Darrang College (Autonomous), Tezpur-784001

Syllabus for FYUGP B.Sc. Biotechnology (Major)

Approved by :

Board of Studies (Biotechnology) meeting held on 26-12-2025 &

&

Academic Council vide Resolution no. 2, dated 29-12-2025

Course eligibility:

The student should have passed Class XII with 1st Division in Biology, Physics, and Chemistry

INTRODUCTION

The Four Year Degree Program (FYUGP) in Biotechnology, as one of the core subject, is 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, 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

Syllabus of FYUGP, as per NEP 2020
Department of Biotechnology
COURSE STRUCTURE

Sem	Course	Paper name	Total Credits	Theory	Practical	Marks	
						External (Theory+ Practical)	Internal
I	1. Major-1: BIT-MJ-01014	Introduction to the Living World	4	3	1	70 (45+25)	30
	2. Minor-1: Chemistry I		4	3	1	70 (45+25)	30
	3. SEC-1	Introduction to Biosafety, Biohazards, & Bioethics	3	2	1	55 (30+25)	20
	4. MDC-1		3	3	0		
	5. AEC-1		4				
	6. VAC-1		2				
	7. VAC-2		2				
II	1. Major-2: BIT-MJ-02014	Biomolecules	4	3	1	70(45+25)	30
	2. Minor-2:	Chemistry II	4	3	1	70(45+25)	30
	3. SEC-2	Microbial Tools and Techniques	3	2	1	55(30+25)	20
	4. MDC-2		3	3	0		
	5. AEC-2		4				
	6. VAC-3		2				
	7. VAC-4		2				
III	1. Major-3: BIT-MJ-03014	Plant and Animal Physiology	4	3	1	70(45+25)	30
	2. Major-4: BIT-MJ-03024	Genetics	4	3	1	70(45+25)	30
	3. Minor-3:	Chemistry III	4	3	1	70(45+25)	30
	4. SEC-3	Plant Tissue Culture	3	2	1	55(30+25)	20
	5. AEC-3		2	2			
	6. MDC-3		3				
	7. VAC-3		2				
IV	1. Major-5: BIT-MJ-04014	Cell Biology	4	3	1	70(45+25)	30
	2. Major-6: BIT-MJ-04024	Microbiology	4	3	1	70(45+25)	30
	3. Major-7: BIT-MJ-04034	Molecular Biology	4	3	1	70(45+25)	30
	4. Major-8: BIT-MJ-04044	Biochemistry and Metabolism	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: BIT-MJ-05014	Immunology	4	3	1	70(45+25)	30
	2. Major-10: BIT-MJ-05024	Recombinant DNA Technology	4	3	1	70(45+25)	30
	3. Major-11: BIT-MJ-05034	Enzymology	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: BIT-MJ-06014	Bio-analytical tools	4	3	1	70(45+25)	30
	2. Major-13: BIT-MJ-06024	Bioinformatics	4	3	1	70(45+25)	30
	3. Major-14: BIT-MJ-06034	Plant and Animal Biotechnology	4	3	1	70(45+25)	30
	4. Major-15:BIT-MJ-06044	Biostatistics	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: BIT-MJ-07014	Bioprocess Technology	4	3	1	70 (45+25)	30
	2. Major-17: BIT-MJ-07024	Medical Biotechnology	4	3	1	70 (45+25)	30
	3. Major-18: BIT-MJ-07034	Food Biotechnology	4	3	1	70 (45+25)	30
	4. Major-19: BIT-MJ-07044	Genomics and Proteomics	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: BIT-MJ-08014	Basics of Phytochemistry & Medicinal Plant based Industry	4	3	1	70 (45+25)	30
	2. Major-21: BIT-MJ-08024	Environmental Biotechnology	4	3	1	70 (45+25)	30
	3. Major-22: BIT-MJ-08034	Bioethics and Intellectual Property Rights	4	3	1	70 (45+25)	30
	4. Minor-8:		4	3	1	70 (45+25)	30
	5. MINI PROJECT/ DISSERTATION		4				

Detailed Syllabus of 1st Semester FYUGP Biotechnology	
Title of the Course	**Introduction to the Living World**
Course Code	**Paper Code: BIT-MJ-01014**
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)	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 (Autonomous), Tezpur. Email id: mkdas116@gmail.com Ms. Minakshee Sarmah, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous), Tezpur Email id: minakshee164@gmail.com Dr. Pranjal Pratim Das, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous), Tezpur Email id: cicibiotech@gmail.com

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**	**L**	**T**	**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.	**5**	**3**	**-**	**08**
II	Life Processes: Nutrition, Digestion, Absorption, Assimilation, Respiration, Growth And Reproduction, Excretion Genetics: Basic principles of inheritance, Testcross, Back cross, Mapping population, Epigenetics, Polyploidy, Aneuploidy, Double Haploids, Hybrids Structure of Nucleic Acid and Chromosome, Molecular Basis of Inheritance	**6**	**3**	**-**	**09**
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.	**6**	**2**		**08**
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.	**7**	**3**		**10**

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**	**4**		**10**

Semester-I (Practical Credit:01)					
UNIT	**CONTENT**	**L**	**T**	**P**	**TOTAL HRS**
Lab Experiment	1. Concept of biological laboratory(Instruments, tools, and appliances) ‘ 2. Preparation of buffer using Henderson-Hassel balch 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 IInd Semester FYUGP Biotechnology (Major)	
Title of the Course	**Biomolecules**
Course Code	**Paper Code: BIT-MJ-02024**
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 marks]
Course Outcome (CO)	After completion of this course/module, students will be able to: **CO1.** Understand the attributes of different chemical, physical, physiological, and nutritional properties of biological building blocks and their polymers. **CO2.** Contextualize the structural interactions supporting life processes. **CO3.** Gain the skills to practically assess the composition of biomolecules present in different biological sources and its application in research work
Course Designer	Dr. Manika Das Kataki, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous), Tezpur. Email id: mkdas116@gmail.com Ms. Minakshee Sarmah, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous), Tezpur Email id: minakshee164@gmail.com Dr. Pranjal Pratim Das, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous), Tezpur Email id: cicibiotech@gmail.com
Reference Books	1. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA. 2. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co. 3. Microbiology- by Prescott, Harley, klein. 4. Molecular Biology of the Gene, Watson, CSH publishing. 5. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.

Semester-II (Theory Credit: 03)

UNIT	CONTENT	L	T	P	TOTAL HOURS
I	**Biomolecules and Water** Biomolecules: Introduction, types and its significance for life. Structure and ionization of water, chemical and physical properties of water in different forms, weak acids and bases, pH, Hendersen-Hasselbalch equation, pKa.	4	2	-	06
II	**Carbohydrates** Carbohydrates sources (Plants, animals, microbes, and marine), nomenclature and structural types (Different carbon number, monomers, dimers, oligomers, and polymers), functional types (Aldoses and ketoses), reducing and non-reducing sugars, anomers, structural conventions (Haworth projection, Fischer model, boat and chair configuration, cyclization, and isomerization), optical properties (α and β, D and L, enantiomers, and epimers) Physical & Chemical Properties of carbohydrates, and its nutritional importance.	6	3	-	09
III	**Lipids** Fatty acids sources (Plants, animals, microbes, and marine), structure and configuration (Saturated, unsaturated, and *trans* fatty acids), structural types (Short, medium, and long chain). Triglyceride, phosphoglyceride, and sphingolipid sources (Plants, animals, microbes, and marine), nomenclature and structural types. Derived lipids- phospholipids and glycolipids. Waxes and long chain fatty alcohols. Conjugated lipids- structural composition, types, and biological significance (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.	7	3	-	10
IV	**Amino acids and proteins** Structure and classification (based on structure, polarity, nutritional importance, metabolic fate and others), optical properties (D and L, chirality), chemical properties of amino acids, isoelectric point. Peptide bond, dipeptide characteristics, dihedral angles, Ramachandran plot, structural levels of proteins (Primary, secondary, tertiary, and quaternary), super secondary structure, peptide plan, helicity, hydropathy and hydrophilicity indices, domains and motifs, protomer, Types of proteins (fibrous and globular), protein folding- chaperones and chaperonins. Protein separation and purification. Conjugated proteins.	7	4	-	11

V	**Nucleic acids** Structures of purines and pyrimidines, nucleotides, nucleosides, forces stabilizing DNA and RNA structures, different types of bonds, base pairing-Hoogsteen pairing, stacking, helicity, forms, supercoiling, twists and bends. Isomorphic, anisomorphic, and cruciform structures in DNA, palindromic sequence. Spectral characteristics (Melting curves, Cot values, and chromacity), RNA types (hn-RNA, r-RNA, m-RNA, t-RNA, mi-RNA, and ribo-switches), polycistronic m-RNA. t-RNA structure, ribozymes. DNA-DNA and DNA-protein interactions, organization of DNA into chromosomes. Significance of nucleic acids in Genetic Inheritance.	**6**	**3**	**-**	**09**

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 and determination of sugar concentration of unknown samples. 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 spectrophotometer. 5. Separation of a mixture of amino acids through thin layer chromatography/paper chromatography. 6. Extraction of DNA/RNA from plant/animal tissues and their estimation through agarose gel electrophoresis 7. Lipid extraction by Folch method/solvent extraction and their separation by silica-based adsorption chromatography.	**0**	**0**	**30**	**30**

Detailed Syllabus of IIIrd Semester FYUGP Biotechnology (Major)

Title of the Course	**Plant and Animal Physiology**	
Course Code	**Paper Code: BIT-MJ-03014**	
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 marks]
Course Outcome (CO)	After completion of this course/module, students will be able to: Understand the principles of physiology of plant and animals. Understand the concepts and mechanisms of integration in the different functional systems of the plants and animals. Able to examine life processes of animals and plants, metabolism, nutrition and digestion, excretion, endocrine function, circulation, respiration and temperature regulation and their inter-relation.
Course Designer	**As per FYUGP Syllabus for Biotechnology of Gauhati University** Dr. Debashree Saikia, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous), Tezpur.
Reference Books	1. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA. 2. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co. 3. Microbiology- by Prescott, Harley, klein. 4. Molecular Biology of the Gene, Watson, CSH publishing. 5. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.

