KALIABOR COLLEGE (AUTONOMOUS)

Kuwaritol, Nagaon, Assam – 782137

SYLLABUS

Learning Outcome Based Curriculum Framework (LOCF)

FOUR-YEAR UNDERGRADUATE PROGRAMME (FYUGP)

BACHELOR OF SCIENCE (B.Sc.) IN BIOTECHNOLOGY

Implemented under the National Education Policy (NEP) 2020

Effective from ACADEMIC SESSION 2026-27

vide Board of Studies Resolution No. KC-AT-ECO/BoS/26/01

Dated:11th June 2026

Offered by

Department of Biotechnology

Kaliabor College (Autonomous)

"Empowering Students through Science, Innovation and Sustainable Biotechnology"

Kaliabor College (Autonomous)

Nagaon-782137: Assam: India

Syllabus for FYUGP BSc Biotechnology Programme
Kaliabor College (Autonomous)

Introduction to the FYUGP B.Sc. Biotechnology Programme

The FYUGP B.Sc. Biotechnology Programme at Kaliabor College (Autonomous) is designed in alignment with the National Education Policy (NEP) 2020 to provide students with a strong foundation in modern biological sciences and biotechnology. The programme integrates theoretical knowledge, laboratory training, field exposure, and research-oriented learning to develop scientific skills, critical thinking, and innovation.

The curriculum covers key areas such as molecular biology, genetics, microbiology, biochemistry, bioinformatics, genetic engineering, ecology, physiology, plant and animal biotechnology, bioethics and food biotechnology etc., preparing students for higher education, research, entrepreneurship, and careers in biotechnology, healthcare, agriculture, environmental management, and allied sectors.

With a focus on academic excellence, ethical practices, and sustainable development, the programme encourages students to apply biotechnology for addressing regional and global challenges while contributing to the bioresource-based economy of Northeast India.

For the FYUGP B.Sc. Biotechnology programme at Kaliabor College (Autonomous), the programme objectives should align with NEP 2020, employability, research orientation, and regional relevance.

Programme Objectives (POs)

1. To provide a strong foundation in biological sciences and biotechnology through interdisciplinary learning in cell biology, genetics, microbiology, biochemistry, molecular biology, and bioinformatics.
2. To develop scientific temperament, critical thinking, and analytical skills for understanding and solving biological and biotechnological problems.
3. To impart practical laboratory skills and technical competence in modern biotechnological tools, techniques, instrumentation, and data analysis.
4. To promote research aptitude, innovation, and entrepreneurship through project-based learning, internships, and exposure to emerging areas of biotechnology.
5. To prepare students for higher education, research, and careers in biotechnology, healthcare, agriculture, environmental management, pharmaceuticals, and allied sectors.
6. To foster ethical values, environmental consciousness, and social responsibility in the application of biotechnology for sustainable development.
7. To enhance communication, leadership, teamwork, and digital skills required for professional success in academia, industry, and society.
8. To encourage the application of biotechnology for addressing regional and national challenges, particularly in agriculture, biodiversity conservation, public health, and bioresource utilization of Northeast India.

Eligibility Clause

As prescribed by Gauhati University (Mother University) and Kaliabor College (Autonomous) admission regulations from time to time.

Eligibility criteria may change periodically.

Semester	**Minor 1 (Credit)**	**Minor 2 (Credit)**	**MDC (Credit)**	**AEC (Credit)**	**SEC(Credit)**	**VAC (Credit)**	**Total Credit**
1st	Major (4)	Minor (4)	MDC (3)	AEC (4)	SEC (2+1)	VAC (2)	20
2nd	Major (4)	Minor (4)	MDC (3)	AEC (4)	SEC (2+1)	VAC (2)	20
3rd	Major (4) Major (4)	Minor (4)	MDC (3)	x	SEC (2+1)	VAC (2)	20
4th	Major (4) Major (4) Major (4) Major (4)	Minor (4)	x	x	x	x	20
5th	Major (4) Major (4) Major (4)	Minor (4)	x	x	Internship (4) During Summer Term	x	20
6th	Major (4) Major (4) Major (4) Major (4)	Minor (4)	x	x	x	x	20
Minimum Credit	60	24	9	8	SEC (9) Internship (4)	6	120

