Discipline : Biotechnology.	**Semester : 5th**	**Name of the teaching faculty : Anasuya Dash**
Subject : Th1 Bioreaction Engineering	No. of Days/ per week class allotted: 3	Semester from date : 01/07/2026 to date : 05/11/2026 No. of weeks : 15
Week	Class Day	Theory / Practical Topics
1st	1st	1.1 Introduction to bioreaction engineering; chemical and biochemical reaction.
	2nd	1.2 Reaction kinetics – definition, importance and basic concept.
	3rd	1.3 Rate laws – definition and type of reaction rates.
2nd	1st	2.1 Zero order reaction – rate equation and characteristics.
	2nd	2.2 First order reactions – rate equation and characteristics.
	3rd	2.3 Comparison of Zero order and first order reactions.
3rd	1st	3.1 Determination of reaction order – graphical and analytical approaches.
	2nd	3.2 Determination of rate constant; introduction to reaction rate in biological system.
	3rd	3.3 Introduction to ideal reactor; classifications and assumptions.
4th	1st	4.1 Batch reactor – principle, operation and characteristics.
	2nd	4.2 Batch reactor – material balance and design equation.
	3rd	4.3 Batch reactor – design, calculation and applications.
5th	1st	5.1 Continuous stirred tank reactor (CSTR) – Principle and operation.
	2nd	5.2 CSTR – material balance and design equation.
	3rd	5.3 CSTR – design, calculation and application.
6th	1st	6.1 Plug flow reactor (PFR) – principle, operation and assumptions.
	2nd	6.2 PFR – design equation and numerical calculation.

	3rd	6.3 Application to ideal reactors in biotechnology; comparison of batch, CSTR and PFR.
7th	1st	7.1 Introduction to enzyme immobilization – definition, importance and advantages.
	2nd	7.2 Methods of enzyme immobilization – Adsorption and covalent binding.
	3rd	7.3 Entrapment and encapsulation methods of enzyme immobilization.
8th	1st	8.1 Crosslinking and other immobilization method.
	2nd	8.2 Comparison of enzyme immobilization methods; applications.
	3rd	8.3 Diffusion in immobilized enzyme systems – introduction and importance.
9th	1st	9.1 Internal and external diffusion limitations.
	2nd	9.2 Thiele modules – concept, significance and interpretations.
	3rd	9.3 Effectiveness factor – concept and relationship with diffusion.
10th	1st	10.1 Damkohler number and impact of diffusion on reactor performance.
	2nd	10.2 Introduction to microbial growth kinetics.
	3rd	10.3 Phases of microbial growth and kinetics of cell growth.
11th	1st	11.1 Substrate utilization and relationship with microbial growth.
	2nd	11.2 Product formation – growth associated and nongrowth associated products.
	3rd	11.3 Monod equation – principle, equation and significance.
12th	1st	12.1 Structured and unstructured models of microbial growth.
	2nd	12.2 Concept of maintenance energy and examples of modelling in microbial system.
	3rd	12.3 Introduction to reactor operations – batch, fed batch and continuous operations.
13th	1st	13.1 Batch reactor operations – characteristics, advantages and limitations.
	2nd	13.2 Fed batch operations – principle, feeding strategy and applications.
	3rd	13.3 Continuous operations – principle, characteristics and operations.
14th	1st	14.1 Microbial and enzyme reactor – Basic principle and example.

	2nd	14.2 Optimization of bioprocess parameters – temperature, pH, substrate and aeration.
	3rd	14.3 Optimization of bioprocess parameters – agitation, dissolved oxygen and other factors.
15th	1st	15.1 Introduction to scale up bioreactor – importance and basic concepts.
	2nd	15.2 Scale up criteria and problems encountered during scale up.
	3rd	15.3 Application of reactor optimization and scale up.