Semester-III (Theory Credit: 03)					
UNIT	**Plant Physiology**	**L**	**T**	**P**	**Total hrs**
I	**Plant Cell Structure** Nature of plant cell wall, Plant tissue- meristematic tissue, permant tissue, secretory and secondary meristem (Apical cell theory, Histogen theory, Tunica-Corpus theory, histogen theory and Korper-Kappe theory).	3	1	-	4
II	**Differentiation** Differentiation of root, stem and leaf, Types of vascular bundles and Vascular cambium, Origin, development, Structure of Dicot and monocot root, Structure of Dicot and monocot stem, Structure of Dicot and monocot leaf, Structure and function of Stomata, Stomatal types.	3	1	-	4
III	**Morphogenesis and reproduction** Differentiation and cell polarity in Unicellular and multicellular system, root hair and stomata formatio), Shoot Apical meristem (SAM): Origin, structure and function and ultrastructure of meristems. Organogenesis: Differentiation of root, stem, leaf and axillary buds. Structure and function of root apical meristem (RAM): Root cap, quiescent centre and origin of lateral roots. Microsporogenesis, Microgametogenesis, Megagametogenesis, Pollination and fertilization in plants.	10	2	-	12
	Animal Physiology				
IV	**Digestion and Respiration** Digestion: Mechanism of digestion and absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice, Respiration: Exchange of gases, Transport of O_2 and CO_2, Oxygen dissociation curve, Chloride shift.	5	1	-	6
V	**Circulation** Composition of blood, Plasma proteins and their role, blood cells, Haemopoiesis, Mechanism of coagulation of blood. Mechanism of working of heart: Cardiac output, cardiac cycle, Origin and conduction of heart beat.	7	1	-	8
VI	**Muscle physiology and Excretion** Structure of cardiac, smooth and skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction. Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation.	4	1	-	5
VII	**Nervous and Endocrine coordination** Structure of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; Structure of synapse, Types of synapse, Synaptic transmission, Neurotransmitters. Types of glands: Exocrine and endocrine; Autocrine, Paracrine and Endocrine glands; Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo and hyper-secretions.	5	1	-	6
Semester-III (Practical Credit: 01)					

UNIT	CONTENT	L	T	P	Total hrs
Lab Experiments	1. Study of meristem (Permanent slides/ Photographs). 2. Study of Simple Tissues (Parenchyma, Collenchyma and Sclerenchyma) and Complex tissues (xylem and phloem). 3. Determination of clotting time and bleeding time of blood. 4. Preparation of blood smears and identifying various WBC. 5. Determination of human blood groups. 6. Determination of specific gravity of blood. 7. Measurement of blood pressure.	-	-	**30**	**30**

Detailed Syllabus of IIIrd Semester FYUGP Biotechnology	
Title of Paper	**GENETICS**
Paper Code	**BIT-MJ-03024**
Semester	**III**
Total Credit (Theory+ Practical)	**Theory Credit:** 03 **Practical Credit:** 01 **No. of Required Classes:** 75 (Theory:45; Practical:30)
Contact Hours/Classe S Required	**75 (Theory Class: 45; Practical Class:30)**
Distribution of Marks	**External (Theory+ Practical)** **70 (45+25)** **Internal** **30** Sessional Exam:15marks, Home Assignment: 6 marks, Class Test: 5 marks, Attendance:4
Course Outcome	**CO1**: Understand and explain chromosome structure at molecular level **CO2**: Understand and illustrate the cyclic events of cell division and types of cell division **CO3**: Explain laws and concepts of Mendelian Genetics and illustrate and compare its deviations **CO4**: Understand and explain linkage and crossing over **CO5**: Determining the chromosome structure using different
Course Designer	Dr. Manika Das Kataki, Asstt. Professor and Head, Dept. of Biotechnology, Darrang College, Tezpur, mkdas116@gmail.com
Suggested Readings	1. Ahluwalia, K.B. Genetics. New Age International(P)Ltd. Publishers 2. Burns, G.W. & Bottino, P.J. The Science of Genetics. Maxwell McMillan 3. Curt Stein. Principles of Human Genetics. Euresia Publishing House 4. Gardner, E.J.et al. Principles of Genetics. John Wiley &Sons. 5. Goodenough, U. Genetics. Halt, Reinharts &Winston 6. Gupta, P.K. Cytogenetics. Rastogi &Co. 7. Sinnott,W. E., Dunn, L. C. and Dobzhansky, T. Principles of Genetics, TMH 8. Verma, P.S. and Agarwal V.K. Genetics. S.Chand and Co.

Semester-III (Theory Credit: 03)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
I	**FUNDAMENTALS OF GENETICS** Mendelian genetics: Laws of inheritance , Allelic /non-allelic Gene Interaction: complete, incomplete dominance, co-dominance Multiple alleles- ABO Blood group system, Rh group and its inheritance; Chromosomal theory of inheritance, Linked genes, factors affecting linkage ,Sex Linkage, , sex influenced genes, Crossing over and recombination; Genetic variation and its significance in biotechnology	**6**	**3**	**-**	**9**
II	**HUMAN GENETICS & POPULATION GENETICS** Karyotyping, normal chromosome complement, pedigree analysis Chromosomal anomalies in Human: Autosomal (eg. Down's syndrome, Edward's syndrome), Allosomal (Klinefelter's syndrome, Turner's syndrome); Biochemical genetics: Human biochemical genetics, biochemical pathway of phenylalanine-tyrosine metabolism in normal human body. Disorders-Phenylketonuria, Alkaptonuria, Tyrosinosis and Albinism; Hardy-Weinberg equilibrium, Genetic drift, gene flow, and population structure, Molecular evolution and phylogenetics; Human population genetics and disease susceptibility	**8**	**4**	**-**	**12**
III	**BASIC GENETIC TECHNIQUES** Gene cloning and expression, Genetically modified organisms (GMOs), Transgenic organisms and their applications; Genetic disorders, gene-therapy	**6**	**3**	**-**	**9**
IV	**PLANT AND MICROBIAL GENETICS** Plant Genetics: Introduction; Plant DNA : Nuclear, Mitochondrial and Chloroplast DNA; Plant Model Organisms: Arabidopsis, Maize, Rice Methods of Genetically Modifying Plants: Microinjection, Electroporation, Particle Bombardment and Agrobacterium-Mediated Transformation; Microbial Genetics: Bacteria, Fungi, Viruses, Applications of Microbial Genetics	**10**	**5**	**-**	**15**

Semester-III (Practical Credit: 01)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
Lab Experiment	1. Study of normal chromosome complement and karyotype of man 2. Preparation of karyo-idiogram from microphotographs 3. Study of abnormal karyotypes and genetic syndromes of man (Down's syndrome, Turner's syndrome and Klinefelter's syndrome) 4. Construction of pedigree chart–any two 5. Frequency of genetic traits in humans: blood groups, eye colour	**-**	**-**	**30**	**30**

- **Assessment Rubrics:** Interactive Quiz, Group Discussions, Assignment, Student Seminar
- **Continuous Comprehensive Assessment:** Observation of practical skills
- **Formative:** Punctuality in lab and time management in completing assigned laboratory task.

Detailed Syllabus of IVth Semester FYUGP Biotechnology	
Paper Name	**Cell Biology**
Paper Code	**Paper Code: BIT-MJ-04014**
Total Credit (Theory+ Practical)	**Theory Credit:** 03 **Practical Credit:** 01 **No. of Required Classes:** 75 (Theory:45; Practical:30)
Contact Hours/Class es Required	75 (Theory Class: 45; PracticalClass:30)
Distribution of Marks	**External (Theory + Practical) 70 (45+25)** **Internal 30** SessionalExam:15marks,HomeAssignment:6marks,ClassTest:5marks, Attendance:4
Course Outcome (CO)	**After completion of this course/module, students will be able to:** **CO1**: Understand the basic structure and functions of cell and cell organelles. **CO2**: Know about skill to isolate, appreciate the architecture and identify different sub-cellular components.
Course Designer	**As per FYUGP Syllabus of B.Sc. Biotechnology, GU** Dr. Debashree Saikia, Asstt. Professor, Darrang College (Autonomous), Tezpur
Reference Books	1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc. 2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology.8th edition. Lippincott Williams and Wilkins, Philadelphia. 3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA. 5. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The WorldoftheCell. 7thedition. PearsonBenjaminCummingsPublishing, San Francisco. 6. T.Devasena2012.CellBiology.OxfordUniversityPress.