Honours

Semester	**Minor 1 (Credit)**	**Minor 2 (Credit)**	**MDC (Credit)**	**AEC (Credit)**	**SEC(Credit)**	**VAC (Credit)**	**Total Credit**
7th	Major (4) Major (4) Major (4) Major (4)	Minor (4)	x	x	x	x	20
8th	Major (4) Major (4) Major (4) Major (4)	Minor (4)	x	x	x	x	20
Minimum Credit	92	32	9	8	SEC (9) Internship (4)	6	160

Sem	Course	Course name	Total Credits	Theory	Practical	Marks	
						External (Theory+ Practical)	Internal
I	1. Major-1: BITU-MAJ-010104	Foundations of Biotechnology	4	3	1	70 (45+25)	30
	2. Minor-1:	Chemistry I	4	3	1	70 (45+25)	30
	3. SEC-1: BITU-SEC-010303	Fundamentals of Food Biotechnology	3	2	1	55 (30+25)	20
	4. MDC-1		3	3	0		
	5. AEC-1		4				
	6. VAC-1		2				
II	1. Major-2: BITU-MAJ-020104	Biochemistry	4	3	1	70(45+25)	30
	2. Minor-2:	Chemistry II	4	3	1	70(45+25)	30
	3. SEC-2: BITU-SEC-020303	Applied Food Biotechnology and Bioprocess engineering	3	2	1	55(30+25)	20
	4. MDC-2		3	3	0		
	5. AEC-2		4				
	6. VAC-3		2				
III	1. Major-3: BITU-MAJ-030104	Microbiology	4	3	1	70(45+25)	30
	2. Major-4: BITU-MAJ-030204	Genetics	4	3	1	70(45+25)	30
	3. Minor-3:	(To be co-opted)	4	3	1	70(45+25)	30
	4. SEC-3: BITU-SEC-030303	Food Bioprocess Technology & Product Development	3	2	1	55(30+25)	20
	5. AEC-3		2	2			
	6. MDC-3		3				
	7. VAC-3		2				
IV	1. Major-5: BITU-MAJ-040104	Cell and Molecular Biology	4	3	1	70(45+25)	30
	2. Major-6: BITU-MAJ-040204	Plant and Animal Physiology	4	3	1	70(45+25)	30
	3. Major-7: BITU-MAJ-040304	Immunology	4	3	1	70(45+25)	30
	4. Major-8: BITU-MAJ-040404	Ethnobiology	4	3	1	70(45+25)	30
	5. Minor-4:	(To be co-opted)	4	3	1	70(45+25)	30
	6. AEC-4		2	2			
V	1. Major-9: BITU-MAJ-050104	Recombinant DNA Technology	4	3	1	70(45+25)	30
	2. Major-10: BITU-MAJ-050204	Biostatistics	4	3	1	70(45+25)	30
	3. Major-11: BITU-MSJ-050304	Developmental Biology	4	3	1	70(45+25)	30
	4. Minor-5:	(To be co-opted)	4	3	1	70(45+25)	30
	5. Internship		4	0	4	70	30
VI	1. Major-12: BITU-MAJ-060104	Plant and Animal Biotechnology	4	3	1	70(45+25)	30
	2. Major-13: BITU-MAJ-060204	Bioinformatics	4	3	1	70(45+25)	30
	3. Major-14: BITU-MAJ-060304	Analytical biotechnology	4	3	1	70(45+25)	30
	4. Major-15: BITU-MAJ-060404	Dissertation	4	1	3	70(Thesis/ Report)	30
	5. Minor -6:	(To be co-opted)	4	3	1	70(45+25)	30

