For the production of r-DNA products; Safety, Good Laboratory and manufacturing practices. Parameter estimation, Model validation and bioprocess optimization.

Course Outcomes:

At the end of the course students will able to:

- Aspect of Biochemical engineering to understand the processes and transport phenomenon in Bioprocess.
- Aerobic and Anaerobic growth mechanism of microbes used in biotechnology industries.
- Kinetics of microbial growth in Batch, Fed-batch and Continuous process.
- Medium sterilization and optimization techniques like Placket-Burman Design.
- Calculate the biomass yield, substrate requirement and product yield using stoichiometric equation.

Suggested Readings:

1. Bailey JE, Ollis DF; Biochemical Engineering Fundamentals, McGraw-Hill Education, 1986.

2. Blanch HW and Clark DS: Biochemical Engineering, Marcel Decker, 1987.
3. D G Rao: Introduction to Biochemical Engineering, Tata, Mc Graw Hill,New Delhi 2005.
4. Wiseman, A: Handbook of Enzyme Biotechnology, 3rd Edition, Ellis Horwood1999.
5. Moser, A; Bioprocess technology, kinetics and reactors, Springer Verlag1988.
6. Syed Tanveer Ahmed Inamdar:Biochemical Engineering Principles and functions, PHI Learning Private Ltd., 2012.

Website Sources:

- https://en.wikipedia.org/wiki/Biochemical_engineering
- https://chem.libretexts.org/
- http://umich.edu/~elements/5e/asyLearn/bits/batch/index.htm

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(Effective from 2021-22)

MTB-203: ENZYME AND PROTEIN ENGINEERING

Objective: The objective of the course:

- To understand the kinetics and mechanisms of action of enzymes, to become familiar with the basic methods of studying enzymes, and to appreciate how individual reactions are controlled and integrated into the metabolic pathways of the cell.

UNIT I: **(8 Sessions)**

Methods of enzymes and protein engineering: Through genetic engineering, protein engineering, chemical modification, intra-molecular cross-linking and immobilization; Molecular structure and function of enzymes; Folding and active site formation in enzymes; Phenomena of allosterism and allosteric kinetics.

UNIT II: **(8 Sessions)**

Various techniques used for the immobilization of enzymes: Kinetics of immobilized enzymes; Types of enzyme reactors: Fed batch reactor, enzyme-catalyzed reactions in CSTR, CSTR rectors ideal plug flow tubular reactors; Heterogeneous reaction systems; Transient analysis of enzyme reactors.

UNIT III: **(8 Sessions)**

Biosynthesis of proteins, structural and conformation studies of proteins: Energy status of a protein molecule, structure; function relation of enzymes; Purification of cell signaling proteins: spectroscopic techniques and chromatography principles; Methods to estimate the concentration & purity.

UNIT IV: **(8 Sessions)**

Methods to determine 3D-Structures: X-ray crystallography and Nuclear Magnetic Resonance methods; Biological Membranes; Membrane Assembly and Protein Targeting; Signal transduction; Receptors and hormones; Antigen-antibody relationship. Protein Folding; Dynamics and Structural Evolution.

UNIT V: **(8 Sessions)**

Protein design and engineering: Strategies to alter catalytic efficiency; structure prediction and modeling proteins; Molecular graphics in protein engineering- Dynamics and mechanics; Drug-protein interactions and Design; applications of engineered proteins.

Course Outcomes:

At the end of the course students will able to:

- Understand the chemical principles of enzyme catalysis, including cofactor chemistry.
- Show insight in the action of enzymes as biocatalysts and in factors that influence enzyme activity and the kinetics of enzymatic reactions.
- Show awareness of the influence of enzyme structure on catalytic properties.
- Show experience with purification, handling and characterization of proteins.
- Understand in the physico-chemical properties of proteins that underlie purification methods.