Semester-IV (Theory Credit: 03)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
I	**Cellular construction** Cell type: History and origin. Prokaryotic and Eukaryotic cell. Difference between Prokaryotic and Eukaryotic cell. Plasma Membrane: History, Ultra structure, and chemical composition of plasma membrane (fluid mosaic model). Transport across the membrane. An insight into the organization of the trans-membrane proteins.	08	03	-	11
II	**Membrane and membranous bodies** Membrane vacuolar system, Cytoskeleton and its different types, Cytoplasmic streaming and Cell motility: Structure, function and importance of cell organelles: Endoplasmic reticulum, Golgi complex, Lysosomes, Ribosomes, Mitochondria and Chloroplasts.	07	04	-	11
III	**Nucleus and chromosomes** Nucleus: Structure and function, chromosomes and their structure, nucleolus. Chromosomes: History, types and functions of chromosomes. Giant chromosomes, Polytene chromosome and Lampbrush chromosome.	07	04	-	11
IV	**Extracellular matrix** Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors, receptor ligand interactions and their function. Signal transduction- basic concept. Basics of apoptosis.	08	04	-	12
PRACTICAL					
Semester-IV (Practical Credit: 01)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
Lab Experiments	1. Demonstration of dialysis/plasmolysis and the effect of temperature and organic solvents on semi permeable membrane. 2. Demonstration of different stages of mitosis and meiosis using onion root tip. 3. Study of structure of blue green algae, algae, fungi and yeast (using permanent slides/photographs) 4. Microtomy: the process (demonstration). 5. Preparation of nuclear, Mitochondrial & cytoplasmic fractions by density gradient centrifugation.	-	-	**30**	**30**

Detailed Syllabus of IVth Semester FYUGP Biotechnology	
Paper Name	**Microbiology**
Paper Code	**Paper Code: BIT-MJ-04024**
Total Credit (Theory+ Practical)	**Theory Credit:** 03 **Practical Credit:** 01 **No. of Required Classes:** 75 (Theory:45;Practical:30)
Contact Hours Required	75 (Theory Class: 45; Practical Class:30)
Distribution of Marks	External (Theory + Practical) 70 (45+25) Internal 30 Sessional Exam:15marks, Home Assignment: 6marks,ClassTest: 5 marks, Attendance: 4
Course Outcome(CO)	After completion of this course /module, students will be able to: **CO1**: Understand the basic microbial structure and functions of various physiological groups of prokaryotes and eukaryotes and also learn the theory and practical skills in microscopy handling and staining techniques **CO2**: Know various Culture media and their applications and understand various physical and chemical means of sterilization and also learn various techniques for isolation of pure cultures **CO3**: Comprehend the various methods for identification of unknown microorganisms and study microbial metabolism – Autotrophy and heterotrophy modes of nutrition **CO4**: Understand the microbial physiology and know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement and preservation
Course Designer	Ms. Minakshee Sarmah, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous), Tezpur
Reference Books	1. Microbiology-by Prescott, Harley,klein 2. Biology of Microorganisms by Brock, Madiganand Martinko. 3. Textbook of Microbiology by Ananthanarayan and Paniker 4. General microbiology by Roger Y Stainer, John LIngraham, Mark L Wheelis, page R Painter 5. Microbiology Diversity, disease, and the environment by A bigail A salyers, Dixie D Whitt 6. Microbial Biotechnology by P C Trivedi 7. Methods for general and molecular microbiology-by C.A. Reddy (Editor), Beverdge, Breznak, Marzluf, Schnider and Sryder 8. Microbiology: An Introduction by Tortora, Funke and Cases.

Semester-IV (Theory Credit: 03)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
I	**History and Origin of Microbiology** Historical development of Microbiology – Theory of spontaneous generation, Biogenesis and Abiogenesis. Contributions of Antony van Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Edward Jenner, Alexander Fleming, Martinus Beijerinck, Sergei Winogradsky and Elie Metchnikoff. General account on microbial diseases. Microscopy-working principle, construction and operation of simple and compound microscopes.	**8**	**2**	**-**	**10**
II	**Microbial Systematics and Diversity** Classification of microorganisms: Carl Woese classification, Whittaker's five kingdom concept. General characteristics and classification of Bacteria, Archaea, Mycoplasmas, Cyanobacteria, Fungi, Algae, Protozoa and viruses. Bergey's Manual of Systematic Bacteriology.	**10**	**2**	**-**	**12**
III	**Staining, sterilization and preservation techniques** Staining: Nature of stains, principles, mechanism, methods and types of staining simple, Differential-Gram staining, acid fast staining, capsule staining, endospore, inclusion bodies. Sterilization: Principles, types and techniques - physical and chemical. Preservation of microorganisms: Methods of preservation, slant culture, stab culture, soil culture, mineral oil overlaying, glycerol preservation, Lyophilization, preservation of microbial cultures.	**8**	**2**	**-**	**10**
IV	**Microbial growth and culture techniques** Nutritional requirements in microorganisms: Modes of nutrition – phototrophy, chemotrophy, methylotrophy, organotrophy, mixotrophy, saprophytic, symbiotic and parastitic modes of nutrition. Principles of growth, Kinetics of growth, Methods of measuring growth: direct and indirect methods. Concepts of culture media and its types. Microbial cultures -Concepts of pure culture, methods of pure culture isolation, Antibiotic resistance in microorganisms	**10**	**3**	**-**	**13**
PRACTICALS					
Semester-IV (Practical Credit: 01)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
Lab Experiments	1. Microscopic observation of bacteria, Algae and Fungi. 2. Simple staining, Gram's staining and spore staining 3. Preparation of culture media for cultivation of bacteria 4. Preparation of culture media for cultivation of fungi 5. Sterilization of medium using Autoclave, handling bacteriological and BOD incubators. 6. Isolation of pure cultures of bacteria by streaking method. 7. Study of bacterial growth curve 8. Study of Zone of Inhibition (ZoI) in response to inhibitory subtance	-	-	**30**	**30**

Detailed Syllabus of IVth Semester FYUGP Biotechnology	
Paper-Molecular Biology	
Title of the Course	**Molecular Biology**
Course Code	**Paper Code: BIT-MJ-04034**
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 marks]
Course Outcome (CO)	After completion of this course/module, students will be able to: **CO1.** Understand the basic concepts of DNA structure and Replication. **CO2.** Learn on damage, repair and homologous recombination in DNA. **CO3.** Explain the transcriptions in prokaryotic and eukaryotic organisms including RNA processing **CO4.** Know how regulations occur in gene expression up to translation
Course Designer	Dr. Pranjal Pratim Das, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous), Tezpur Dr. Manika Das Kataki, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous),, Tezpur Ms. Minakshee Sarmah, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous),, Tezpur
Reference Books	6. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc. 7. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia. 8. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco. 9. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

Semester-IV (Theory Credit: 03)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
I	**DNA structure and replication** DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-primming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.	**7**	**4**	**-**	**11**
II	**DNA damage, repair and homologous recombination** DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair, base excision repair, nucleotide excision repair, mismatch repair, translation synthesis, Homologous recombination**.**	**7**	**3**	**-**	**10**
III	**Transcription and RNA processing** RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains. Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.	**8**	**4**	**-**	**12**
IV	**Regulation of gene expression and translation** Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Posttranslational modifications of proteins.	**8**	**4**	**-**	**12**
PRACTICALS					
Semester-IV (Practical Credit: 01)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
Lab Experiments	1. Preparation of solutions for Molecular Biology experiments. 2. Isolation and quatification of chromosomal DNA from bacterial cells. 3. Isolation of Plasmid DNA by alkaline lysis method 4. Agarose gel electrophoresis of genomic DNA & plasmid DNA 5. Preparation of restriction enzyme digests of DNA samples.	**0**	**0**	**30**	**30**

Detailed Syllabus of IVth Semester FYUGP Biotechnology, Major	
Paper Name	**Biochemistry and Metabolism**
Paper Code	**Paper Code: BIT-MJ-04044**
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)	**After completion of this course/module, students will be able to:** **CO-1**: Understanding how chemical constituents of life in a biotechnological perspective **CO-2**: Explain biomolecules modifications and biological significance of various bio-conjugates **CO-3**: Understand complex metabolic pathways in living cells **CO-4**: Evaluate various tests for presence of amino acids
Course Designer	Dr. Manika Das Kataki, Asstt. Professor, Dept. of Biotechnology Darrang College (Autonomous), Tezpur
Reference Books	1. Lehninger Principles of Biochemistry, 4th Edition by David L. Nelson 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 DM 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. E S West, W R Todd, H S 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-IV (Theory Credit: 03)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
I	**Basic Chemical constituents of Life-Overview** Chemical Constituents of Life, Importance of water and physiological buffer system; Glyco-conjugates and its biological significance. Glycosides, deoxy sugars, amino sugars, sugar alcohols and sugar acids (Lectins-CS). Function of Steroids–cholesterol(CS) and ergosterol, phosphatidyl choline and phosphatidyl ethanolamine, cerebrosides and Gangliosides. Biological significance of Dipeptides and Tripeptides (CS-motifs) oligo peptides-glutathione; Hemoglobin-structure and functions	4	2	-	6
II	**Basic concepts of Metabolism** Metabolism basic concepts- Energy rich compounds-ATP, Common types of reaction in metabolism-Oxidation, reduction, phosphorylation, hydrolysis, hydroxylation, carboxylation. High energy compounds with structures (ATP, ADP, Creatine phosphate,1,3 bisphosphoglycerate, PEP)	5	3	-	8
III	**Metabolism of carbohydrates** Glycolysis. Gluconeogenesis, Glycogen metabolism-glycogenesis, glycogenolysis. Regulation (Only pathway outlines, structures not required**)**	6	2	-	8
IV	**Metabolism of Lipids** Scheme of β-oxidation, ATP yield in β-oxidation (stearate, palmitateas examples) and regulation. Basics of α- and ω-oxidation, ketone body formation, cytoplasmic system of fatty acid biosynthesis and regulation of pathway, outline study of cholesterol and bile acids biosynthesis (Pathway outlines, structures not required**)**	6	3	-	9
V	**Metabolism of Proteins** Reactions involved in the metabolism of amino acids-deamination, transamination and decarboxylation; coenzymes involved in these reactions. Urea cycle (structure not required). Metabolism of Nucleic Acids-*De Novo* & Salvage Pathway	5	2	-	7
VI	**Metabolites** Definition; classification: primary and secondary metabolites; biological roles; metabolites as precursors, regulators and cofactors; industrially important metabolites (organic acids, antibiotics, vitamins and pigments); introduction to metabolomics, types: targeted and untargeted, applications of metabolomics; metabolite databases (HMDB, KEGG, MetaCyc, MetaboLights)	5	2	-	7
PRACTICALS					
Semester-IV (Practical Credit: 01)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
Lab Experiments	1. Tests for amino acids: Solubility, ninhydrin reaction, xanthoproteic reaction, Millon's test/ lead acetate, test for methionine/aldehyde test, Sakaguchi reaction 2. Tests for proteins: Solubility, Ninhydrin reaction, Braford assay, Folin'stest/ Lowry's test, Biuret test, Heat denaturation, TCA precipitation, Alcohol precipitation. 3. Demonstration of Kinetics of Urease/Trypsin (Effect of pH, substrate Concentration, enzyme concentration• and temperature). 4. Progress curve of Urease/Trypsin• 5. Digestion of carbohydrates –action of salivary amylase 6.Anthorne test for carbohydrate	**-**	**-**	**30**	**30**