Sem	Course name	Paper name	Total Credit	Theory	Practical	Marks	
						External (Theory+ Practical)	Internal
VII	1. Major-16: BITU-MAJ-070104	Genomics and Proteomics	4	3	1	70 (45+25)	30
	2. Major-17: BITU-MAJ-070204	Microbial and Industrial Biotechnology	4	3	1	70 (45+25)	30
	3. Major-18: BITU-MAJ-070304	Biochemical Technology	4	3	1	70 (45+25)	30
	4. Major-19: BITU-MAJ-070404	Ecology and Environmental Biotechnology	4	3	1	70 (45+25)	30
	5. Minor-7:	Research Methodology/Research Methodology course from MOOCs	4	3	1	70 (45+25)	30
VIII	1. Major-20: BITU-MAJ-080104	Biophysics	4	3	1	70 (45+25)	30
	2.Major-21: BITU-MAJ-080204	Medical and Forensic Biotechnology	4	3	1	70 (45+25)	30
	3.Major-22: BITU-MAJ-080304	Bioethics and Intellectual Property Rights	4	3	1	70 (45+25)	30
	4.Major-23: BITU-MAJ-080304	Mini Project/ Dissertation	4	3	1	70 (45+25)	30
	5. Minor-8:	To be decided A course from MOOCs	4				

FYUGP B.Sc. Biotechnology (Major)
Semester I
Foundations of Biotechnology

Course Details

Particulars	**Details**
Programme	FYUGP B.Sc. Biotechnology
Course Title	Foundations of Biotechnology
Course Code	BITU-MAJ-010104
Course Type	Major
Credits	4 (Theory: 3 + Practical: 1)
Total Contact Hours	Theory: 45 Hours + Practical: 30 Hours
Total Marks	100 (Theory: 75 + Practical: 25)
Level	Undergraduate
NEP Category	Major Core Course

Course Description

This course is a simple and interesting journey from the origin of molecules, to cells and organisms, and finally to modern biotechnology where humans can edit and even create life. A practical unit ensures students learn by doing, not just reading. It serves as a gateway course for advanced studies in biotechnology and life sciences.

Course Outcomes (COs)

After successful completion of the course, students will be able to:

CO1: Explain the origin and evolution of life, the formation of biomolecules, and the structure–function relationships of carbohydrates, proteins, lipids, nucleic acids, and water in biological systems.

CO2: Describe the organization, diversity, and functioning of prokaryotic and eukaryotic cells, including cell compartmentalization, endosymbiotic theory, and cellular bioenergetics.

CO3: Interpret the diversity and evolution of living organisms, including microorganisms, plants, and animals, and explain fundamental physiological processes and evolutionary mechanisms.

CO4: Introduce students to the fundamental concepts of biotechnology. Demonstrate an understanding of modern biotechnology tools and techniques, including recombinant DNA technology, PCR, gel electrophoresis, gene cloning, gene therapy, CRISPR-Cas systems, and synthetic biology.

CO5: Evaluate the ethical, biosafety, and societal implications of genetic engineering, synthetic biology, and emerging life science technologies.

CO6: Apply basic laboratory skills in life sciences, including safe handling of biological materials, use of laboratory instruments, microscopic observation of cells and microorganisms, isolation and visualization of DNA, and exposure to advanced research facilities and practices.

Bloom's Taxonomy Level of the Course

CO1: Understand (U)
CO2: Understand (U)
CO3: Analyze (A)
CO4: Apply (Ap)
CO5: Evaluate (E)
CO6: Apply (Ap)

Learning outcomes (LOs)

By the end of this course, students will be able to:

- Explain biomolecule evolution and the rise of cells.
- Describe organisms from microbes to plants and animals.
- Understand biotechnology and gene editing tools.
- Apply practical experiments to connect theory with real-world science.
- Discuss synthetic biology and ethical issues in creating artificial life.

Unit I: From Molecules to Cells (15 Hours)

Origin and Evolution of Life: Chemical evolution and origin of life, Oparin-Haldane hypothesis, Miller-Urey experiment, Evolution of biomolecules, Biomolecules of Life. Structure and biological significance of: Carbohydrates, Proteins, Lipids, Nucleic acids.

Water as a biological solvent, Prokaryotic and eukaryotic cells, Endosymbiotic theory, Cell organization and compartmentalization, Bioenergetics, ATP as energy currency.