Suggested Readings:

1. Nicolas Price & Lewis Stevens: Fundamentals of Enymology, 2nd edition, Oxford Univ. Press, New York, NY.
2. Trevor Palmer: Understanding Enzymes, Second Edition, J. Wiley & Sons, New York.
3. Geoffrey Zubay: Biochemistry, 3rd edition, Wm. C. Brown, Oxford, (1993).
4. Berg, Tymoczo and Stryer: Biochemistry, 7th Edition., W.H.Freeman, 2010.

5. Practical Chemical Biochemistry Ed. H.V.Varley, A.H.Goven Lock and M. Bell William Heinnemann Medical Books Ltd. London.
6. David L. Nelson; Michael M. Cox.Lehninger Principles of Biochemistry, Fourth Edition.W. H. Freeman, 2004.

Website Sources:

- https://onlinecourses.swayam2.ac.in/cec20_bt20/preview
- http://www.gbu.ac.in/coursestructure/biotech/MSc_Biotech_17July2019.pdf
- https://en.wikipedia.org/wiki/Protein_engineering
- https://www.researchgate.net/publication/221925539_Protein_Engineering_Methods_and_Applications
- http://www.sau.int/ISA/protein%20engg.pdf
- https://academic.oup.com/peds

IFTM University, Moradabad
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MTB-204: BIOPHYSICAL & BIOCHEMICAL TECHNIQUES

Objective(s): The objectives of this course:

- Is to impart knowledge to students about the concepts related to the biophysical properties of biomolecules.
- Students will learn the techniques and tools employed in the various qualitative and quantitative analyses of molecules.

UNIT I: **(8 Sessions)**

Colloids Of Biopolymers and Their Properties: Colloidal solutions of biopolymers and their electrochemical properties. Hydrodynamic properties: Viscosity, diffusion etc of biopolymers; Molecular weight determination, osmotic pressure, reverse osmosis, and Donnan effect. Structure of Bio membranes and their electrochemical properties, membrane potential, action potential and propagation of impulses.

UNIT II: **(8 Sessions)**

Microscopy: Introduction to principles and working of light & Electron Microscope, Scanning Tunneling Microcopy, SEM, TEM, AIM, Sample preparation for Electron Microscopy.

UNIT III: **(8 Sessions)**

Electrophoresis & Advanced Immuno techniques: Different methods of electrophoresis for protein, nucleic acids, small molecular weight compounds. Peptide mapping and combination of electro focusing and SDS-PAGE, Comet assay, Karyotyping, FISH, Rocket Immuno electrophoresis, ELISA, RIA, western blot.

UNIT IV: **(8 Sessions)**

Spectrophotometry And Radio Activity: Introduction to principles and applications of (a) spectroscopic methods (UV, Vis, IR, Fluorescence, ORD, CD & PAS) (b) NMR, ESR & Mass spectrometry. Use of radioactive and stable isotopes and their detection in biological systems.

UNIT V: **(8 Sessions)**

Separation And Sequencing Techniques: Automatic analyzer for amino acids, protein sequenator, peptide synthesizer & nucleic acid synthesizer. Cell sorters and their applications. Theory of lyophilization and its applications to biological systems.

Course Outcomes:

At the end of the course students will able to:

- Explain the fundamental properties of molecules like electrochemical proiperties, hydrodynamic properties, viscosity, diffusion, osmosis etc.
- Gain sound knowledge related to the working and functions of different types of microscopes.
- Describe the various biochemical techniques employed in the analysis of biomolecules.
- Explain the working principle and functions of important instruments used in the quantitative and qualitative analysis of molecules and compounds.
- Describe the principle of various sequencing techniques, synthesis of nucleic acids and peptides.
- Explain the concept of lyophilization and its application in biological systems

Suggested Readings:

1. Introduction to Biophysics by Pranab Kumar Banerjee, S Chand and company, 2008.

2. Instrumental methods of chemical analysis by G. R Chatwal and S .K Anand, Himalaya publishing house, 2008.
3. Biotechnology Procedures and Experiments handbook by S. Harisha, Infinity Science, Press LIC, 2008.