Detailed Syllabus of Vth Semester FYUGP Biotechnology	
Title of the Paper	**Immunology**
Paper Code	**BIT-MJ-05014**
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:15marks, Home Assignment: 6marks,Class Test:5marks, Attendance:4
Course Outcome (CO)	After completion of this course/module, students will be able to: **CO1.** Describe the basic concepts and scope of immunology, including the historical development of the field and the organization of the immune system. **CO2.**Explain the structure, types, and functions of immune cells, tissues, and organs**,** and their roles in innate and adaptive immunity. **CO3.**Differentiate between humoral and cell-mediated immune responses**,** and outline the mechanisms of antigen recognition, processing, and presentation. **CO4.** Illustrate the structure and function of immunoglobulins (antibodies)**,** antigen–antibody interactions, and principles of immunodiagnostic techniques. **CO5.**Discuss the molecular and cellular basis of immune regulation**,** including cytokines, complement system, hypersensitivity, autoimmunity, and Immunodeficiency disorders.
Course Designer	Ms. Minakshee Sarmah, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous), Tezpur
Reference Books	1. Kuby Immunology by Jenni Punt, Sharon Stranford, Patricia Jones, Judith A Owen. 2. The elements of immunology by Fahim Halim Khan 3. Cellular & Molecular Immunology—Abul K. Abbas; Andrew H.H.Lichtman; Shiv Pillai. 10th Edition. Elsevier Health Sciences, 2021. 4. Immunology: A Short Course—Richard Coico; Geoffrey Sunshine.7thEdition. Wiley-Blackwell, 2015

Semester-V (Theory Credit: 03)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Tota lhrs**
I	**Introduction:** Scope of Immunology, Historical background of Immunology, Biological aspects of Immunology, Self and non-self recognition, specificity, memory of immune system. Antigens: Essential features of Ag, haptens, Carrier molecule, Immunological valence, Antigenic determinants. Adjuvants: Freund's complete and incomplete. Antibodies: Properties, Primary structure of immunoglobulins. Classification of Immuno globulins and its types, Basics of VDJ recombination.	**8**	**3**	**-**	**11**
II	**Immunity:** Types: Active and passive immunity. Cell mediated immunity, humoral immunity, immune response; primary and secondary response. Phagocytosis, mechanism of phagocytosis. Interferon: Types of Interferons. Natural Killer cells. Complement system: Properties and components of compliment, Pathways: Classical and alternative pathways, Immunodeficiency and immunosuppression	**8**	**4**	**-**	**12**
III	**Hypersensitivity(HS):**Type I:Allergies and anaphylaxis -IgE, Mast cell degranulation. Type II: Antibody mediated HS reactions; Mechanism, pathogencity and cases of type II reactions; Type III: Immune complex mediated HS reactions: Mechanism & pathogenecity of type III reactions. Type IV: Delayed type (or) cell- mediated HS reactions; Mechanisms and pathogenecity, Type V: Stimulatory HS reactions. Mechanism and pathogenecity, Autoimmunity: Introduction, Auto-recognition, classes of auto-immune diseases.	**7**	**3**	**-**	**10**
IV	**Immunological techniques:** Precipitin curve and Immuno diffusion, Rocket immuno- electrophoresis.: Direct and Indirect Agglutination, Widal test, VDRL test. Radioimmunoassay: ELISA – Principle, Types, Methodology and applications. Immuno-fluorescence, *In- situ* localization techniques	**8**	**4**	**-**	**12**
PRACTICALS					
Semester-V (Practical Credit: 01)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
Lab Experiments	1. Separate serum/plasma from the blood sample 2. Total and/or differential Leukocyte Count of the given blood sample. 3. Identification of human blood groups 4. Demonstration of ELISA using dot-ELISA method 5. Rocket immune-electrophoresis	**-**	**-**	**30**	**30**

Detailed Syllabus of Vth Semester FYUGP Biotechnology

Paper-Recombinant DNA Technology

Title of the Course	**Recombinant DNA Technology**
Course Code	**Paper Code: BIT-MJ-05024**
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 marks]
Course Outcome (CO)	After completion of this course/module, students will be able to: **CO1.** Understand the basic concepts of genetic engineering and PCR **CO2.** Learn on different applications of restriction enzymes in genetic Engineering. **CO3.** Explain the techniques in mutagenesis **CO4.** Know about genetic engineering in plants through direct DNA transfer methods.
Course Designer	Dr. Pranjal Pratim Das, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous), Tezpur Dr. Manika Das Kataki, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous),, Tezpur Ms. Minakshee Sarmah, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous),, Tezpur
Reference Books	1. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K. 2. Clark DP and Pazdernik NJ. (2009). Biotechnology-Applying the Genetic Revolution. Elsevier Academic Press, USA. 3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington 4. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K. 5. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.

Semester-V (Theory Credit: 03)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
I	**Introduction to Genetic Engineering and PCR** Molecular tools and applications- restriction enzymes, ligases, polymerases, alkaline phosphatase. Gene Recombination and Gene transfer: Transformation-Microinjection, Electroporation, Ultrasonication, Episomes, Plasmids and other cloning vectors (Bacteriophage-derived vectors, artificial chromosomes), Principle and applications of Polymerase chain reaction (PCR), primer-design, and RT-(Reverse transcription) PCR types	**8**	**4**	**-**	**12**
II	**Tools and Techniques of Genetic Engineering** Restriction enzymes and restriction modification system, restriction mapping. Southern and Northern hybridization. Preparation and comparison of Genomic and cDNA library, screening of recombinants, reverse transcription,. DNA fingerprinting.	**7**	**3**	**-**	**10**
III	**Mutagenesis** Introduction, Random, site-directed, oligonucleotide-directed, and casettee mutagenesis: Primer extension and PCR based methods of site directed mutagenesis, Random mutagenesis, Protein engineering- introduction, concepts and examples (Any two).	**6**	**4**	**-**	**10**
IV	**Applications of Genetic engineering** Applications of Genetic Engineering in animals. Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines (one example each).Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants-Ti and Ri plasmids-structure, Mechanism of T-DNA transfer and integration, Ti-plasmid derived vectors, Marker genes for plant transformation, chloroplast engineering	**9**	**4**	**-**	**13**

PRACTICALS

Semester-V (Practical Credit: 01)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
Lab Experiments	1. Isolation of chromosomal DNA from plant cells 2. Isolation of chromosomal DNA from *E.coli* 3. Qualitative and quantitative analysis of DNA using spectrophotometer 4. Plasmid DNA isolation 5. Restriction digestion of DNA 6. Preparation of competent cells 7. Demonstration of PCR and primer designing	**-**	**-**	**30**	**30**

Detailed Syllabus of Vth Semester FYUGP Biotechnology	
Title of the Paper	**Enzymology**
Paper Code	**BIT-MJ-05034**
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	**Upon completion of the course the graduate will be able to** **CO 1**: Understand Enzyme nomenclature, classification, extraction and purification of Enzymes **CO 2**: Understand the Structure and General properties of enzymes and enzyme specificity **CO 3**: Explain Kinetics of enzyme catalysed reactions factors affecting enzyme catalysed reactions **CO 4**: Understand Regulatory mechanism in enzyme catalysis and metabolic regulations
Course Designer	Dr. Manika Das Kataki, Asstt. Professor, Dept. of Biotechnology, Darrang College, (Autonomous), Tezpur Email id; mkdas116@gmail.com
Suggested Readings	1. Lehninger Principles of Biochemistry" by David L. Nelson and Michael M. Cox 2. "Enzymes: Biochemistry, Biotechnology, Clinical Chemistry" by Trevor Palmer 3. "Principles of Enzymology for the Food Sciences" by John R. Whitaker, Alphons G.J. Voragen, and Dominic W.S. Wong 4. "Introduction to Enzyme and Coenzyme Chemistry" by T. D. H. Bugg 5. "Enzyme Kinetics: Catalysis and Control" by DanielL. Purich 6. "Biochemical Calculations: How to Solve Mathematical Problems in General Biochemistry" by Irwin H .Segel 7. "Practical Enzymology" by Hans Bisswanger

Semester-V (Theory Credit: 03)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
I	**Nomenclature, Classification & Purification of Enzymes** Brief History, Enzyme nomenclature and classification, Extraction and Purification of Enzymes:Extraction of soluble and membrane bound enzymes; Purification of enzymes; Criteria of enzyme purity, Assay of enzymes	7	3	-	10
II	**Structure and General properties of enzymes** Cofactors and enzymes; Active site; Specificity of enzyme-Types of specificity; Lock and Key hypothesis & Induced Fit Hypothesis and Transition state stabilization hypothesis. Mechanism of enzyme catalysis: Acid Base catalysis, covalent catalysis and metal ion catalysis, Factors affecting enzyme activity. Isozymes; Coenzymes; Metalloenzymes (Nucleases); Membrane Bound enzymes	8	4	-	12
III	**Enzyme Kinetics and Regulation** Kinetics of enzyme catalysed reactions: Michaelis-Menton, Lineweaver–Burk plot, Kinetics of bi-substrate enzyme catalyzed reactions–Ping-pong and random order mechanisms, Allosteric enzymes-Properties, Factors affecting enzyme kinetics; Enzyme inhibitors: types of inhibitors; Mechanism of enzyme inhibition–competitive, non– competitive, uncompetitive and mixed inhibition, Regulation of enzymes by covalent modification	9	5	-	14
IV	**Enzyme technology** Applications of Enzymes; Applications in medicine: diagnostic enzymes, therapeutic enzymes, Industrial application of enzymes, Immobilization of enzymes and their applications, Application of Endo-nucleases and Exo-nucleases	6	3	-	9
PRACTICALS					
Semester-V (Practical Credit:01)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
Lab Experiments	1. Enzyme kinetic Assay: Conduct experiments varying substrate concentrations while keeping enzyme concentration constant, and vice versa (use crude extract of enzymes if, possible eg: cellulose). 2. Investigate the effect of temperature and pH on enzyme activity 3. Test the ability of the enzyme to catalyze reactions with different substrates. 4. Determine the pH and temperature at which the enzyme exhibits maximum activity. 5. Enzyme immobilization onto a solid support such as beads, membranes, or nano-particles, and assess its stability and activity under different conditions. 6. Compare the properties of free and immobilized enzymes, including substrate specificity, stability, and reusability.	**0**	**0**	**30**	**30**

Detailed Syllabus for VIth Sem FYUGP Biotechnology	
Title of the Paper	**Bio-analytical Tools**
Paper Code	**BIT-MJ-06014**
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:15marks, Home Assignment: 6marks,Class Test:5marks, Attendance:4
Course Outcome (CO)	After completion of this course/module, students will be able to: Understand the working principles of Instruments Know the applications of Biotechniques Handle and operate Instruments
Course Designer	**As per FYUGP Syllabus for Biotechnology, Gauhati University** Dr. Debashree Saikia, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous), Tezpur
Reference Books	1. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia. 2. Biochemical methods by Sadasivam and Manickam, Third edition, New Age International Publishers, New Delhi. An introduction to practical biochemistry by David T. Plummer. McGraw Hill Education, 3rd Edition. 3. Spectroscopy: Fundamentals and Data interpretation by Neeraj Kumar Fuloria, Shivkanya Fuloria. 4. Computer Assisted Microscopy: The Measurement and Analysis of Images by John C Russ, 2011. Springer Verlag.