Unit II: Biological Diversity and Evolution (15 Hours)

Early Life Forms, Bacteria and Archaea, Characteristics and diversity of microorganisms, Role of microbes in ecosystem functioning, Evolutionary transitions in life forms.

Plant and Animal Systems, Basic plant physiology: Water transport, Photosynthesis, Mineral nutrition. Basic animal physiology: Digestion, Respiration, Circulation

Evolutionary Biology: Darwin’s theory of natural selection, Mutation and variation, Adaptation and speciation.

Unit III: Human Technologies and Artificial Life (15 Hours)

Definition, scope and historical development of biotechnology: classical (traditional fermentation, selective breeding) and modern (rDNA, cell culture, omics) perspectives. Gene cloning principles, Genetic engineering tools, Molecular Biology Tools, Polymerase Chain Reaction (PCR), Gel electrophoresis, Gene therapy concepts, CRISPR-Cas systems, Applications in medicine and agriculture, Synthetic Biology, Engineering biological systems, Artificial cells, Minimal genomes, Genome synthesis.

Bioethics and Biosafety, Ethical concerns in genetic engineering, Biosafety regulations, Societal implications of synthetic life.

Unit IV: Practicals **(30 Hours)**

1. Laboratory safety practices and handling of biological materials.
2. Identification and use of common laboratory instruments, glass wares and plastic wares
3. Study of cell structure using compound microscope: Onion peel cells, Human cheek epithelial cells, fungal hyphy and microbe from curd.
4. Observation of microorganisms from environmental samples.
5. Isolation of genomic DNA from plant material.
6. Visualization of DNA using agarose gel electrophoresis (demonstration).
7. Visit to a higher institute or advanced laboratory

ASSESSMENT PATTERN

Component	**Marks**
Internal Assessment	30 (20 +5+5=Sessional Exam+ attendance+ seminar/assignment)
Semester End Examination	45
Practical Examination	25
Total	100

CO–PO Mapping Matrix

3 = High, 2 = Moderate, 1 = Low, – = No Significant Correlation

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1:	3	2	-	-	1	-	-	-
CO2:	3	2	1	-	1	-	-	-
CO3:	3	3	-	1	2	1	-	2
CO4:	3	2	2	2	3	1	-	1
CO5:	1	2	-	1	1	3	1	2
CO6:	1	2	3	1	2	2	2	1

Suggested Readings

1. Campbell Biology – Urry, Cain, Wasserman, Minorsky & Orr.
2. Molecular Biology of the Cell – Alberts et al.
3. Lehninger Principles of Biochemistry – Nelson & Cox.

4. Biotechnology: Expanding Horizons – B.D. Singh.
5. Molecular Biotechnology – Glick, Pasternak & Patten.
6. Prescott's Microbiology – Willey, Sherwood & Woolverton.
7. Principles of Gene Manipulation and Genomics – Primrose & Twyman.
8. An Introduction to Genetic Engineering – Desmond Nicholl.

Contact Person: Dr. Barnali Sarma, ph- 8724079558

FYUGP B.Sc. Biotechnology (Major)
Semester I
SEC-I: Fundamentals of Food Biotechnology

Course Details

Particulars	**Details**
Programme	FYUGP B.Sc. Biotechnology
Course Title	Fundamentals of Food Biotechnology
Course Code	BITU-SEC-010303
Course Type	SEC
Credits	3 (Theory: 2 + Practical: 1)
Total Contact Hours	Theory: 30 Hours + Practical: 30 Hours
Total Marks	75 (Theory: 50 + Practical: 25)
Level	Undergraduate
NEP Category	SEC

Course Objectives (CObs)

The course is designed to:

1. Introduce students to the fundamental concepts, principles, and scope of food biotechnology.
2. Familiarize students with the microorganisms commonly used in food production, fermentation, and processing.
3. Develop an understanding of basic food fermentation processes and their applications in the food industry.
4. Create awareness of food preservation techniques, food safety principles, and quality management practices.
5. Provide hands-on exposure to basic laboratory techniques and experimental procedures relevant to food biotechnology.