Website Sources:

- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5695667/
- https://www.biophysics.org/education-careers/education-resources/selected-topics-in-biophysics/biophysical-techniques
- https://www.omicsonline.org/scholarly/biophysical-techniques
- http://nsdl.niscair.res.in/jspui/bitstream/123456789/104/1/Spectroscopic_techniques.pdf
- https://www.biophysics.org/education-careers/education-resources/selected-topics-in-biophysics/biophysical-techniques

IFTM University, Moradabad
Master of Technology (M.Tech.), Programme
M.Tech. Biotechnology I Year (II Semester)
(Effective from 2021-22)

MTB-211: WASTE WATER ENGINEERING

Objective(s): The objectives of this course:

- Is to describe wastewater treatment technologies predominantly in use today.
- Ultimately, the technology selected as appropriate for one application may not be the optimal for another.
- Selection will be based on site-specific factors, such as resources available, climate, land availability, economics, etc.

UNIT I: **(8 Sessions)**

Introduction: Uses of water by industry- sources and types of industrial waste water disposal and environmental impacts, waste water reuse and applications, public health and environment issues, constituents (Physical, chemical and biological) found in waste water, units to measure physical, chemical and biological parameters, water quality standards, An overview of waste water treatment, Eutrophication.

UNIT II: **(8 Sessions)**

Unit Operations for waste water treatment: Principle physical and chemical unit operations used in waste water treatment – aeration, coagulation and flocculation, screening, sedimentation, flotation, neutralization and equalization.

UNIT III: **(8 Sessions)**

Biological waste water treatment: Biological Waste treatment principle and objectives, Role of microorganisms in waste treatment, Bacterial growth kinetics, Biological organic material, Nitrogen and Phosphorus removal and its process description; Type of Biological process for waste water treatment: suspended and attached waste water treatment process with special reference to activated sludge process, oxidation ditch, Sequential batch reactor UFSBR, rotating biological contractors, trickling filters, packed bed reactor, designing and operating parameters for suspended and attached waste water treatment process, Solid Retention Time, Sluge Volume Index, Loading Rate, F/M ratio, Substrate utilization rate, substrate removal in attached growth process.

UNIT IV: **(8 Sessions)**

Advanced treatment processes and sludge Treatment: Sludge thickening and stabilization, aerobic anaerobic digesters, single stage and two stage anaerobic digesters, alkaline treatment, composting, Membrane filtration, carbon adsorption, Ion exchange, disinfection and theory of disinfection.

UNIT V: **(8 Sessions)**

Characteristic and treatment: Characteristic and treatment of industrial waste water treatment from textiles, pulp and paper, sugar and distilleries, dairy industries.

Course Outcomes:

At the end of the course students will able to:

- Understand basics water chemistry to solve problems associated with water/wastewater treatment and natural water quality.
- Understand Basics of two phase (water and solid) reactions and solubility to solve problems associated with water/wastewater treatment and natural water quality.
- Understand several tools and techniques employed to treat waste water.

Suggested Readings:

1. Waste Water Engineering- Metcalf &Fuddy, 3rded. McGraw Hill.
2. Environmental Biotechnology Prof.S.V.SRana. Rastogi Publication.
3. Industrial & Environmental Biotechnology, Ahmed, Ane/Rout Publishers.
4. Introduction to Waste Water Treatment- R. S. Ramalho, Academic Press.
5. Environmental Biotechnology, B.C. Bhattacharya &Ritu Banerjee, Oxford Press, 2007.
6. Environmental Biotech., PradiptaKrimar, I.K. International Pvt. Ltd., 2006.
7. Environmental Microbiology & Biotechnology, D.P. Singh, S.K. Dwivedi, New Age International Publishers, 2004.