Semester-VI (Theory Credit: 03)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
I	**Microscopy:** Principle of operation and Instrumentation, Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase Contrast microscopy, electron microscopy (TEM, SEM).	7	3	-	10
II	**Centrifugation:** Basic principles of sedimentation – Types of centrifuges and their uses –Preparative and Analytical centrifuge, rpm and rcf, cell fractionation techniques, isolation of sub-cellular organelles and particles.	5	3	-	08
III	**Spectroscopy:** General principles and law of absorption, Types of spectra and their biochemical applications, fluorimetry, colorimetry, spectrophotometry (visible, UV, infrared), IR spectroscopy, CD spectroscopy, NMR, X-ray diffraction: Principles and Application.	6	2	-	08
IV	**Chromatography**: Concept of Chromatography, Working principles and applications: Partition Chromatography, Adsorption Chromatography, Paper Chromatography, thin layer chromatography, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, gas chromatography, Liquid Chromatography.	6	4	-	10
V	**Electrophoresis:** General principles – apparatus, methods and applications, Agarose gel electrophoresis, SDS-PAGE, immuno- electrophoresis, isoelectric focusing, Blotting techniques.	6	3	-	9
PRACTICALS					
Semester-VI (Practical Credit: 01)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
Lab Experiments	1. Light microscope, principles, components, functions, and operations 2. Principles and operations of centrifuge 3. Quantitative analysis of biological samples by spectrophotometric methods 4. Separation of amino acids by paper chromatography 5. Electrophoretic separation of nucleic acids/proteins	**-**	**-**	**30**	**30**

Detailed Syllabus of VIth Semester FYUGP Biotechnology	
Title of the Paper	**Bioinformatics**
Paper Code	**BIT-MJ-06024**
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, ClassTest:5 marks, Attendance: 4 marks
Course Outcome (CO)	After completion of this course/module, students will be able to: **CO1:** Understand the evolution, interdisciplinary nature, and objectives of bioinformatics as a field integrating biology, computer science, and statistics. Comprehend the structure and function of biological information systems and their role in modern research. Explain how computational approaches assist in managing, interpreting, and visualizing biological data. **CO2:** Understand the structure, purpose, and content of major biological databases such as NCBI, EMBL, DDBJ, UniProt, and PDB. Explain the distinction between primary, secondary, and specialized databases, and how they are interlinked. **CO3:** Explain the concepts of sequence homology, similarity, and identity. Understand algorithms and scoring systems used in local and global alignments (Needleman–Wunsch, Smith–Waterman). Recognize the principles of multiple sequence alignment and phylogenetic tree construction **CO4**: Understand genome organization, gene prediction, and functional annotation processes. Describe the principles of comparative and functional genomics, and their implications in understanding gene function. Explain the scope of proteomics, including protein expression profiling,2 D gel electrophoresis, and mass spectrometry-based analysis
Course Designer	Ms. Minakshee Sarmah, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous), Tezpur. Email id: minakshee164@gmail.com
Reference Books	1. Mount, D.W.(2004).*Bioinformatics: Sequence and Genome Analysis.* Cold Spring Harbor Laboratory Press. 2. Lesk, A. M.(2017).*Introduction to Bioinformatics.* Oxford University Press. 3. Ghosh, Z. &Mallick, B. (2008).*Bioinformatics : Principles and Applications.* Oxford University Press. 4. Baxevanis, A.D.& Ouellette, B.F.F.(2005). *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins.* Wiley. 5. Attwood,T. K. &Parry-Smith, D.J. (2001).*Introduction to Bioinformatics.* Pearson Education

Semester-VIth (Theory Credit: 03)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
I	**Introduction to Bioinformatics** -Definition, scope, and history of bioinformatics, Components and importance in biological research, Overview of computational biology, Human Genome Project	**4**	**1**	**-**	**5**
II	**Biological Databases-**Types of Biological Data, Classification of Biological databases, GenBank, EMBL, DDBJ, Protein databases: UniProt, PDB, Swiss-Prot , Specialized: KEGG, Pfam, OMIM, Ensembl , Database searching: BLAST, ENTREZ , Data formats: FASTA, PDB	**7**	**1**	**-**	**8**
III	**Biological Sequence Analysis -** Sequence Retrival, Similarity search, Homology, alignment principles: global vs local, Scoring matrices: PAM, BLOSUM , Pairwise & multiple sequence alignment (CLUSTALW, MUSCLE), Phylogenetic tree construction(UPGMA,NJ),Applications in taxonomy and evolution	**10**	**2**	**-**	**12**
IV	**Structural Bioinformatics -** Gene prediction and annotation (Genemark and Gnomon) , Protein structure prediction and visualization (AlphaFold, Swiss-Model, PyMOL, RasMol) ,Molecular docking (Basic concepts).	**9**	**1**	**-**	**10**
V	**Emerging areas of Bioinformatics -** Applications in medicine, agriculture, and industry, Systems biology and metabolic pathway analysis , Basic introduction to Synthetic Biology, Ethical, legal, and social issues (ELSI) in bioinformatics	**9**	**1**	**-**	**10**
PRACTICALS					
Semester-VI (Practical Credit: 01)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
Lab Experiments	1. Literature survey using Pubmed 2. Introduction to major biological databases(NCBI,EMBL, PDB) and their use 3. Sequence similarity search using BLAST. 4. Pairwise and multiple sequence alignment using CLUSTAL Omega / MUSCLE. 5. Construction of phylogenetic tree using MEGA/ Phylogeny.fr. 6. Protein structure visualization and docking using HDock 7. Gene prediction using ORF Finder /GENSCAN 8. KEGG pathway mapping and annotation.	**-**	**-**	**30**	**30**

Detailed Syllabus of VIth Semester FYUGP Biotechnology	
Title of the Paper	**PLANT AND ANIMAL BIOTECHNOLOGY**
Paper Code	**BIT-MJ-06034**
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, ClassTest:5 marks, Attendance: 4 marks
Course Outcome (CO)	**Upon completion of the course the graduate will be able to** **CO 1**: Understand fundamentals of plant tissue culture and its tools **CO 2**: Evaluate how plant tissue culture techniques is useful in research and agriculture **CO 3**: To understand genetic variation mechanisms and to evaluate its applications in agriculture **CO 4**: Evaluate how to improve the quality of plants through genetic engineering methods **CO 5**: Understand the application of transgenic plants in various fields and awareness about basic ethical concerns related to it
Course Designer	Dr. Manika Das Kataki, Asstt. Professor, Dept. of Biotechnology, Darrang College, (Autonomous), Tezpur Email id; mkdas116@gmail.com
Reference Books	1. Plant Biotechnology-Recent Advances (2000),P C Trivedi, Panima Publishing Corporation, New Delhi 2. Introduction to Plant Biotechnology (2020), H S Chawla, Oxford & IBH publishing Co. Pvt. Ltd, New Delhi 3. Basics of Biotechnology (2004), A J Nair; Laxmi Publications, New Delhi 4. An Introduction to Plant Tissue Culture (2016), M K Razdan, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi 5. Role of Biotechnology in Medicinal and aromatic plants (2011), Irfan A Khanand Atiya Khanum, Ukaaz Publications, Hyderabad 6. Plant Cell, Tissue, and Organ Culture-Fundamental Methods (2004) O L Gamborg, G C Phillips Narosa Publishing House, New Delhi 7. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications-7th Edition (2016)-Freshney R I, Wiley –Blackwell 8. Animal Cell Culture: A Practical Approach,3rd Edition (2000) –Masters J,OUP Oxford 9. Biotechnology (2015)-B D Singh, Kalyani Publisher Biotechnology, 5th Edition (2009) –Smith J E, Cambridge