Course Outcomes (COs)

1. After completing this course, students will be able to:
2. Define basic concepts of food biotechnology.
3. Identify microorganisms used in food production.
4. Describe simple food fermentation processes.
5. Explain the importance of food preservation and food safety.
6. Demonstrate basic laboratory techniques related to food biotechnology.

The course is designed at lower Bloom's Taxonomy levels (Remembering, Understanding, and Basic Application).

Learning Outcomes

Students will be able to:

- Define food biotechnology and major applications of food biotechnology.
- Recall important milestones in food biotechnology.

- Name important food microorganisms and describe their role in food production.
- Identify common fermented foods.
- Explain the process of fermentation.
- Describe the benefits of fermentation.
- List methods of food preservation.
- Identify causes of food spoilage.
- Explain basic food safety measures.
- Follow basic laboratory safety rules.
- Perform simple fermentation experiments.
- Observe food spoilage and preservation techniques.
- Measure pH of food samples.

Theory (2 Credits)

Unit I: Introduction to Food Biotechnology and food microbiology (15 Hours)

Meaning and scope of food biotechnology, Relationship between food science and biotechnology, History and development of food biotechnology, Major food biotechnology products. Introduction to microorganisms and beneficial microorganisms used in foods, Yeasts, bacteria, and moulds: basic characteristics, Role of microorganisms in food production.

Unit II: Food Fermentation, Preservation and food safety (15 Hours)

Common fermented foods. Concept of fermentation, Types of food fermentation, Fermentation of milk, vegetables, and cereals, Traditional fermented foods of India, Advantages of fermentation. Need for food preservation, Traditional and modern preservation methods, Food spoilage and its causes, Basic food safety practices, Personal hygiene in food handling.

Practical (1 Credit) (30 Hours)

1. Laboratory safety rules and good laboratory practices.
2. Observation of common microorganisms used in food fermentation.
3. Preparation of curd/yogurt using starter culture.
4. Preparation of fermented rice product.
5. Demonstration of bread making using yeast.
6. Study of food spoilage in different food samples.
7. Demonstration of food preservation by salting and sugaring.
8. Determination of pH of common food samples.
9. Visit to a local food processing unit/fermentation unit and submission of report.

ASSESSMENT PATTERN

Component	**Marks**
Internal Assessment	20 (15+5=Sessional Exam+ attendance)
Semester End Examination	30

Component	Marks
Practical Examination	25
Total	**75**

CO–PO Mapping Matrix

3 = High, 2 = Moderate, 1 = Low, – = No Significant Correlation

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	–	–	1	1	–	1
CO2	3	2	1	–	1	1	–	2
CO3	3	2	1	1	1	2	–	2
CO4	2	2	1	–	2	3	1	2
CO5	1	2	3	1	2	2	1	–

Suggested Reading

1. Adams, M.R. & Moss, M.O. Food Microbiology.
2. Frazier, W.C. & Westhoff, D.C. Food Microbiology.
3. Jay, J.M. Modern Food Microbiology.
4. Bawa, A.S. & Rai, A.K. Food Science and Technology.
5. Potter, N.N. & Hotchkiss, J.H. Food Science.

Bloom’s Taxonomy level

This syllabus keeps the content introductory and skill-oriented, suitable for a 1st-semester SEC course with emphasis on Remember, Understand, and basic Apply levels of Bloom's Taxonomy.

Contact Person: Dr. Barnali Sarma

FYUGP B.Sc. Biotechnology (Major)

Semester II

Course Details

Particulars	Details
Programme	FYUGP B.Sc. Biotechnology
Course Title	Biochemistry
Course Code	BITU-MAJ-010204
Course Type	Major
Credits	4 (Theory: 3 + Practical: 1)
Total Contact Hours	Theory: 45 Hours + Practical: 30 Hours
Total Marks	100 (Theory: 75 + Practical: 25)
Level	Undergraduate
NEP Category	Major Core Course

COURSE OBJECTIVES (CObs)

The course is designed to:

1. Introduce the chemistry, structure, and biological significance of biomolecules.
2. Familiarize students with enzymes and nucleic acids at structural and functional levels.
3. Develop laboratory skills in biomolecular analysis.
4. Promote scientific reasoning, analytical thinking, and practical competency aligned with NEP 2020.

