COURSE CURRICULUM FOR BIOTECHNOLOGY (MINOR COURSE)

NAME OF THE PROGRAMME: Biotechnology Minor Course

JAGANNATH BAROOAH COLLEGE, JORHAT (ASSAM)

SYLLABUS

UNDER NEP

Objective of the Programme:

- **To provide quality education and in-depth knowledge in the field of Biotechnology**
- **To inculcate the spirit of conservation of resources, biodiversity and their interaction with environment and love for nature.**
- **To provide quality education offering skill-based programme and motivate the students for selfemployment.**
- **To enhance academic standards and quality of higher education system of our country.**

Expected Outcome of the Course:

- **More and more students will get admission in PG programs in higher institutes of learning.**
- **Interested students may take up entrepreneurship in biological sciences**

Course Structure- BIOTECHNOLOGY (Minor)

Sem	Course No	Course Code	Course Title	Course Type Theory (TH) + Practical (PR)	Marks Distribution			
					End Semester		In Semester	Total
					TH	PR		
1st	BTC-01	BTCMI-011	Cell Biology	TH + PR	50	20	30	100
2nd	BTC-02	BTCMI-021	Biochemistry	TH + PR	50	20	30	100
3rd	BTC-03	BTCMI-031	Genetics	TH + PR	50	20	30	100
4th	BTC-04	BTCMI-041	Molecular Biology	TH + PR	50	20	30	100
5th	BTC-05	BTCMI-051	Microbiology	TH + PR	50	20	30	100
6th	BTC-06	BTCMI-061	Immunology	TH + PR	50	20	30	100
7th	BTC-07	BTCMI-071	Plant Biotechnology	TH + PR	50	20	30	100
8th	BTC-08	BTCMI-081	Animal Biotechnology	TH + PR	50	20	30	100

Detailed Syllabus for Minor Course
Sub: Biotechnology

Semester-I
Course Title : Cell Biology

Course Code : BTCMI-011 **Course No : BTC- 01**
Credits : 04 (03-Theory, 01-Practical)
Total Marks-100
End Semester :Theory : 50 **Practical: 20**
In Semester : 30

Course objective: To provide the concepts of Cell Biology

Cell Biology	
Topics	**Marks**
Unit – 1. Cell Structure 1. Cell as the basic unit of living system and the cell theory 2. Prokaryotic versus Eukaryotic cells 3. Ultra-structure and chemical composition of cellular components of prokaryotic and eukaryotic cells (Cell wall, Plasma membrane, Cytoplasm, Chloroplast, Mitochondria, Ribosome, SER & RER, Golgi complex, Nucleus, Lysosome, Vacuole, Peroxisome etc)	10
Unit -2. Cytoskeleton and endomembrane system 1. Structural organization and properties of microtubules, 2. intermediate filaments and microfilaments. 3. Arrangement and function of Cilia and flagella in eukaryotes and prokaryotes 4. Components of endomembrane and their detail function as a unit.	10
Unit – 3. Cell Division, signalling and some diseases 1. Cell Division – Mitosis and Meiosis, 2. Cell Cycle and its regulation, checkpoints in cell cycle 3. Cell signalling – Signal transduction pathways and G-protein mediated signalling, Apoptosis, Cancer	10
Unit – 4. Genetic Material 1. Chromosome – Chemical composition, Nucleosome, Euchromatin and Heterochromatin. 2. DNA as genetic material – Experiments of Griffiths, Avery, Mc Leod and Mc Carty, and Hershey and Chase, experiment to prove Semiconservative nature of DNA replication, 3. Central dogma of molecular biology 4. DNA replication in Prokaryotes and Eukaryotes	10
Unit – 5. Biophysical Techniques to study cell 1. Principles and Biological application of Bright field (Simple and compound) and Dark field microscopy, Electron Microscopy, 2. Fixation and Staining of cells/tissue 3. Centrifugation techniques and separation of sub-cellular organelles 4. Cell fractionation techniques 5. Techniques of Cell lysis and disintegration	10

