Darrang College (Autonomous), Tezpur-784001

Syllabus for FYUGP Biotechnology (Minor)

Approved by :

Board of Studies meeting held on 31-07-2025

&

Academic Council vide Resolution no. 04, dated- 12-08-2025

DARRANG COLLEGE (AUTONOMOUS)

SYLLABUS

FYUGP IN BIOTECHNOLOGY

MINOR PAPER

Course eligibility

The student should have passed Class XII in Biology, Chemistry, and Physics

Approved by

Board of Studies (Biotechnology) meeting held on 31th July, 2025, Darrang College

INTRODUCTION

The Four Year Degree Programme (FYUGP) in Biotechnology as one of the core subject, designed to develop a scientific temperament to find out technological interface in modern areas of biotechnology to achieve its goal at applied level. It will help the students to become critical and curious in their outlook about modern Biotechnology. The courses are designed to impart the essential basics in biotechnology as well as its advanced fields.

This syllabus of FYUGP Biotechnology at Darrang College (Autonomous) has been designed in alignment with National Education Policy (NEP) 2020, which emphasizes a holistic, multidisciplinary, and flexible education system and preparedness for facing the challenges with promising solutions.

Aims of FYUGP B.Sc. in Biotechnology

The aims of various courses in the FYUGP Biotechnology programme are:

- **To develop proficiency and critical thinking, scientific reasoning, and analytical skills** in the theory as well as practical experiments that enable students to approach scientific problems methodically and creatively.
- **To explore the cognitive level of students at its maximum level**, by enriching knowledge of students in the modern areas of biotechnology and its application in medical science, agriculture, industry, proteomics, genomics, bioinformatics, nano-biotechnology etc.
- **To understand biotechnology and its potential in developing the nation**, it will create awareness about the socio, ethical and environmental aspects of the course also.
- **To promote experiential learning through practical laboratory work, fieldwork, and research projects**, encouraging innovation, curiosity and hands-on skills through Practical experiments and Project works.
- **To prepare students for diverse career aspects** like opting for higher studies, research, teaching, industry, entrepreneurship and public service, by integrating skill development and value-added courses.

- **To achieve the goal of this course in applied as well as research level**. The course structure will develop hands on skill to manage equipments, laboratory experiments, individual or group-projects along with case study reports and preparation of research proposals at advanced level
- **To foster interdisciplinary learning and flexibility**, in accordance with NEP 2020, allowing students to explore the interdisciplinary aspects.
- **To enhance communication skills and ensuring** that students can effectively disseminate scientific knowledge and for solving societal and environmental problems.

Programme outcome of FYUGP Biotechnology

No.	Programme Outcomes (POs)
PO- 1	**Critical thinking** o Analyze information objectively and make areas on judgment o Draw reasonable conclusions from a set of information, and discriminate between useful and less useful details to solve problems or make decisions o Identify logical flaws in the arguments of others o Evaluate data, facts, observable phenomena, and research findings to draw valid and relevant results that are domain-specific
PO- 2	**Complex problem-solving** o Solve different kinds of problems in familiar and no-familiar contexts and apply the learning to real-life situations o Analyze a problem, generate and implement as solution and to assess the success of the plan o Understand how the solution will affect both the people involved and the surrounding environment
PO- 3	**Creativity** o Produce or develop original work, theories and techniques o Think in multiple ways for making connections between seemingly unrelated concepts or phenomena o Add a unique perspective or improve existing ideas or solutions o Generate, develop and express original ideas that are useful or have values