COURSE OUTCOMES (COs)

1. After successful completion of the course, students will be able to:
2. Explain the structure, properties, and biological significance of water, carbohydrates, and lipids, and relate their roles to cellular functions.
3. Classify and analyze carbohydrates and lipids based on their chemical structures, properties, and biological functions.
4. Describe the structure, classification, properties, and functions of amino acids, proteins, and enzymes, including enzyme kinetics.
5. Analyze the relationship between protein structure and function, including protein folding, domains, motifs, and enzyme activity.
6. Explain the structure, organization, and functions of nucleic acids, RNA types, and biomolecular interactions, and discuss their applications in biotechnology.
7. Perform basic biochemical experiments including preparation of solutions and buffers, qualitative analysis of biomolecules, chromatography, enzyme assays, nucleic acid extraction, and gel electrophoresis, and interpret the results.

Bloom's Taxonomy Level of the Course

CO1: Understand (U)
CO2: Analyze (A)
CO3: Understand (U)
CO4: Analyze (A)
CO5: Understand (U)
CO6: Apply (Ap)

Learning Outcomes

By the end of this course, students will be able to:

1. Explain the structure, properties, and biological significance of water, carbohydrates, lipids, proteins, and nucleic acids.
2. Classify and compare major biomolecules based on their chemical structure and functions.
3. Interpret biochemical properties such as pH, buffer systems, stereochemistry, and molecular interactions.
4. Analyze the structural organization and functional relationships of proteins and nucleic acids.
5. Apply biochemical principles in laboratory experiments involving biomolecule estimation and separation techniques.
6. Perform quantitative and qualitative biochemical analyses using standard laboratory methods.

UNIT I: Water, Carbohydrates and Lipids (15 Hours)

Structure and ionization of water, Physical and chemical properties of water, Weak acids and bases, pH and pKa, Henderson–Hasselbalch equation, biological significance of water

Sources and classification of carbohydrates, Monosaccharides, disaccharides, oligosaccharides, and polysaccharides, Aldoses and ketoses, Reducing and non-reducing sugars, Structural representations: Fischer and Haworth projections, Cyclization and isomerization, Optical properties: D/L forms, α/β anomers, enantiomers, epimers, Biological and nutritional importance of carbohydrates

Classification and sources of lipids, Fatty acids: saturated, unsaturated, and trans fatty acids, Triacylglycerols, phospholipids, glycolipids, and sphingolipids, Waxes and derived lipids, Lipoproteins and chylomicrons, Sterols and steroids, Essential fatty acids, Prostaglandins, eicosanoids, and lipid-soluble antioxidants, biological significance of lipids

UNIT II: Amino Acids and Proteins (15 Hours)

Structure and classification of amino acids, Essential and non-essential amino acids, Optical activity and chirality, Acid-base properties and isoelectric point (pI), Peptide bond formation, biologically important peptides

Classification and functions of proteins, Levels of protein structure: primary, secondary, tertiary, and quaternary, Ramachandran plot and protein helicity, Hydropathy and hydrophilicity indices, Structural and functional domains, Protein motifs, Fibrous and globular proteins, Protein folding, chaperones, and chaperonins, Principles of protein separation and purification

Nomenclature and classification, Holoenzymes and apoenzymes, Cofactors and coenzymes, Prosthetic groups and metalloenzymes, Monomeric and oligomeric enzymes, Activation energy and transition state, Enzyme activity and kinetics, Determination of Km and Vmax

UNIT III: Nucleic Acids and Biomolecular Interactions (15 Hours)

Structure of purines and pyrimidines, Nucleosides and nucleotides, DNA and RNA structure, Base pairing and stacking interactions, DNA forms and helicity, Supercoiling, twists, and bends, DNA melting and renaturation, Cot curves and chromaticity, Organization of DNA into chromosomes.