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books

IFTM University, Moradabad
Master of Technology (M.Tech.), Programme
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(Effective from 2021-22)

MTB-251: Recombinant DNA Technology; Microbiological Engineering

1.	Introduction of Laboratory Practices	
2	Safety Measures	
3	Do and Don't	
4	About Equipment and Accessories and Working	
5	To study different growth phases of bacterial population and plot a bacterial growth curve.	Experiment 1
6	To produce ethanol under submerged conditions using *Saccharomyces cerevisiae.*	Experiment 2
7	To purify ethanol produced under submerged conditions.	Experiment 3
8	To immobilize microbial cells using sodium- alginate gel entrapment method.	Experiment 4
9	To produce amylase enzyme under solid state fermentation and submerged state fermentation.	Experiment 5
10	To extract the genomic DNA from Plant Leaves.	Experiment 6
11	Electrophoresis of extracted DNA.	Experiment 7
12	Isolation and purification of plasmid DNA.	Experiment 8
13	To perform restriction digestion of λ- DNA with EcoR1 & HIND-III enzymes and electrophoresis of digested DNA.	Experiment 9
14.	To perform ligation of Lambda (λ) HindIII digest.	Experiment 10
15.	To transform plasmid DNA into bacteria.	Experiment 12
16.	To amplify a specific DNA fragment by Polymerase Chain Reaction using random primers.	Experiment 13

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MTB-252: Enzyme & Protein Engineering

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3	Do and Don't	
4	About Equipment and Accessories and Working	
5	To isolate and assay a plant enzyme, glucosidase.	Experiment 1
6	To determine the optimum temperature for enzyme activity.	Experiment 2
7	To determine the optimum pH for enzyme activity.	Experiment 3
8	To determine the effect of substrate concentration on the enzyme activity.	Experiment 4
9	To determine the effect of enzyme concentration on the enzyme activity.	Experiment 5
10	To determine Km and Vmax for alkaline phosphatase enzyme.	Experiment 6
11	Immobilization of salivary amylase enzyme.	Experiment 7
12	Estimation of disulphide bonds using Edman's reagent.	Experiment 8
13	To Perform chemical cleavage of proteins at methionyl-X peptide and cysteinyl-X peptide bonds.	Experiment 9
14	To perform enzymatic digestion of proteins in solution and SDS-polyacrylamide gels.	Experiments 10

IFTM UNIVERSITY, MORADABAD
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COURSE STRUCUTRE
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Third Semester

S.N.	Module Code	Module Name	Periods			EVALUATION SCHEME			End Sem Exam	Course Total	Credits
			L	T	P	Mid Sem Exam	AS +AT	Total			
THEORY											
1.	MTB-301	Immunotechnology & Immunoinformatics	3	1	0	20	10	30	70	100	4
2.	MTB-302	Bioreactor Analysis & Design	3	1	0	20	10	30	70	100	4
3.	MTB-303	Solid Waste Management	3	1	0	20	10	30	70	100	4
4.	MTB-304-308	Department Elective – III	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT											
5.	MTB-351	Immunotechnology	0	0	4	20	10	30	70	100	2
6.	MTB-352	Solid Waste Management	0	0	4	20	10	30	70	100	2
7.	MTB-353	Mini Project	0	0	2	-	-	100	-	100	1
		Total Credit	12	4	10			280	420	700	**21**

IFTM University, Moradabad
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(Effective from 2021-22)

MTB-301: IMMUNOTECHNOLOGY & IMMUNOINFORMATICS

Objective(s): The objectives of this course:

- Is to provide students with basic understanding and applications of bioinformatics in the field of immunology.
- Will provide the basic concepts of immunology and also help students understand the concepts behind the sequence and structural alignment, database searching, protein structure predictions and applications and limitations of T cell & B cell epitopes.

UNIT I: **(8 Sessions)**

Overview of Immune System: Types of Immunity, Cells of Immune system, Antigens, Fine structure and biological functions of Immunoglobulins, Phagocytosis, Opsonization and Neutralization, Cytokines and their role in immune response through JAK-STAT signaling.