Semester-VI (Theory Credit: 03)					
Unit	**Content**	**L**	**T**	**P**	**Total**
I	**Overview: Plant Tissue Culture** Types of *in vitro* cultures: Callus cultures, cell suspension cultures, organ cultures-root cultures, hairy root cultures, embryo cultures. Plant secondary metabolites production through cell, tissue and organ cultures, Advantages, and disadvantages of in vitro methods Somaclonal Variation: Possible reasons for somaclonal variations, Selection of somaclones. Applications of somaclonal variations in agriculture and Horticulture; Merits, and demerits of somaclonal variation. Protoplast-isolation and culturing of protoplast-principle and application, Regeneration of protoplasts, protoplast fusion and somatic hybridization-selection of hybrid cells	6	3	-	9
II	**Gene Transfer Techniques in Plants** Methods of gene transfer in plants–Physical, chemical, and biological methods (Agrobacterium mediated and Virus mediated). Transgenic crops, Impact of transgenic plants in agriculture and Horticulture, Non-Agricultural applications of transgenic plants	6	3	-	9
III	**Introduction to Animal cell culture** History-Relevance of studying Animal cell culture, Animal cell culture techniques, Primary cell cultures and secondary cell cultures, sub culture techniques, Cell lines, Immortalized cell lines, transformed cell lines, Cell strains, Finite and continuous cell lines, Anchorage dependent and anchorage independent cells, Characterization of cell lines. Basic requirements in animal cell culture lab- instruments and equipment Media-Media components and physical parameters, Growth factors promoting proliferation of animal cell cultures. Principles of sterile techniques, Maintenance of animal cell culture, Cryopreservation, and transport of animal cell cultures, Cell viability assays	5	3	-	8
IV	**Gene transfer techniques & Stem cell technology** Gene transfer techniques-Direct methods, Indirect methods-Animal viral vectors, Transgenesis-Transgenic animals and its practical uses-Animals as Bioreactors Stem cell technology: Types of stem cells,Stem cell culture and its clinical uses, Tissue engineered grafts, Gene therapy	7	3	-	10
V	**Application of Animal Cell Cultures** Products of animal cell cultures- hormones (Insulin, growth hormones), interferon, t-plasminogen activator, factor VIII, Factor IX , Production of vaccines in animal cells	6	3	-	9

PRACTICALS

Semester-VI (Practical Credit: 01)

UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
Lab Experiments	• Isolation and Culture of protoplast • Somatic embryogenesis in carrot • Demonstration of confirmation of genetic transformation • To prepare artificial seeds *in vitro* • Visit to Animal Cell Laboratory to demonstrate animal cell culture techniques	-	-	**30**	**30**

Detailed Syllabus of VIth Semester FYUGP Biotechnology	
Paper-Biostatistics	
Title of the Course	**Biostatistics**
Course Code	**Paper Code: BIT-MJ-06044**
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 marks]
Course Outcome (CO)	After completion of this course/module, students will be able to: **CO1.** Understand the basic introductory concepts of the primary objective of this course with a solid foundation in the principles and applications of statistical analysis in the context of biological and medical research **CO2.** Will be able to effectively collect, analyze, and interpret data to support evidence-based decision-making. **CO3.** Exercise the statistical software package like SPSS and R-studio.
Course Designer	Dr. Debashree Saikia, Assistant Professor, Department of Biotechnology, Darrang College (Autonomous), Tezpur-784001, Assam
Reference Books	1. Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA 2. Glaser AN (2001) High Yield™ Biostatistics. Lippincott Williams and Wilkins, USA 3. Edmondson A and Druce D (1996) Advanced Biology Statistics, Oxford University Press. 4. Danial W (2004) Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and Sons Inc.

	Semester-VI (Theory Credit: 03)				
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
I	Types of Data, Collection of data; Primary & Secondary data, Classification and Graphical representation of Statistical data. Measures of central tendency and Dispersion.	7	3	-	10
II	Probability classical & axiomatic definition of probability, Elementary ideas of Binomial, Poisson and Normal distributions.	6	4	-	10
III	Methods of sampling, confidence level, critical region, testing of hypothesis and standard error, large sample test and small sample test. Problems on test of significance, t-test, chi-square test for goodness of fit and analysis of variance (ANOVA)	10	5	-	15
IV	Correlation and Regression. Emphasis on examples from Biological Sciences, Basic introduction to R and R Studio.	7	3	-	10
PRACTICALS					
Semester-VI (Practical Credit: 01)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
Lab Experiments	1. Based on graphical Representation 2. Based on measures of Central Tendency & Dispersion 3. Based on Distributions Binomial Poisson Normal 4. Based on t, f, z and Chi-square	**-**	**-**	**30**	**30**

Detailed Syllabus of VIIth Semester FYUGP Biotechnology	
Paper-Bioprocess Technology	
Title of the Course	**Bioprocess Technology**
Course Code	**Paper Code: BIT-MJ-07014**
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 marks]
Course Outcome (CO)	After completion of this course/module, students will be able to: **CO1.** Understand the **basic introductory** concepts of Bioprocess Technology. **CO2.** Learn on different stages and components of Upstream Bioprocess Technology. **CO3.** Explain the Downstream Processing up to product formulation. **CO4.** Know about the different control measures in Bioprocess Technology.
Course Designer	Dr. Pranjal Pratim Das, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous), Tezpur Dr. Manika Das Kataki, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous),, Tezpur Ms. Minakshee Sarmah, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous),, Tezpur
Reference Books	1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited. 2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi. 3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited. 4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.

Semester-VII (Theory Credit: 03)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
I	**Introduction to Bioprocess Technology** Introduction to bioprocess technology. Techniques and .basic principle components of fermentation technology. Types of microbial fermentation and their uses. Substrates for industrial fermentation, Microbial metabolic products, Principles of microbial growth and culture system	**7**	**4**	**-**	**11**
II	**Introduction to Upstream bioprocessing** Principles of upstream processing – Introduction, operation of a conventional bioreactor, Media preparation, Development of inoculum and sterilization, Design of bioprocess vessels- Significance of Impeller, Baffles, and Sparger. Types of culture/production vessels- Airlift; Cyclone Column; Packed Tower and their application in production processes.	**7**	**3**	**-**	**10**
III	**Introduction to Downstream Processing** Stages in downstream processing, Solid-liquid separation, Release of intracellular products, Liquid-liquid separation (Membrane filtration, precipitation, and adsorption), Purification by chromatography, Microbial production of ethanol, amylase, lactic acid and single cell proteins.	**8**	**4**	**-**	**12**
IV	**Control Measures in Bioprocess Technology** Introduction to oxygen requirement in bioprocess technology; mass transfer coefficient; factors affecting KLa. Bioprocess measurement and control system with special reference to computer aided process control.	**8**	**4**	**-**	**12**

PRACTICAL

Semester-VII (Practical Credit: 01)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
Lab Experiments	1. Bacterial growth curve. 2. Calculation of thermal death point (TDP) of a microbial sample. 3. Production and analysis of ethanol. 4. Production and analysis of amylase. 5. Production and analysis of lactic acid. 6. Isolation of industrially important microorganism from natural resource 7. Case study	**0**	**0**	**30**	**30**

Detailed Syllabus of VIIth Semester FYUGP Biotechnology	
Paper-Medical Biotechnology	
Title of the Course	**Medical Biotechnology**
Course Code	**Paper Code: BIT-MJ-07024**
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 marks]
Course Outcome (CO)	After completion of this course/module, students will be able to: **CO1.** Understand the **basic concepts of medical biotechnology and molecular diagnosis techniques.** **CO2.** Learn on gene editing and gene expression systems in advanced field of genetic engineering. **CO3.** Explain the fundamentals of drug delivery. **CO4.** Know the importance of immunology in biotechnology and **CO5**. Understand the applications of animal tissue culture in medical biotechnology.
Course Designer	Dr. Pranjal Pratim Das, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous), Tezpur Dr. Manika Das Kataki, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous), Tezpur Ms. Minakshee Sarmah, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous), Tezpur
Reference Books	1. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington. B.B. Nanda and R.K. Tiwari. 2. S B Primrose, R M Twyman and R W Old (2001). Principles of gene manipulation 6th Edition, S B University Press. 3. J. Sambrook and D W Russel (2001). Molecular cloning: A laboratory Manual, Vol-1-3, CSHL. 4. R. Ian Freshney, culture of animal cells, a manual of basic technique and specialized applications, sixth edition

Semester-VII (Theory Credit: 03)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
I	**Molecular Diagnosis** The Advent of Medical Biotechnology-Historical Background, Biotechnology in Medicine: Fundamentals and Advances, Analytical Techniques in Medical Biotechnology-DNA sequencing, RT-PCR, Functional genomics, Microarray-types and its analysis techniques, Molecular markers-RFLP, RAPD, KFLP, Microsatellites, Molecular pharming. Interferons and Interleukins, Modern vaccine technologies, Development of monoclonal antibodies, gene therapy	**7**	**3**	**-**	**10**
II	**Advanced Genetic Engineering** Gene editing Tools-CRISPR, Manipulation of gene expression in prokaryotes - Prokaryotic gene expression - Gene expression from strong and regulatable promoters - Fusion proteins - Translation expression vectors, Heterologous Protein Production in Eukaryotic cells - Saccharomyces cerevisiae expression systems - Other yeast expression system - Insect cell expression system - Mammalian cell expression system	**6**	**3**	**-**	**09**
III	**Drug Delivery** Drug delivery-Basic concepts, Pharmacokinetics and Pharmacodynamics-Introduction, Rate control in drug delivery and targeting, Drug targeting systems: Fundamental and applications to parental drug delivery, Routes of drug delivery, Future direction of drug delivery and targeting, Plasmid based gene therapy, Integrating drug discovery and delivery • New generation technologies	**6**	**3**	**-**	**09**
IV	**Immunology in Biotechnology** Introduction, Epigenetics, Stem Cell Technology in Medical Biotechnology. Molecular methods in Clinical Microbiology-Introduction, Immune diagnostic test- Immunofluorescent, Enzyme Immunoassay- Enzymes for Enzyme immune assays and conjugation of enzymes, Solid phases used in Enzyme Immunoassays. Homogeneous and Heterogenous Enzyme Immunoassays, Enzyme Immune Histochemical Techniques.	**6**	**3**	**-**	**09**
V	**Animal Tissue Culture** Introduction to animal tissue culture- Historical background, Outline of the key techniques of animal cell culture, Animal cell culture media,- Natural and Synthetic media, Preservation of animal cell lines Hybridomas- human hybridomas.	**5**	**3**	**-**	**08**
PRACTICAL					
Semester-VII (Practical Credit: 01)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
Lab Experiments	1. Gene and pathway analysis using KEGG database. 2. CRISPR RNAs (crRNAs) to identify target DNA sequences. 3. Determination of ADME of small molecule using Swiss ADME 4. Identification of active site of a given protein. 5. Handling in Biosafety cabinets (Demonstration)	**0**	**0**	**30**	**30**