Types of RNA: mRNA, tRNA, rRNA, hnRNA, miRNA, riboswitches, Structure and function of tRNA, Ribozymes and catalytic RNA. Biomolecular Interactions: DNA–DNA interactions, DNA–protein interactions, Molecular recognition and biological significance, Applications of nucleic acid studies in biotechnology.

PRACTICALS (30 Hours)

1. Preparation of stock and working solutions: PPM solution, Percent solution, Normal solution, Molar and millimolar solutions
2. Preparation of biological buffers
3. Concept and preparation of glucose standard curve
4. Qualitative tests for carbohydrates, proteins, and amino acids
5. Separation of lipids and plant pigments using TLC/paper chromatography
6. Study of effect of pH and temperature on salivary amylase activity
7. Extraction of DNA/RNA from plant/animal tissues and agarose gel electrophoresis

ASSESSMENT PATTERN

Component	**Marks**
Internal Assessment	30 (20+5+5)
Semester End Examination	45
Practical Examination	25
Total	100

CO–PO Mapping Matrix

3 = High, 2 = Moderate, 1 = Low, – = No Significant Correlation

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**3**	**2**	**-**	**-**	**1**	**-**	**-**	**-**
CO2	**3**	**3**	**-**	**-**	**1**	**-**	**-**	**-**
CO3	**3**	**2**	**1**	**-**	**1**	**-**	**-**	**-**
CO4	**3**	**3**	**1**	**1**	**1**	**-**	**-**	**-**
CO5	**3**	**2**	**1**	**2**	**2**	**1**	**-**	**1**
CO6	**2**	**3**	**3**	**2**	**2**	**1**	**2**	**-**

SUGGESTED READINGS

1. Lehninger A.L. — *Principles of Biochemistry*
2. Voet D. and Voet J. — *Biochemistry*
3. Lodish H. — *Molecular Cell Biology*
4. Nelson D.L. and Cox M.M. — *Lehninger Principles of Biochemistry*
5. Rastogi S.C. — *Cell Biology*
6. Satyanarayana U. — *Biochemistry*
7. Conn E.E. and Stumpf P.K. — *Outlines of Biochemistry*
8. Wilson and Walker — *Principles and Techniques of Biochemistry and Molecular Biology*
9. Plummer D.T. — *Practical Biochemistry*
10. Sadashivam and Manickam- *Biochemical Methods*

Contact Persons: Dr. Dipanjali Saikia, Dr. Barnali Sarma

SEC-II: Applied Food Biotechnology and Bioprocess Engineering

B.Sc. Biotechnology Semester II

Particulars	Details
Programme	FYUGP B.Sc. Biotechnology
Course Title	Applied Food Biotechnology and Bioprocess Engineering
Course Code	BITU-SEC-020303
Course Type	SEC
Credits	3 (Theory: 2 + Practical: 1)
Total Contact Hours	Theory: 30 Hours + Practical: 30 Hours
Total Marks	75 (Theory: 50 + Practical: 25)
Level	Undergraduate
NEP Category	SEC

Course Description

This course builds upon the foundational concepts of Food Biotechnology introduced in Semester I and focuses on the application of biotechnology in food production, processing, quality assessment, and basic bioprocess engineering. The course emphasizes practical applications and analytical skills suitable for undergraduate beginners.

Bloom's Taxonomy Level: Apply and Analyse

Course Objectives (CObs)

This course is designed to:

1. Introduce students to the principles and applications of food biotechnology in food production, preservation, functional foods, and nutraceutical development.
2. Provide fundamental knowledge of bioprocess engineering, including upstream and downstream processing, sterilization methods, and the operation of fermenters and bioreactors.
3. Develop an understanding of microbial fermentation processes and the factors influencing fermentation efficiency in food industries.
4. Familiarize students with food quality assessment, food safety standards, food spoilage mechanisms, and quality management systems such as GMP and HACCP.
5. Train students in basic laboratory and practical techniques related to fermented food production, food quality analysis, aseptic handling, and sterilization procedures.
6. Enhance analytical, technical, and problem-solving skills required for the application of biotechnology in food processing and food industry practices.