Practical (Credit – 1) **Marks - 20** **Cell Biology**	
Practical	**Marks**
Mitosis and the Cell Cycle in Onion Root-Tip Cells	10
Meiosis in Onion Flower bud /Tradescantia Flower bud /Grasshopper testes	10
Buccal smear – Identification of Barr Body	5
Histochemical localization of Protein and Lipid	5+5
Anatomical studies of different types of cell & tissue (Histology): • Plant: Leaf of monocot & dicot, Stem of monocot & dicot, Root of monocot & dicot, Stomata • Animal: Simple epithelium, Squamous epithelium, Columnar Epithelium, Stratified	5 in each

Detailed Syllabus for Minor Course
Sub: Biotechnology

Semester-II
Course Title : Biochemistry

Course Code : BTCMI-021 **Course No : BTC- 02**
Credits : 04 (03-Theory, 01-Practical)
Total Marks-100
End Semester :Theory : 50 **Practical: 20**
In Semester : 30

Course objective: To provide the concepts of Biochemistry

Biochemistry	
Topics	**Marks**
Unit-1. Biochemical Basis of Life 1. Importance of Biochemistry 2. General properties, Classification, Structure and function of Carbohydrates - Monosaccharide, Oligosaccharide and Polysaccharide. 3. Protein - Classification and structures of amino acids. Physical and chemical properties of amino acids. Essential and non-essential amino acids. Structure (Primary, Secondary, Tertiary and Quaternary) and Classification of proteins, 4. Lipids: Definition and classification. Fatty acids: classification, nomenclature, structure and properties of saturated and unsaturated fatty acids. Essential fatty acids. 5. Nucleic acids – Properties of DNA and RNA, building blocks of nucleic acids - Structure: Purines and pyrimidines, Nucleosides, Nucleotides.	15
Unit – 2. Enzymes 1. Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzymes, prosthetic groups. Monomeric &oligomeric enzymes. Activation energy and transition state. 2. Enzyme activity, specific activity and active site. Enzyme specificity-definition and significance. 3. Role of: NAD+, NADP+, FMN/FAD, coenzyme A,Thiamine pyrophosphate, Pyridoxal phosphate, Lipoicacid, Biotin,Vitamin B12 and Tetrahydrofolate.	15
Unit – 3. Metabolism of Biomolecules 1. Photosynthesis: Light and Dark Reactions, Chemiosmotic hypothesis. 2. Carbohydrates metabolism reactions, energetics and regulation. 3. Glycolysis: Fate of pyruvateunder aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Glycogen synthesis and breakdown. 4. Citric Acid Cycle, Electron Transport Chain, Oxidative phosphorylation.	10
Unit-2. Biophysical techniques to study Biochemistry 1. pH and buffers, Handerson Hasselbalch equation, pK and pI values of buffers, Basic principle of pH meter 2. Principle and law of spectrophotometry (visible, UV, infrared), 3. Introduction to the principle and use of chromatography in life sciences: Paper chromatography, Thin layer chromatography, Column chromatography, gel filtration, affinity & ion exchange chromatography, gas chromatography and HPLC	10

Practical (Credit – 1) **Biochemistry**	**Marks - 20**
Practical	**Marks**
Preparation of Buffer and pH adjustment	5
Qualitative analysis of Carbohydrates	10
Qualitative test for detection of Lipids and Proteins	10
Separation and detection of Amino acid by paper chromatography	10
Principles of Colorimetry: To study relation between absorbance and % transmission	5
Quantitative estimation of Sugar, protein and nucleic acids	10
Extraction and determination of Enzyme activity (Urease / Phosphatase)	10

Detailed Syllabus for Minor Course
Sub: Biotechnology

Semester-III
Course Title : Genetics

Course Code : BTCMI-031 **Course No : BTC- 03**
Credits : 04 (03-Theory, 01-Practical)
Total Marks-100
End Semester :Theory : 50 **Practical: 20**
In Semester : 30
Course objective: To provide the concepts of Genetics