PO- 4	**Communication skills** o Convey or share ideas or feelings effectively o Use words in delivering the intended message with utmost clarity o Engage the audience effectively o Be a good listener who are able to understand, respond and empathize with the speaker o Confidently share views and express himself/herself
PO- 5	**Leadership qualities** o Work effectively and lead respectfully with diverse teams o Build a team working towards a common goal o Motivate a group of people and make them achieve the best possible solution. o Help and support others in their difficult times to tide overtheadverse situations with courage
PO- 6	**Learning 'how to learn' skills** o Acquire new knowledge and skills, including 'learning how to learn skills, that are necessary for pursuing learning activities throughout life, through self-paced and self-directed learning o Work independently, identify appropriate resources required for further learning o Acquire organizational skills and time management to set self-defined goals and targets with timelines o Inculcate a healthy attitude to be a lifelong learner
PO- 7	**Digital and technological skills** o Use ICT in a variety of learning and work situations, access, evaluate, and use a variety of relevant information sources o Use appropriate software for analysis of data o Understand the pitfalls in the digital world and keep safe from them
PO- 8	**Value inculcation** o Embrace and practice constitutional, humanistic, ethical, and moral values in life including universal human values of truth, righteous conduct,peace,love,nonviolence,scientifictemper,citizenshipvalues o Formulate a position/argument about an ethical issue from multiple perspectives o Identify ethical issues related to work, and follow ethical practices, including avoiding unethical behaviour such as fabrication, falsification or misrepresentation of data, or committing plagiarism, and adhering to intellectual property rights o Adopt an objective, unbiased and truthful actions in all aspects of work

Teaching Learning Process

Learners should be encouraged to focus on key areas of the course and spend time on learning the course fundamentals and their application. In teaching and learning pedagogy, there should be a shift from domain-based approach to the experiential-based approach. The teaching of undergraduate Biotechnology for each course, shall include lectures followed by laboratory hours for that particular course.

Lectures should include good proportion of visuals learning component and ICT enabled delivery. In order to achieve its objective of focused process based learning and holistic development the department uses various teaching methodologies such as, lecture method, group discussion, problem solving, and other innovative method such as case studies, laboratory work, project work, study/ field visits.

Different pedagogical methods and techniques are to be used both in the classroom through the following ways:

- Lecture
- Tutorials/Remedial classes
- Power-point Presentation
- Google Classroom
- Seminars/workshops/conferences
- Project Work/Dissertation
- Educational tours/Trips

Teaching Learning Tools

- White/Green/BlackBoard
- LCD projectors
- Smart Board
- Learning through Practical Lab. experiments
- Educational trips/Industry/field visits

Evaluation/Assessment

- Assignment Work
- Project Work
- Educational Trips/Industry/Filed Visit Report
- Class Seminar Presentation (PPT)
- Internal semester/Sessional examinations(Theory)
- End Semester examinations (Theory and Practical)
-

LTP Components of FYUGP Biotechnology Syllabus (Minor)

Title of the Course	**Introduction to the living world**
Course Code	**Paper Code: BIT-MN-01014**
Total Credit (Theory+ Practical)	**Theory Credit:** 03 **Practical Credit:** 01 **No. of Required Classes:** 75 (Theory: 45; Practical: 30)
Contact Hours	75 (Theory: 45; Practical: 30)
Distribution of Marks	**External (Theory+Practical) 70 (45+25)** **Internal 30**
Course Outcome	After completion of this course/module, students will be able to: • **CO1:** Understand the concept of different forms of life in biosphere and their basic life processes. • **CO 2:** Understand the collection of biological samples and their systematic identification and implement the methods in future for research/experimental work. • **CO 3:** Collect insights on various applications of life forms and their basic structures which will help them for innovation. Interpret and analyze experimental data using appropriate scientific methodology. • CO 4: Develop problem-solving skills through troubleshooting of experimental errors and optimizing analytical methods. • **CO 5:** Evaluate the impact of biological diversity on environment and its scope of applications for human welfare.

Course Designer	Dr. Manika Das Kataki, Asstt. Professor, Dept. of Biotechnology, Darrang College, Tezpur Ms. Minakshee Sarmah, Asstt. Professor, Dept. of Biotechnology, Darrang College, Tezpur Dr. Pranjal Pratim Das, Asstt. Professor, Dept. of Biotechnology, Darrang College, Tezpur
Reference Books	1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons. 2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc. 3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings. 4. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings. 5. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company. 6. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan. 7. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9 th edition. Pearson Education.