Course Outcomes (COs)

After successful completion of this course, students will be able to:

1. **CO1:** Explain the applications of food biotechnology in food production, preservation, and development of functional foods and nutraceuticals.
2. **CO2:** Apply basic concepts of bioprocess engineering, including upstream and downstream processing, sterilization, and operation of fermenters and bioreactors.
3. **CO3:** Analyze microbial fermentation processes and evaluate the factors affecting fermentation in food industries.
4. **CO4:** Assess food quality and safety parameters, identify causes of food spoilage and contamination, and explain GMP and HACCP practices.
5. **CO5:** Demonstrate practical skills in preparation of fermented food products, measurement of food quality parameters, and implementation of aseptic and sterilization techniques.

Learning Outcomes (LOs)

Students will be able to:

Explain applications of food biotechnology.
Differentiate probiotics, functional foods, and nutraceuticals.
Describe biotechnology-based food products.
Describe the steps of a bioprocess.
Identify different types of bioreactors.
Explain the importance of sterilization.
Explain fermentation processes.
Analyse factors affecting fermentation.
Compare batch and continuous fermentation.
Assess basic food quality parameters.
Identify causes of food contamination.
Explain food safety practices.

THEORY (2 Credits)

Unit I: Food Biotechnology & Bioprocess Engineering (15 Hours)

Applications of biotechnology in food production, Production of fermented foods and beverages, Probiotics and their significance, Functional foods and nutraceuticals: basic concepts, Biotechnology in food preservation.

Introduction to bioprocess engineering, Components of a bioprocess Upstream and downstream processing: basic concepts, Types of bioreactors and fermenters, Sterilization in food processing industries.

Unit III: Fermentation Technology & Food Quality and Safety Assessment (15 Hours)

Principles of microbial fermentation, Factors affecting fermentation, Batch and continuous fermentation, Industrial production of yogurt, bread, and vinegar, Applications of fermentation in food industries, Food quality parameters, Food spoilage and contamination.

Good Manufacturing Practices (GMP), Hazard Analysis and Critical Control Points (HACCP): Introduction, Food labelling and standards,

PRACTICAL (1 Credit)

Laboratory Exercises **(30 Hours)**

1. Laboratory safety and aseptic techniques.
2. Preparation of fermented food products (curd/yogurt).
3. Bread preparation using baker's yeast.
4. Vinegar production demonstration.
5. Determination of pH of fermented food samples.
6. Estimation of acidity in food products.
7. Observation of microbial growth under different environmental conditions.
8. Demonstration of sterilization methods used in food processing.
9. Visit to a local food processing or fermentation unit and submission of report.

ASSESSMENT PATTERN

Component	**Marks**
Internal Assessment	20 (15+5=Sessional Exam+ attendance)
Semester End Examination	30
Practical Examination	25
Total	**75**

Suggested Reading

Stanbury, P.F., Whitaker, A. & Hall, S.J. Principles of Fermentation Technology.
Shuler, M.L. & Kargi, F. Bioprocess Engineering: Basic Concepts.
Frazier, W.C. & Westhoff, D.C. Food Microbiology.
Jay, J.M. Modern Food Microbiology.
Bawa, A.S. & Rai, A.K. Food Science and Technology.

Skill Components

Preparation of fermented foods.
Measurement of food quality parameters.
Basic operation and understanding of fermentation systems.
Food safety and quality assessment practices.

This syllabus provides a natural progression from "Fundamentals of Food Biotechnology" (Semester I) to a more application-oriented "Applied Food Biotechnology and Bioprocess Engineering" (Semester II).

CO–PO Mapping Matrix

Scale: 3 = High, 2 = Moderate, 1 = Low, Blank = No Significant Correlation

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1:	**3**	**2**	**1**	**1**	**2**	**2**	**–**	**3**
CO2:	**2**	**3**	**3**	**2**	**2**	**1**	**1**	**1**
CO3:	**3**	**3**	**2**	**2**	**2**	**1**	**–**	**2**
CO4:	**2**	**3**	**2**	**1**	**3**	**3**	**1**	**2**
CO5:	**1**	**2**	**3**	**2**	**2**	**2**	**2**	**1**

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