UNIT II: **(8 Sessions)**

Antigen-Antibody Interactions: Flocculation, Precipitation, Agglutination, Immunodiffusion- principle and techniques, ELISA, Western blotting, Immunofluorescence, Flow cytometry for separation of immune cells, Complement system-components, activation, and its regulation.

UNIT III: **(8 Sessions)**

MHC and Transplantation Immunology: MHC and the HLA system – Structure of HLA class I, class II and class III molecules, Presentation and Processing of Antigen derived peptides by MHC (endocytic and cytosolic processing), Genetic Organization of HLA genes, Types of graft, Graft-Versus-Host Reactions (GVHR), Mechanism of graft rejection.

UNIT IV: **(8 Sessions)**

Immunization: Objectives of Immunization, Active and Passive Immunization, Types of Vaccines, methods for designing Vaccines, Vaccinology and immunoinformatics, Reverse Vaccinology, Databases & Tools for prediction of B & T-cell epitopes – SYFPEITHI, Pred, ProPred etc. and their limitations.

UNIT V: **(8 Sessions)**

Structure Activity Relationship: QSARs and QSPRs, QSAR Methodology, Various Descriptors used in QSARs: Electronics; Topology; Quantum Chemical based Descriptors. Use of Genetic Algorithms, Neural Networks and Principle Components Analysis in the QSAR equations.

Course Outcomes:

At the end of the course students will able to:

- Explain the basic concepts of immunology.
- Describe the different types of immunity, antigens, epitopes.
- Explain the structure and function of different types of antibodies.
- Describe various types of antigen-antibody interactions and different types of immunological techniques like ELISA, Western blotting, immune precipitation.
- Apply key concepts of different immunoinformatic tools.
- Analyze sequence and structure analysis of T cell and B cell epitopes.
- Apply the knowledge of bioinformatics in the immunology research.

Suggested Readings:

1. Richard A. Goldsby, Thomas J. Kindt and Barbara A. Osborne Kuby Immunology 4th Edition.
2. Darren R Flower. Immunoinformatics: Predicting Immunogeni city in Silico.Publisher: Humana Press.
3. Abul K. Abbas, Andrew H. H. Lichtman, Shiv Pillai, Basic Immunology (Function and Disorder of Immune System), 4th Edition; Elsevier Publisher.
4. Thomas J. Kindt, Barbara A. Osborne, Richard A. Goldsby, Kuby Immunology, 6th Edition; Publisher: W H Freeman & Co.
5. Roitt's Immunology, P.J. Delves, S. J. Martine, D.R. Burton, I.M. Roitt, 12th Edition. Wiley-Blackwell.
6. Shoba Ranganathan ,Vladimir Brusic , Christian Schonbach. Immunoinformatics (Immunomics Reviews),Publisher:Springer.

Website Sources:

- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2967261/
- http://www.imgt.org/about/immunoinformatics.php
- https://www.biorxiv.org/content/10.1101/2020.02.28.970343v1.full
- https://www.limswiki.org/index.php/Immunoinformatics
- https://biology.mit.edu/faculty-and-research/areas-of-research/immunology/
- https://www.coursera.org/learn/immunologyfundamentalsimmunitybcells

IFTM University, Moradabad
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MTB-302: BIOREACTOR ANALYSIS AND DESIGN

Objective(s): The objectives of the course:

- Is to inculcate the different types of bioreactors used in biotechnology industries application of material and energy balance to design the reactor kinetics.
- Will give the explanation of mixing in transport phenomenon and scale up of bioreactors for large volume production.

UNIT I: **(8 Sessions)**

Basic concept: Definition of bioreactor, fundamental principles, classification of reactors and their configurations, general design information, concept in energy and mass balances, flow-sheet, piping and instrumentation, material for construction of bioprocess plant.