Discipline : Biotechnology.	**Semester : 5th**	**Name of the teaching faculty : Sweta Mishra**
Subject : TH2 Genetics	No. of Days/ per week class allotted: 3	Semester from date : 01/07/2026 to date : 05/11/2026 No. of weeks : 15
Week	Class Day	Theory / Practical Topics
1st	1st	1.1 Introduction to Genetics: Definition, scope, and significance
	2nd	1.2 History of Genetics: Pre-Mendelian concepts to Mendel's breakthroughs
	3rd	1.3 Structure of DNA: Nucleotides, double helix model, and chemical properties
2nd	1st	2.1 Structure of RNA: Types (mRNA, tRNA, rRNA) and functional differences
	2nd	2.2 History of Genetics: Transition from Mendel to modern genetics
	3rd	2.3 Chromosomes & Organization: Prokaryotic vs. eukaryotic packaging
3rd	1st	3.1 Chromosome Structure: Histones, nucleosomes, chromatin, and karyotypes
	2nd	3.2 Central Dogma of Molecular Biology: Overview (DNA → RNA → Protein)
	3rd	3.3 Central Dogma: Exceptions (Reverse transcription) & Unit I Review
4th	1st	4.1 Mendelian Genetics: Mendel's experiments and Law of Dominance
	2nd	4.2 Law of Segregation: Monohybrid crosses & Punnett square analysis
	3rd	4.3 Law of Independent Assortment: Dihybrid crosses & phenotypic ratios
5th	1st	5.1 Non-Mendelian Inheritance: Incomplete dominance & Codominance
	2nd	5.2 Multiple Alleles: ABO blood group system & allele interactions
	3rd	5.3 Polygenic Inheritance: Continuous variation and quantitative traits
6th	1st	6.1 Sex-Linked Inheritance: X-linked and Y-linked traits
	2nd	6.2 Applications of Mendelian & Non-Mendelian problem-solving
	3rd	6.3 Unit II Comprehensive Review & Problem Set Workshop
7th	1st	7.1 Genetic Variation & Mutation: Overview and classification
	2nd	7.2 Point Mutations: Silent, missense, and nonsense mutations

	3rd	7.3 Frameshift Mutations: Insertions, deletions, and reading frame shifts
8th	1st	8.1 Chromosomal Aberrations: Structural changes (deletion, duplication, inversion, translocation)
	2nd	8.2 Chromosomal Aberrations: Numerical changes (aneuploidy, polyploidy)
	3rd	8.3 Causes and Effects of Mutations: Spontaneous vs. induced, chemical & physical mutagens
9th	1st	9.1 Genetic Disorders: Inheritance patterns of Sickle Cell Anemia
	2nd	9.2 Genetic Disorders: Inheritance patterns of Hemophilia
	3rd	9.3 DNA Repair Mechanisms: Base Excision Repair (BER) & Nucleotide Excision Repair (NER)
10th	1st	10.1 Transcription in Prokaryotes: Initiation, elongation, and termination
	2nd	10.2 Transcription in Eukaryotes: RNA Polymerases & post-transcriptional modifications
	3rd	10.3 Translation: Genetic code, tRNA charging, ribosomal machinery
11th	1st	11.1 Translation: Polypeptide chain elongation, termination, and post-translational folding
	2nd	11.2 Regulation of Gene Expression: Principles in prokaryotes vs. eukaryotes
	3rd	11.3 Operon Concept: Structure, promoter, operator, and regulatory genes
12th	1st	12.1 Lac Operon: Inducible control and catabolite repression
	2nd	12.2 Trp Operon: Repressible control and attenuation mechanism
	3rd	12.3 Epigenetics & Gene Silencing: DNA methylation, histone modification, and RNAi
13th	1st	13.1 Recombinant DNA Technology: Restriction enzymes, vectors, and ligases
	2nd	13.2 Genetic Engineering: Cloning strategies and transformation methods
	3rd	13.3Polymerase Chain Reaction (PCR): Steps (denaturation, annealing, extension) and variants
14th	1st	14.1 Applications of PCR in diagnostic & research technologies
	2nd	14.2 CRISPR-Cas9 & Gene Editing: Mechanism, guide RNA, and target cleavage

	3rd	14. 3 Applications of Genetics in Medicine (gene therapy, personalized medicine
15th	1st	15.1 Applications in Agriculture (transgenic crops) & Forensic Science (DNA profiling)
	2nd	15.2 Ethical, Legal, and Social Concerns in Genetic Research
	3rd	15.3 Final Course Review & Assessment Preparation

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Discipline: Biotechnology.	**Semester: 5th**	**Name of the teaching faculty: Swetangini Naik**
Subject: Food Biotechnology (Th3a)	No. of Days/ per week class allotted: 3	Semester from date : 01/07/2026 to date : 05/11/2026 No. of weeks : 15
Week	Class Day	Theory / Practical Topics
1st	1st	**Unit: I** Introduction to Food Biotechnology: Definition and scope of food biotechnology,
	2nd	Historical developments in food biotechnology,
	3rd	Role of biotechnology in food processing and
2nd	1st	Role of biotechnology in food preservation
	2nd	Advantages and concerns of genetically modified (GM) foods
	3rd	**Unit: II** Microorganisms in Food Processing: Introduction
3rd	1st	Beneficial microorganisms in food: yeasts, bacteria, and Molds
	2nd	Beneficial microorganisms in food: yeasts, bacteria, and Molds
	3rd	Fermented foods: Types
4th	1st	production processes
	2nd	Probiotics and prebiotics: Health benefits and applications,
	3rd	Spoilage microorganisms
5th	1st	foodborne pathogens
	2nd	yogurt, cheese, and bread
	3rd	Doubt clearing class
6th	1st	**Unit:III** Fermentation and Enzyme Technology
	2nd	Basics of fermentation
	3rd	types batch, continuous, solid-state