Genetics	
Theory	**Marks**
Unit-1. Basic Genetics 1. Genetics: Mendelian laws of inheritance, Complete dominance, and Chromosomal theory of inheritance 2. Deviation from Mendel's ratios- Incomplete dominance and codominance, complementary factor, supplementary factor, epistasis, Multiple alleles, Lethal alleles, Pleiotropy 3. Linkage and Dominance 3. Inheritance of Sex-linked characters 4. Inheritance pattern of qualitative and quantitative characters	15
Unit-2. Chromosome 1. Chemical composition, 2. Structural organization of chromatid: Euchromatin and heterochromatin, 3. Special chromosomes: Polytene and lampbrush Chromosome, 4. Linkage and Crossing over	10
Unit – 3. Mutation and transposable elements 1. Mutations: Occurrence, types of Mutation: spontaneous & induced Mutation, point mutation & frameshift mutation, mis-sense, non-sense & neutral mutations, mutagens, Lethal Mutations, Phenotypic effects of Mutation, Molecular basis of Mutation 2. Chromosomal aberration (Structural and numerical) 3. Transposable elements: class I & class II transposons 4. Genetic syndromes and hereditary defects 5. Population genetics and Hardy Weinberg Equilibrium	15
Unit – 4. Applied Genetics 1. Pedigree analysis 2. Genetic disorders. Mendelian inheritance patterns of human disorders 3. Mapping genes on chromosomes based on linkage analysis; 4. Plant breeding. 5. Epigenetics.	10

Practical (Credit – 1) **Marks - 20** **Genetics**	
Practical	**Marks**
Preparation of Karyotype	10
Preparation of Ideogram	10
To study Chromosome banding.	10
Pedigree charts of some common characters like blood group, colour blindness	10
Study of polyploidy in plant cells by colchicine treatment.	10
Demonstration of Monohybrid cross	10

Detailed Syllabus for Minor Course
Sub: Biotechnology

Semester-IV
Course Title : Molecular Biology

Course Code : BTCMI-041 **Course No : BTC- 04**
Credits : 04 (03-Theory, 01-Practical)
Total Marks-100
End Semester :Theory : 50 **Practical: 20**
In Semester : 30
Course objective: To provide the concepts of Molecular Biology

Molecular Biology	
Theory	**Marks**
Unit – 1. Molecular understanding the Genome functioning 1. Conventional and modern views of gene. Fine structure of gene, split genes, pseudogenes, non-coding genes, overlapping genes and multi-gene families. 2. DNA damage, repair and homologous recombination, 3. Transcription – In Prokaryotes and Eukaryotes. RNA Polymerases, Transcription factor, Initiation, Elongation and Termination, Post transcriptional modifications – capping, poly-adenylation, splicing RNA processing, 4. Translation – genetic code, ribosome structure, the process of translation. Post translational modification in Protein,	20
Unit – 2 Regulation of gene expression in prokaryotes and eukaryotes 1. levels of regulation, evidences and experimental designs/methodologies, role of genetic analysis in understanding gene function and regulation. 2. Regulation of gene expression in Bacteria: regulation at lac, trp and ara operons; control of lysis and lysogeny in λ phage. 3. Yeast: Gene regulation in a single celled eukaryote using a model case of GAL gene	15
Unit – 3. Methods to study Genome at molecular level 1. Principle & procedure of DNA, RNA and Protein extraction methods 2. Principle and procedure of electrophoresis; types of electrophoresis: agarose gel electrophoresis, PAGE and SDS-PAGE, and their applications. 3. Principle, technique and application of Southern, Northern and Western hybridization, Polymerase Chain Reaction. 4. Principles of primer designing, Molecular Marker – RAPD, AFLP, SSR, ISSR 5. Human genome mapping 6. Molecular plant breeding	15

Practical (Credit – 1)	**Marks - 20**
Molecular Biology	
Practical	**Marks**
Preparation of buffers & solutions for Molecular Biology experiments.	5
Isolation of genomic DNA from Bacterial cells	10
Isolation of genomic DNA from Plant tissue	10
Demonstration of PCR using RAPD and ISSR markers	10
Agarose gel electrophoresis of genomic DNA and PCR products	5 + 5
Separation of proteins by SDS-PAGE	10