UNIT II: **(8 Sessions)**

Analysis of ideal reactors: Concepts of reactors based on flow characteristics, design of ideal reactors using material and energy balance, batch bioreactor design, chemostat analysis, definition of chemostat, turbidostat, single flow single stage chemostat, single flow multistage chemostat, recycle flow in chemostat, concepts of dilution rate productivity analysis.

UNIT III: **(8 Sessions)**

Mixing, mass transfer and instrumentation control of bioreactors: Concepts introduction, mass transfer, theory of mixing, rheological properties, bioreactor sensor, temperature measurement control, principle of dissolved oxygen measurement and control, principle of pH/redox measurement and control, deduction and prevention of foam.

UNIT IV: **(8 Sessions)**

Vessels for biotechnology application: Different bioreactor configuration, design considerations for maintaining sterility of process streams and process equipment, selection and specification of major equipment used in bioprocess industries.

UNIT V: **(8 Sessions)**

Specific Bioreactor analysis and scale up: Design and analysis of fed-batch and air-lift bioreactors, application in animal cell culture, basic concept of scale-up, non-dimensional analysis, utilities for biotechnology production plants, process economics, bioprocess validation, safety considerations.

Course Outcomes:

At the end of the course students will able to:

- Theory of mixing in bioreactor, operation and designing of chemostat & turbidostat.
- Design & Analysis of single and multiple reactor system.
- Selection of criterion for scale-up of the reactors.
-

Suggested Readings:

1. Octave Levenspiel: Chemical Reaction Engineering,John Wiley & Sons,1999.
2. Rao, D.G.: Introduction to Biochemical Engineering. McGraw-Hill Inc.2005.
3. Doran, P.M.: Bioprocess Engineering Principles. Academic Press,1995.
4. Bailey, J. E. and Ollis, D. F.: Biochemical Engineering Fundamentals. Mc-Graw Hill Inc.1986.

Website Sources:

- https://nptel.ac.in/courses/103/103/103103035/
- http://www.ric.edu/faculty/ptiskus/reactions/
- https://www.khanacademy.org
- https://nptel.ac.in/courses/102/106/102106053/

IFTM University, Moradabad
Master of Technology (M.Tech.), Programme
M.Tech. Biotechnology II Year (III Semester)
(Effective from 2021-22)
MTB-303: SOLID WASTE MANAGEMENT

Objective(s): The objectives of this course:

- Has been design to familiarize a post graduate student with the understanding of the challenges that governing body has to face and how to tackle those challenges.
- Various adopted treatment technologies for MSW are critically reviewed, along with their advantages and limitations.

UNIT I: **(8 Sessions)**

Solid wastes: Sources, nature and characteristics, Quantities and qualities, Rates of generation and factors affecting them, Potential of diseases, nuisances and other problems due to solid wastes, Changing nature of solid wastes and its impact on solid waste management. Solid wastes management- Generation, on-site storage, collection, separation, processing and disposal. On-site storage methods-containers, their type, size and location

UNIT II: **(8 Sessions)**

Solid waste characterization: ultimate and proximate analysis , Waste reduction at source- volume reduction, Collection techniques Transport of solid waste and its optimization, transfer stations, Materials recovery/recycling; - Recycling of Aluminum, glass, plastic and, paper, Treatment and disposal techniques - Burning, Open dumping, Landfill : land filling methods and operation, Landfill emissions : Leachate and Landfill gas, Leachate collection & analysis, Composting, Vermi-composting, Incineration.

UNIT III: **(8 Sessions)**

Energy from Waste: Pyrolysis, Gasification, Refuse derived fuels, Merits and demerits of waste disposal methods, Municipal Waste (Management and Handling) Rules 2000Vadose and saturated zone monitoring of solid waste dumps, Evaluation of ground water pollution, sampling and analysis, protection at disposal sites.

UNIT IV: **(8 Sessions)**

Waste generation, Need and requirements for management and planning: Solid waste- types, generation trends, quality and quantity aspects, Integrated Solid waste Management. Biomedical waste: Introduction: definition, Classification, types and composition, Types of solids, liquids, sharps, blood and blood tissue, radioactive material, biological and chemical material.