7th	1st	Industrial production of fermented foods (e.g., beer, wine, vinegar),
	2nd	Enzymes in food biotechnology
	3rd	Types, sources
8th	1st	and applications
	2nd	Immobilized enzyme technology in food processing
	3rd	Types of immobilized enzymes
9th	1st	Importance
	2nd	**Unit: IV** Genetic Engineering in Food Biotechnology
	3rd	Introduction to genetic modification in food,
10th	1st	Techniques used in genetically modified organisms (GMOs)
	2nd	Golden Rice, BT- Brinjal
	3rd	Applications of GMOs in agriculture
11th	1st	Applications of GMOs in food production
	2nd	Applications of GMOs in food production
	3rd	Regulatory aspects and ethical concerns of GM Foods
12th	1st	Regulatory aspects and ethical concerns of GM Foods
	2nd	Doubt clearing class
	3rd	**Unit: V** Food Safety and Quality Control:
13th	1st	Importance of food safety
	2nd	Guidelines and protocol for food safety
	3rd	HACCP (Hazard Analysis and critical Control Points) in food biotechnology,
14th	1st	Detection methods for GMOs in food products,
	2nd	Food allergens

	3rd	Safety regulations
15th	1st	Impact of biotechnology on food security and sustainability
	2nd	Probable questions discussion
	3rd	Doubt clearing class

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Discipline: Biotechnology.	**Semester: 5th**	**Name of the teaching faculty: Swetangini Naik**
Subject: Pharmacogenomics (Th4a)	No. of Days/ per week class allotted: 3	Semester from date: 01/07/2026 to date: 05/11/2026 No. of weeks: 15
Week	Class Day	Theory / Practical Topics
1st	1st	**UNIT-I** Introduction to Pharmacogenomics
	2nd	Definition, history, and scope of pharmacogenomics
	3rd	Role of pharmacogenomics in drug discovery
2nd	1st	Role of pharmacogenomics in drug development
	2nd	Importance of personalized medicine in healthcare
	3rd	**UNIT-II** Genetic Basis of Drug Response: Introduction
3rd	1st	Overview of pharmacokinetics (ADME: Absorption, Distribution, Metabolism, Excretion),
	2nd	Absorption of Drug
	3rd	Distribution of drug
4th	1st	Metabolism of Drug
	2nd	Excretion of Drug
	3rd	Genetic polymorphisms and their impact on drug metabolism,
5th	1st	Cytochrome P450 enzymes

	2nd	Their (Enzymes) role in drug metabolism,
	3rd	Examples of genetic variations affecting drug response
6th	1st	**UNIT-III** Pharmacogenomic Testing and Biomarkers: Introduction
	2nd	Pharmacogenomic Testing
	3rd	Biomarkers and its types, role
7th	1st	Techniques for pharmacogenomic testing (PCR, microarrays, NGS),
	2nd	PCR, microarrays
	3rd	NGS
8th	1st	Identification of genetic biomarkers for drug efficacy
	2nd	Toxicity
	3rd	Doubt clearing session
9th	1st	Class test
	2nd	**UNIT-IV** Applications of Pharmacogenomics
	3rd	Pharmacogenomics in cancer therapy (targeted therapy),
10th	1st	Role in psychiatric disorders
	2nd	Cardiovascular diseases,
	3rd	Impact on adverse drug reactions
11th	1st	Impact on adverse drug reactions
	2nd	Drug repurposing,
	3rd	Pharmacogenomics in clinical trials

12th	1st	Drug development
	2nd	Targeted therapy
	3rd	**UNIT-V** Ethical, Legal, and Regulatory Aspects
13th	1st	Ethical concerns in pharmacogenomic research
	2nd	Ethical concerns in pharmacogenomic research
	3rd	FDA guidelines and regulatory policies on pharmacogenomics,
14th	1st	FDA guidelines and regulatory policies on pharmacogenomics,
	2nd	Privacy and confidentiality in genetic data,
	3rd	Future trends in pharmacogenomics
15th	1st	Advantages of Future pharmacogenomics
	2nd	Challenges
	3rd	Precision medicine