Detailed Syllabus of VIIth Semester FYUGP Biotechnology

Paper-Food Biotechnology

Title of the Course	**Food Biotechnology**
Course Code	**Paper Code: BIT-MJ-07034**
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 marks]
Course Outcome (CO)	**Upon completion of the course the graduate will be able to** **CO1:**Describe the selection of industrially important microbes for production of food products for human welfare **CO2**:Design a controlled environment for microbes for optimum growth and production **CO3**:Evaluate various methods for recovery and purification of byproduct after fermentation **CO4**:Aware about application of industrial food biotechnology in various field of biotechnology such as fermented food production **CO5**:Identify biotechnology industries in India and its opportunities
Course Designer	Dr. Manika D Kataki, Asstt. Professor, Darrang College (Autonomous), Tezpur, Assam, Email id:mkdas116@gmail.com
Reference Books	1. Food Microbiology, 2nd Edition(2002)-Adamas M Rand Moss MO; Panima Publishing Corporation, New Delhi. 2. Fermentation technology,3rdEdition(2016) -Stanbury PF, Whitaker A, Hall S J, Butterworth-Heinemann 3. Food Microbiology,5thEdition(2017)-Frazier WC, Dennis C. Westhoff and N.M. Vanitha, McGraw Hill Education 4. Microbiology,8thEdition(2011)-Prescott L.M., Harley, J.P., and Klein D. A. Mc Graw Hill, New York 5. Industrial Microbiology,2ndEdition(2022)–Patel A H, Laxmi Publications 6. Food Processing :Biotechnological Applications, Reprint Edition 2015-Marwaha SS and Arora JK, Asiatech Publishers Inc., New Delhi 7. Modern concept of Biotechnology,1st Edition(1998)-HDKumar; Vikas Publishing House, Pvt. Ltd., New Delhi. 8. Industrial microbiology,2nd Edition(2019)-CasidaL E, New Age International Private Limited

Semester-VII (Theory Credit: 03)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
I	**Introduction to Food Microbiology** Overview of microorganisms in food Microbial growth and factors affecting growth Food microbiota: beneficial and spoilage microorganisms Microbial Ecology in food systems, Soil, Air, water-borne bacteria and fungi. spores and their significance, Microbial contamination and food borne pathogens, foodborne infections and ,intoxications, Biotechnological approaches for enhancing food quality and safety-detection of pathogens, toxins, and allergens, Microbial cultures and starter cultures in food fermentation, Microbes in food industry-Dairy Biotechnology-dairy products, Industrial process of cheese making, spoilage, milk borne diseases	10	5	-	15
II	**Bioreactors, Upstream and Downstream processing** Bioreactor Design and Operation: Principles of bioreactor design, types of bioreactors, and parameters influencing bioprocesses. Fermentation Technology: Optimization of fermentation processes and scale-up strategies; Upstream Processing: Media for fermentation, characteristics of ideal production media, media sterilization, aeration, pH, temperature; Bioprocess Monitoring and Control: Techniques for monitoring cell growth, product formation, and controlling bioreactor conditions, Batch fermentation, Continuous fermentation, Chemostatic cultures; Downstream processing: Downstream processing and product recovery, Different physical and chemical methods for the separation of fermentation products	10	5	-	15
III	**Food Preservation Techniques** Heat processing(pasteurization, sterilization), Low-temperature storage and refrigeration, Control of water activity; Emerging preservation methods(e.g., high-pressure processing, irradiation, novel physical methods); Chemical preservatives and natural food antimicrobials; Microbiological Analysis of Foods, Sampling techniques and sample preparation, Microbial enumeration methods (e.g., plate count, Membrane filtration), Detection and identification of specific microorganisms (e.g., pathogens, indicator organisms), Food preservation-principles of preservation of foods,	10	5	-	15
PRACTICALS					
Semester-VII (Practical Credit: 01)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
Lab Experiments	1. Microbial Fermentation & Culture Yogurt Production 2. Vinegar & Alcohol Production using yeast and bacteria 3. Studying microbial changes in products like sauerkraut. 4. Serial dilution and plating to isolate specific microbes (like Lactobacillus, Saccharomyces) from fermented foods. 5. Proximate Analysis: Determining moisture, ash, fat, protein, fiber, and carbohydrate content in foods. 6. Adulteration Detection: Testing for contaminants in milk, honey, oils, spices. 7. Sensory Evaluation: Using hedonic scales, triangle tests, and ranking to assess flavor, texture, and acceptability.	-	-	30	30

Detailed Syllabus of VIIth Semester FYUGP Biotechnology	
Title of the Paper	**Genomics and Proteomics**
Paper Code	**BIT-MJ-07044**
Total Credit (Theory+ Practical)	**Theory Credit:** 03 **Practical Credit:** 01 **No. of Required Classes:** 75 (Theory:45; Practical: 30)
Contact Hours	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,ClassTest:5 marks, Attendance: 4
Course Outcome (CO)	After completion of this course/module, students will be able to: **CO1**: Describe the structure, organization, and evolution of prokaryotic and eukaryotic genomes, including nuclear, mitochondrial, and chloroplast genomes. **CO2**: Explain major genomics technologies such as DNA sequencing (Sanger and NGS), genome mapping, assembly, and annotation. Retrieve, interpret, and analyze genomic and proteomic data using major biological databases (NCBI, UniProt, PDB) and bioinformatics tools (BLAST, genome browsers). **CO3:** Explain principles and methodologies used in proteomics, including protein separation techniques, 2D-gel electrophoresis, mass spectrometry, peptide fingerprinting, and protein-protein interaction analysis. Demonstrate basic skills in computational analysis, such as sequence alignment, structural prediction, and comparative genomics/proteomics. **CO4**: Interpret omics datasets (Genomic, transcriptomic, and proteomic outputs) and understand their relevance to functional biology, health, agriculture, and biotechnology. **CO5**: Apply concepts of genomics and proteomics in real-world applications such as biomarker discovery, drug design, diagnostics, microbial identification, and personalized medicine.
Course Designer	Ms. Minakshee Sarmah, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous), Tezpur
Reference Books	• S.B. Primrose & R.M.Twyman, Principles of Genome Analysis & Genomics (7th Edition) • S.Sahai, Genomics and Proteomics: Functional and Computational Aspects (Springer) • D.C.Liebler, Introduction to Proteomics– Tools for the New Biology

Semester-VII (Theory Credit: 03)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
I	Overview of "omics", Introduction to Genomics, Structure & organization of prokaryotic and eukaryotic genomes: nuclear, mitochondrial, chloroplast genomes, DNA sequencing methods – manual & automated: Maxam & Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun& Hierarchical methods, Computer tools for sequencing projects: Genome sequence Assembly software	**6**	**3**	**-**	**9**
II	Managing and Distributing Genome Data: Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organisms' Genomes and Databases.	**6**	**3**	**-**	**9**
III	Introduction to protein structure, Chemical properties of proteins. Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, van der waal interactions, Hydrogen bonds, Hydrophobic interactions. Determination of sizes (Sedimentation analysis, gel filteration, SDS-PAGE), Determination of covalent structures– Edman degradation.	**7**	**2**	**-**	**9**
IV	Introduction to Proteomics, Analysis of proteomes.2D-PAGE. Sample preparation, Solubilisation, reduction, resolution. 2D-PAGE, Mass spectrometry based method. Protein-protein interactions; structural proteomics; functional proteomics; expression proteomics	**7**	**2**	**-**	**9**
V	Applications of Genomics & Proteomics- Functional genomics: gene expression profiling (microarrays, RNA-seq), epigenomics. Comparative genomics and systems biology approaches Role in drug discovery, diagnostics, toxicology, personalised medicine. Emerging topics: AI in genomics & proteomics; single-cell technologies; big data challenges.	**7**	**2**	**-**	**9**
PRACTICALS					
Semester-VII (Practical Credit: 01)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
Lab Experiments	1.Use of SNP databases at NCBI and other sites 2.Use of OMIM database 3.Detection of Open Reading Frames using ORF Finder 4.Proteomics 2D PAGE database 5. Softwares for Protein localization. 6. Hydropathy plots 7. SDS-PAGE	-	-	**30**	**30**

Detailed Syllabus of VIIIth Semester FYUGP Biotechnology	
Title of the Paper	**Basics of Phyto-Chemistry and Medicinal Plant-Based Industry**
Paper Code	**BIT-MJ-08014**
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:1 5 marks, Home Assignment: 6 marks, Class Test: 5marks, Attendance:4
Course Outcome (CO)	**After completion of this course/module, students will be able to:** **CO1**: Summarise the various natural products and apply the methods of phyto-chemical evaluation. Identify the various processes in bioprospecting and importance of access and benefit sharing. **CO2:** Distinguish among the various extraction and characterization techniques of phytochemicals **CO3:** Understand the various metabolic pathways and classify among the various phytochemicals involved and list the pathway manipulation techniques **CO4:** Identify a few important medicinal plants and compare the various methods of extraction of phytochemicals and their uses. **CO5:** Demonstrate the various techniques for extraction and analysis of any one phytochemical of choice
Course Designer	Dr. Manika D Kataki, Asstt. Professor, Dept. of Biotechnology, Darrang College (Autonomous), Tezpur, Assam. Email id: mkdas116@gmail.com
Reference Books	1. Phytochemical Methods A Guide to Modern Techniques of Plant Analysis by J B Harborne. Springer, 1998**.** 2. Krishnaswamy, N.R.,2003.Chemistry of Natural Products. Universities press, Hyderabad 3. Daniel, M.,1991.Methods in Plant chemistry and Economic Botany. Kalyani publishers, New Delhi 4. Phytochemistry-Vol1-Fundamentals, Modern techniques, and applications, ChukwuebukaEgbuna, Ifemeje, J.C(Editors).CRCTaylor&Francis,2019.