UNIT V: **(8 Sessions)**

Industrial and Hazardous solid waste management: Urban solid waste management and its modeling. Disposal methods such as sanitary landfill, biological digestion etc.

Course Outcomes:

At the end of the course students will able to:

- Understand basics of solid waste management.
- Understand how solid waste is analysed and how it is managed by several methods like recycling etc.
- Understand several tools and techniques employed to treat solid waste.

Suggested Readings:

1. Tchobanogloas, G. Integrated Solid Waste Management: Engineering, Principle and Management. McGraw Hill, USA. 1993
2. Kreith, F. Handbook of Solid Waste Management. McGraw Hill Publishers, USA. 1999.
3. Shah, K. L. Basics of Solid and Hazardous Waste Management Technology. McGraw Hill, USA. 1999.
4. Vesilind, P. A., Worrell, W. and Reinhart, D. Solid Waste Engineering. Brooks/Cole Thomson Learning Inc., USA. 2002.
5. Peavey, H. S, Rowe, D. R and Tchobanoglous, G. Environmental Engineering. International Ed. McGraw-Hill, New York, USA. 1985.
6. White, P, Frank, M. and Hindle, P. Integrated Solid Waste Management- A Life Cycle Inventory. Chapman &Hall, USA. 1999.
7. Noble, G. Sanitary Landfill Design Handbook. Technomic Westport Connecticut, USA. 8. Evans, G. 2005. Biowaste and Biological Waste Treatment. James and James (Science Publishers) Ltd, U.K. 1976.
8. Kumar, R and Singh, R.N. Municipal Water and Wastewater Treatment. Capitol Pub. Co., New Delhi. 2006.

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books

IFTM University, Moradabad
Master of Technology (M.Tech.), Programme
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(Effective from 2021-22)

MTB-305: BIOMEDICAL INSTRUMENTATION & MEASUREMENTS

Objective: The objective of this course:

- With widespread use and requirements of medical instruments, this course gives knowledge of the principle of operation and design of biomedical instruments.

UNIT I: **(8 Sessions)**

Overview of Biomedical Instrumentation system – History of biomedical instrumentation, Biometrics, Introduction to the man-instrument system, Components of the man-instrument system, Types of biomedical equipments – Analytical, Diagnostic, Therapeutic and Surgical equipments; Calibration of medical devices and testing of biomedical equipments; Electrical classification of Biomedical Equipments.

UNIT II: **(8 Sessions)**

Analytic Equipments: Flame photometers, Spectro photometers, Beer lambert law, Colorimeters, Blood gas analyzers –Electrodes for pH, pO_2 and pCO_2. Hb meter, Blood cell counters, Auto analyzers. transducer and transduction principles, Active transducers, Passive transducers, Transducers for biomedical applications.

UNIT III: **(8 Sessions)**

Diagnostic Equipments: Electrocardiography (ECG) –ECG in diagnosis, Lead systems, Artifacts, ECG Machine. Principles and applications–Vector cardiography (VCG), Magnetocardiography (MCG) – SQUIDS and Phonocardiography (PCG). Electro encephalography (EEG), EEG Machine, Electroretinography (ERG) and Electrooculography (EOG). Principles and applications–Electromyography (EMG); Electroneurography (ENG). Endoscopy, Laparoscopy.

UNIT IV: **(8 Sessions)**

Patient monitoring system–Bed-side monitors, Central station monitors, Computerized arrhythmia monitors, Cardio scope, Ambulatory monitors, Neonatal monitors, Holter monitoring, Infant Warmer, Neonatal Incubator, Infusion pump, syringe pump, Cardiotocograph – Plethysmography, Measurement of heart sounds Methods of monitoring fetal heart rate. Biotelemetry – Principles – Types – Single channel and Multichannel – Frequency division and Time division multiplexing, Tele-stimulation, Telemedicine – Principles and applications.