Semester-I (Theory Credit:03)

UNIT	CONTENT	LECTURES	TUTORIAL (T)	PRACTICAL (P)	TOTAL HOURS
I	The Plant, Animal and the Microbial world: Diversity, nomenclature, Taxonomy, Cell as fundamental unit of life: structural organization, dimensions, cellular membrane and organelles.	**10**		**2**	**10**
II	Life Processes: Nutrition, Digestion, Absorption, Assimilation, Respiration, Growth And Reproduction, Excretion Genetics: Basic principles of inheritance, Test cross, Back cross, Mapping population, Epigenetics, Polyploidy, Aneuploidy, Double Haploids, Hybrids Structure of Nucleic Acid and Chromosome, Molecular Basis of Inheritance	**10**		**2**	**12**

III	Introduction to Ecosystem, Environment and Evolution: Functions of Ecosystem, Terrestrial and Aquatic Ecosystem, Biodiversity: Plants, Animals & Marine organisms Biomes and Biomass, Niche, habitat, stratification, Biotic and Abiotic factors, Energy flow, Productivity, Nutrient Cycle, Adaptations, Population, Population interactions, Ecological successions.	**7**		2	**9**
IV	Plants, Animals, and Microbes in Human welfare; Plant and animal breeding (Introductory), High yielding crops and breeds, Agriculture practices- Psiciculture, Apiculture, and Sericulture (Introductory), Plant Tissue Culture (Introductory), Single cell proteins Food processing and methods, Production of fermented foods (Cheese, curd, and brewing alcohol), Biopesticide and biofertilizers Biopharmaceuticals: Antibiotics Sewage treatment and Swastha Bharat campaign.	**10**		2	**12**
V	Natural resources and sustainable management: Renewable and non-renewable resources (Air, water, soil, sunlight, plants, animals, microbes, fossil fuel), Sustainable exploitation of resources, Three Rs- Reduce, Recycle, and Reuse. Biotechnological solutions to challenges faced by humankind-bioremediation, Genetically modified organisms-Superbug, GM-crops, Vaccines, Novel Proteins. United Nation sustainable developmental Goals	**6**		2	**8**

Semester-I (Practical Credit:01)					
UNIT	**CONTENT**	**L**	**T**	**P**	**TOTAL HOURS**
Lab Experiments	1. Concept of biological laboratory (Instruments, tools, and appliances) ‘ 2. Preparation of buffer using Henderson-Hasselbalch equation. 3. Slide preparation for study of bacteria, fungi and cyanobacteria 4. Study and use of light microscope 5. Study of meristematic tissue of dicot and monocot plants 6. Study of nitrogen fixing bacteria from leguminous plants. 7. Preparation of bio-fertilizer 8. Estimating population- Plants & Microbes by Random/Non-random sampling methods. 9. Measuring biodiversity of an area: plants, animals, birds, insects, microbes. 10. To demonstrate the fermentation process and factors influencing its rate.			**30**	**30**

Detailed Syllabus of 2nd Semester FYUGP Biotechnology

Title of the Course	**Biomolecules**
Course Code	**BIT-M-02014**
Total Credit (Theory+ Practical)	**Theory Credit:** 03 **Practical Credit:** 01 **No. of Required Classes:** 75 (Theory: 45; Practical: 30)
Contact Hours/Classes Required	75 (Theory Class: 45; Practical Class : 30)
Distribution of Marks	**External (Theory+Practical) 70 (45+25)** **Internal 30** Sessional Exam: 15 marks, Home Assignment: 6 marks, Class Test: 5 marks, Attendance: 4

Course Outcome (CO)	CO- 1 Understanding the chemical constituents of life in a biotechnological perspective CO- 2 Explain biomolecule modifications and biological significance of various bio-conjugates CO-3 Understand correlations between the biomolecules in living cells CO-4 Evaluate various tests for presence of amino acids, carbohydrates on the basis of qualitative tests
Course Designer	Dr. Manika Das Kataki, Asstt. Professor, Dept. of Biotechnology, Darrang College, Tezpur Ms. Minakshee Sarmah, Asstt. Professor, Dept. of Biotechnology, Darrang College, Tezpur Dr. Pranjal Pratim Das, Asstt. Professor, Dept. of Biotechnology, Darrang College, Tezpur
Reference Books	1. Lehninger Principles of Biochemistry, 4th Edition by David Lelson David L. Nelson (Author) 2. Biochemistry (2004) by Donald Voet , Judith G. Voet Publisher: John Wiley & Sons Inc 3. Text Book of Biochemistry, 5th edition by D M Vasudevan and Sreekumar S, JAYPEE Publishers, New Delhi 4. Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi . 5. Introductory Practical biochemistry, S.K.Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, 6. Standard Methods of Biochemical Analysis, S.K. Thimmaiah (Ed), Kalyani Publishers, Ludhiana. 7. ES West, WR Todd, HS Mason and J Tvan Bruggen. A text Book of Biochemistry, Oxford and IBH Publishing Co., New Delhi, 1974. 8. E.S. West, W.R.Todd, H.S. Mason and J.T. van Bruggen, A Text Book of Biochemistry, Oxford and IBH Publishing Co., New Delhi, 1974 9. Principles and Techniques of Practical Biochemistry by Keith M. Wilson ,John M. Walker Cambridge University Press.