Semester-VIII (Theory Credit: 03)

UNIT	CONTENT	L	T	P	Total hrs
I	**Introduction to phytochemistry and medicinal plant-based industry** Natural products from plants, History, Phytochemical evaluation of plant drugs, morphological, organoleptic, microscopic, and biological study of aromatic plants Applications of Phyto-chemistry and Phytochemicals, Medicinal and aromatic plant-based industries – phyto-pharmaceutical products, use in indigenous medicine, bio-prospecting and introduction to access and benefit sharing Pharmacology and pharmacognosy	6	3	-	09
II	**Extraction and characterization techniques** Types and principles of extraction–cold, hot-Soxhlet, steam distillation, solid liquid extraction, Clevenger apparatus. Separation and characterization techniques-Chromatography types- TLC, HPLC, GC-MS, HPTLC, UV-visible spectroscopy, IR spectroscopy, NMR.	**6**	**3**	**–**	**09**
III	**Active principles from plants** Primary and secondary metabolic pathways (Shikimic–chorismic,mevalonate pathways) and metabolites. Types and features of active constituents, quality purity and pharmaceutical use. Classification of phytochemicals, Sources, Biosynthesis, extraction, isolation, identification and therapeutic applications-Alkaloids, Flavonoids, Phenolics, Terpenes, Volatile oils. Adulteration and alternation-Detection methods.	**6**	**3**	**-**	**09**
IV	**Study of a few important medicinal plants** Utilization of Medicinal Plants in Pharmaceuticals, Drug discovery From natural sources, Development of plant-based medicines, Formulation and dosage forms. Study of medicinal plants, methods of extraction, therapeutic uses- *Ocimum sanctum,Aegle marmalos,Cymbopogan citratus*, *Curcuma longa,Santalum album,Aloe barbadensis*	**6**	**3**	**-**	**09**
V	**Herbal Products and Nutraceuticals** Dietary supplements, Functional foods, Herbal cosmetics, Regulatory Aspects and Quality Control, Good Manufacturing Practices (GMP),Quality control parameters(purity, potency, identity), Safety and Toxicological assessment, Ethical considerations in wild harvesting	**6**	**3**	**-**	**09**
PRACTICALS					

Semester-VIII (Practical Credit: 01)

UNIT	CONTENT	L	T	P	Total hrs
Lab Experiments	1.Determination of flavonoids and alkaloids from plants 2. Separation of different organic fractions of medicinal plants using TLC 3. Extraction of essential oil using steam distillation 4. Compound n identification using PubChem database 5. Identification of few medicinal plants 6. Preparation of herbal cosmetics	-	-	**30**	**30**

Detailed Syllabus of VIIIth Semester FYUGP Biotechnology	
Title of the Paper	**Environmental Biotechnology**
Paper Code	**BIT-MJ-08024**
Total Credit (Theory+ Practical)	**Theory Credit:** 03 **Practical Credit:** 01 **No. of Required Classes:** 75 (Theory: 45; Practical:30)
Contact Hours 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)	After completion of this course/module, students will be able to: **CO1:** To attain theoretical and methodological knowledge of surrounding environmental problems and the use of biotechnology for environmental goals. **CO2:** Identify environmental pollution and side effects to our ecosystem and health. **CO3:** Understand the fundamentals of waste management and green economy **CO4**: Recognize the importance of Bioremediation and Bio-monitoring in environmental pollution.
Course Designer	Dr. Debashree Saikia, Assistant Professor, Department of Biotechnology, Darrang College (Autonomous), Tezpur-784001, Assam
Reference Books	1.GarethM. Evansand Judith C.Furlong, 201EnvironmentaBiotechnology: Theory and Application 2nd edn, Wiley Blackwell. 2.BruceE.Rittmann,2020.Environmental Biotechnology: Principles and Applications, Second Edition, McGraw-Hill Education 3. Indu Shekhar Thakur, 2011. Environmental Biotechnology: Basic Concepts and Applications 2nd Revised edition, I K International Publishing House

Semester-VIII (Theory Credit: 03)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
I	**Introduction to environmental biotechnology** Components of environment: Hydrosphere, lithosphere, atmosphere and biosphere; Interaction of man and environment. Introduction to environmental biotechnology, Non Renewable resources (coal, petroleum, and natural gas) and Renewable resources (solar, wind, tidal, biomass, nuclear, geothermal and hydroelectric resources). Current status and environmental impact of renewable and non-renewable resources. Global Environmental Problems: Green House Effect, Acid rain, El Nino, Ozone depletion, deforestation, desertification, salination, biodiversity loss; chemical and radiation hazards.	11	1	-	12
II	**Environmental pollution and degradation** Pollution of air, water and land with reference to their causes, nature of pollutions, impact and control strategies; noise pollution; environmental damage by agriculture, perspectives of pollution in urban, industrial and rural areas.	7	1	-	8
III	**Waste management** Principles of waste management, types, sources and effects of solid waste, Physical and biological treatment methods, waste water treatment, Waste to energy conversion, Disposal of wastes.	8	1	-	9
IV	**Bioremediation and Bio-monitoring** Basics and types of bioremediation, Bioremediation of oil, heavy metals, pesticides contaminated soil and water, Phytoremediation and its types, Biochemical and genetic basis of biodegradation, Biodegradation of pesticides and petroleum products, Biotransformation of heavy metals, Biopolymers and Biodegradable plastics. Bio-monitoring, Bioassays, Biosensors, Biochips, Biological indicators and Biomarkers, Bioconversion, Microbial Enhanced Oil Recovery (MEOR), Role of Biotechnology in pollution abatement.	14	2	-	16
PRACTICALS					
Semester-VIII (Practical Credit: 01)					
UNIT	**CONTENT**	**L**	**T**	**P**	**Total hrs**
Lab Experiments	1. Study on how the community deals with domestic solid waste (Collection, disposal and treatment) 2. A case study of Solid waste composition and its management 3. Measure the BOD, phosphate, sulphate and nitrate content in water collected from any of these sources (well/ lake/ wetland/ wastewater) 4. Study of the types of soil, rapid tests for –pH, chlorides, nitrates, carbonates and organic carbon 5. Study on Waste water treatment (Sewage and Industrial effluents treatment) 6. Determination of pH, carbonates and nitrates in soil. 7. Preparation of liquid bioformulation and assessing its shelf life 8. A case study of bio-monitoring system.	-	-	30	30

Detailed Syllabus of VIIIth Semester FYUGP Biotechnology	
Title of the Paper	**Bioethics and Intellectual Property Rights**
Paper Code	**BIT-MJ-08034**
Total Credit (Theory+ Practical)	**Theory Credit:** 03 **Practical Credit:** 01 **No. of Required Classes:** 75 (Theory:45; Practical:30)
Contact Hours Required	75(Theory Class: 45; PracticalClass: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)	After completion of this course/module, students will be able to: **CO1:** Understand the concept of ethical issues related to biotechnology, genetics, and human/animal experimentation. **CO2:** Identify biosafety levels, containment procedures, and regulatory guidelines. **CO3:** Understand the fundamentals of patents, copyrights, trademarks,and related IPR processes. **CO4**: Recognize the importance of ethical and legal compliance in research and product development. **CO5:** Appreciate the role of ethics and IPR in sustainable innovation and bioeconomy.
Course Designer	Ms. Minakshee Sarmah, Asstt. Professor, Dept. of Biotechnology, Darrang College, Tezpur. E.mail id:minakshee164@gmail.com
Reference Books	1. Beauchamp, T.L.&Childress, J.F.(2019). *Principles of Biomedical Ethics.* Oxford University Press. 2. Krattiger, A.etal.(2007).*Intellectual Property Management in Health and Agricultural Innovation.* MIHR. 3. Singh, K.(2017). *Textbook on Bioethics and Biosafety.* IKInternational. 4. Meenu Kalia(2015).*Biosafety and Bioethics.* IKInternational. 5. Goel, A.K.(2013).*IPR, Biosafety and Bioethics*.Pearson Education. 6. DBT, Govt.ofIndia– *Biosafety Guidelines (Revised2023)*. 7. WIPO & Indian Patent Office websites (for latest patent rules).

Semester-VIII (Theory Credit: 03)

UNIT	CONTENT	L	T	P	Total hrs
I	**Introduction to Bioethics** Definition, scope, and need for bioethics, Ethical principles , Ethics in biomedical and biotechnological research, Human genome project and ethical issues, Ethics in stem cell research, cloning, genetic testing, and organ transplantation, Ethical concerns in animal experimentation—CPCSEA guideline, Environmental ethics and sustainability in biotechnology	9	2	-	11
II	**Biosafety** Introduction to biosafety: definitions, objectives, and significance, Biological risk assessment and management, Biosafety levels (BSL-1 to BSL-4) and containment facilities, Good Laboratory Practices (GLP) and Good Microbiological Techniques (GMT), Biosafety in recombinant DNA technology – NIH and DBT guidelines	6	2	-	8
III	**Intellectual Property Rights** Introduction and importance of IPR in biological sciences, Types of IPR: Patents, Copyrights, Trademarks, Trade Secrets, Geographical Indications, Criteria for patentability and process of patent filing (Indian & international systems), Patent laws in India: Indian Patent Act 1970 and Amendments, Patenting of biological materials, microorganisms, and biotechnological inventions, Case studies: Patenting of genes, basmati rice, turmeric, neem, etc, Role of IPR in research, innovation, and entrepreneurship	10	4	-	14
IV	**Regulatory and Ethical Framework** National and international regulatory bodies (ICMR, DBT, WHO, WIPO), Ethical review committees and informed consent, Bioethics and biosafety in publication and data sharing, Dual-use research of concern (DURC), Emerging issues: synthetic biology, biosecurity, AI and data ethics in biosciences	9	3	-	12

PRACTICALS

Semester-VIII (Practical Credit: 01)

UNIT	CONTENT	L	T	P	Total hrs
Lab Experiments	1. Study of biosafety symbols, signs, and risk groups. 2. Preparation of a short policy brief on ethical issue. 3. Case study discussions on cloning, GMOs,and CRISPR ethics 4. Visit to institutional biosafety committee (ifpossible) and learn proceedings 5. Case study presentation on ethical dilemma in biotechnology. 6. Patent search and report on a biological innovation. 7. Preparation of an IPR filing flowchart for a biotech product.	-	-	30	30