UNIT V: **(8 Sessions)**

Audiometers –Pure tone, Speech and Mask audiometers, Bekesy audiometers, Tympanometers. Hearing aids, Cochlear implants, Ear moulds. Densitometers – Principle and applications. Robotic surgery –Orthopedic prostheses fixation.

Course Outcomes:

At the end of the course students will able to:

- Develop a thorough understanding on basics of biomedical amplifiers
- Develop a thorough understanding on basics of biomedical measurements
- Develop a thorough understanding on principles of medical instrumentations
- Develop a thorough understanding on clinical applications of medical instrumentation systems

Suggested Readings:

1. Biomedical Instrumentation and Measurement by Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer.
2. Medical Instrumentation for Health Care by Leslie Cromwell.
3. Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation by Robert B. Northrop.
4. Introduction to Bioinstrumentation: With Biological, Environmental, and Medical Application by Clifford D. Ferris.
5. Biomedical Instrumentation: Technology and Applications by Raghbir Singh

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://library.nitrkl.ac.in/
- https://study.com/

IFTM University, Moradabad
Master of Technology (M.Tech.), Programme
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(Effective from 2021-22)

MTB-351: Immunotechnology

1	Introduction of Laboratory Practices	
2	Safety Measures	
3	Do and Don't	
4	About Equipment and Accessories and Working	
5	To enumerate the total number of RBCs and WBCs in the blood sample.	Experiment 1
6	Estimation of specific antibodies present in serum by rapid slide test (WIDAL test).	Experiment 2
7	To Perform Ouchterlony double diffusion.	Experiment 3
8	To perform Sandwich ELISA by using microtiter plate reader.	Experiment 4
9	To perform Counter current immune electrophoresis.	Experiment 5
10	To isolate the lymphocyte from whole blood by density gradient centrifugation method.	Experiment 6
11	To perform the precipitation technique by single radial immunodiffusion.	Experiment 7
12	To perform the technique of Immunoprecipitation to precipitate of the antigen-antibody complex by using Protein A beads.	Experiment 8

IFTM University, Moradabad
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MTB-352: Solid Waste Management

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipment and Accessories and Working	
5.	Isolation and enumeration of microorganisms from soil by serial dilution agar plating method and to obtain pure culture of microorganisms by pour, spread and streak plate method	Experiment 1
6.	To determine the alkalinity of given sample of water in mg/l.	Experiment 2
7.	To determine the chloride content of the given sample by Mohr's method.	Experiment 3
8.	To determine the total suspended solids, total dissolved solids and total solids of given sample.	Experiment 4
9.	To determine the turbidity of the given sample using nephelometer in N.T.U.	Experiment 5
10.	To determine the hardness of the given water sample using EDTA method.	Experiment 6
11.	To determine the amount of dissolved oxygen present in the given sample.	Experiment 7
12.	To determine the BOD of the given sample.	Experiment 8
13.	To determine the Chemical oxygen demand (COD) of the given sample.	Experiment 9
14.	To Perform presumptive test for water potability.	Experiment 10

IFTM UNIVERSITY, MORADABAD
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(Effective from 2021-22)

Fourth Semester

S.N.	Module Code	Module Name	Periods			EVALUATION SCHEME			End Sem Exam	Course Total	Credits
			L	T	P	Mid Sem Exam	AS +AT	Total			
PRACTICALS / PROJECT											
1.	MTB-482	Dissertation	0	0	0	0	0	150	250	400	20
		Total Credit									**20**

List of Electives

Department Elective-III

S. N.	Course Code	Course Name
1.	MTB-304	IPR, Bioethics & Biosafety
2.	MTB-305	Biomedical Instrumentation & Measurements
3.	MTB-306	Medical Biotechnology
4.	MTB-307	Computer Aided Drug Design
5.	MTB-308	Metabolic Engineering