Semester-II (Theory Credit:03)					
UNIT	**CONTENT**	**L**	**T**	**P**	**TOTAL HRS**
I **Water**	Structure and ionization of water, chemical and physical properties of different forms of water, weak acids and bases, pH, Hendersen-Hasselbalch equation, pKa.	**4**		**6**	**10**
II Carbohydrates	Sources (plants, animals, microbes, marine), nomenclature and structural types (different carbon number, monomers, dimers, oligomers, polymers), functional types (aldoses, ketoses), reducing and non-reducing, structural conventions (Haworth projection, Fischer model, boat and chair configuration, cyclisation, isomerisation), optical properties (α and β, D and L, enantiomers, epimers), nutritional importance.	**6**		**6**	**12**
III Lipids	Fatty acids sources (plants, animals, microbes, marine), structure, configuration (saturated, unsaturated and *trans* fatty acids), structural types (short, medium and long chain). Triglyceride, phosphoglyceride and sphingolipid sources (plants, animals, microbes, marine), nomenclature and structural types. Derived lipids- phospholipids and glycolipids. Waxes and long chain fatty alcohols. Structural composition, types and biological significance of conjugated lipids (chylomicrons and lipoproteins). Sterol sources, types and their biological significance, steroids and steroid derived vitamins, prostanoids and eicosanoids and their biological significance. Lipid soluble antioxidants.	**9**		6	**15**
IV Amino acids and proteins	Structure, classification (based on structure, polarity, nutritional importance, metabolic fate and others), optical properties (D and L, chirality), chemical properties, pI. Peptide bond, dipeptide characteristics, Ramachandran plot, structural levels of proteins (primary, secondary, tertiary, quaternary), helicity, pI, hydropathy and hydrophilicity indices, structural and functional domains, motifs. Types of proteins (fibrous and globular), protein folding, chaperones and chaperonins, protein separation and purification.	**9**		6	**15**
V Nucleic Acids	Structures of purines and pyrimidines, nucleotides, nucleosides, forces stabilizing DNA and RNA structures, different types of bonds, base pairing, stacking, helicity, forms, supercoiling, twists and bends, isomorphic, anisomorphic and cruciform structures in DNA, spectral characteristics (melting curves, C_ot values, chromacity),	**9**		6	**15**

	RNA types (hnRNA, rRNA, mRNA, tRNA, miRNA and riboswitches), tRNA structure, ribozymes. DNA-DNA and DNA-protein interactions, organization of DNA into chromosomes.				

Semester-II (Practical Credit:01)					
UNIT	**CONTENT**	**L**	**T**	**P**	**TOTAL HRS**
Lab Experiments	1. Preparation of biological buffers. 2. Preparation of standard curve of glucose by anthrone method / phenol-sulphuric acid method and determination of unknown sugar concentrations. 3. Preparation of BSA standard curve using Folin-Lowry reagent / Bradford method and determination of unknown protein concentrations. 4. Preparation of standard curve of DNA by diphenylamine reaction and estimation of unknown DNA by spectrophotometric determination. 5. Preparation of standard curve of RNA by orcinol reaction and estimation of unknown RNA by spectrophotometric determination. 6. Separation of a mixture of amino acids through thin layer chromatography/ paper chromatography 7. Extraction of DNA/RNA from plant/animal tissues and their estimation through agarose gel electrophoresis **8.** Lipid extraction by Folch's method/ solvent extraction and their separation by silica-based adsorption chromatography.			**30**	**30**