Detailed Syllabus for Minor Course
Sub: Biotechnology

Semester- V
Course Title : Microbiology

Course Code : BTCMI-051 **Course No : BTC- 05**
Credits : 04 (03-Theory, 01-Practical)
Total Marks-100
End Semester :Theory : 50 **Practical: 20**
In Semester : 30

Course objective: To provide the concepts of Microbiology

Microbiology	
Theory	**Marks**
Unit – 1. Fundamentals of Microbiology 1. History and Evolution of Microbiology. Classification of microorganisms: Microbial taxonomy, criteria used including molecular approaches, Microbial phylogeny and current classification of bacteria. 2. Three domains of life, Microbial Diversity: Morphology and cell structure, general characteristics of major groups of microorganisms e.g. Bacteria, Algae, Fungi & Protozoa and Unique features of viruses. 3. Principle of Gram's staining technique, difference between gram positive & gram-negative bacteria, bacterial antigens and serotyping of bacteria 4. Pathogenic microorganisms	20
Unit – 2. Sterilization and Cultivation of Microbes 1. The concept of sterilization, Methods of sterilization (Dry heat, Moist heat, Irradiation, filtration and chemical disinfection) 2. Cultivation and Maintenance of microorganisms: Nutritional categories of micro-organisms, methods of isolation – serial dilution, purification and preservation of bacterial culture, Pour plate and Streak Plate 3. Artificial and Natural Culture media. Cultivation of pathogenic microorganisms. 4. Techniques for studying bacteriophages: Virulent phage (TB4B) and Temperate phage (phage lambda). Important aspects of lytic cycle, phage-host relationships, immunity and repression. Site specific recombination (lambda)	15
Unit – 3. Methods of Microbiology and Economic aspects 1. Bacterial growth: Growth curve, Generation time, synchronous, batch and continuous culture, measurement of growth and factors affecting growth of bacteria. 2. Basic bacterial genetics, auxotroph, replica plating technique, transformation, conjugation and transduction. 3. Use of Microorganisms in Agriculture, sewage treatment and bioremediation, production of antibiotics and food, Production of biomass and primary/secondary metabolites - Biofuels, bioplastics, industrial enzymes,; Large scale production and purification of recombinant proteins and metabolites; Clinical-, industrial- microbiology; Screening strategies for new products.	15

Practical (Credit – 1)	**Marks - 20**
Microbiology	
Practical	**Marks**
Demonstration on cleaning and sterilization of glassware	10
Preparation of bacteriological media – Nutrient Agar, LB Broth, Potato Dextrose Agar and Sterilization by autoclaving	10
Isolation of pure culture of Bacteria and Fungi & maintenance of culture.	10
Gram staining of bacteria isolated from skin swab and curd/milk	5
To determine bacterial growth kinetics by turbido-metric method	10
Antibiotic sensitivity testing of microbes	5

Detailed Syllabus for Minor Course
Sub: Biotechnology

Semester- VI
Course Title : Immunology

Course Code : BTCMI-061 **Course No : BTC- 06**
Credits : 04 (03-Theory, 01-Practical)
Total Marks-100
End Semester :Theory : 50 **Practical: 20**
In Semester : 30

Course objective: To provide the concepts of Immunology

Immunology	
Theory	**Marks**
Unit – 1. Basic Immunology 1. Immune Response - An overview, components of mammalian immune system, Innate versus Acquired immunity, active & passive immunity 2. Immunoglobulins - basic structure, classes & subclasses of immunoglobulins, Humoral & Cellular immune responses, B & T-lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), 3. T-cell receptors, genome rearrangements during B-lymphocyte differentiation 4. Primary and secondary lymphoid organs; Major histocompatibility complex (MHC); Antigen processing and presentation; Polyclonal and monoclonal antibody; Regulation of immune response;	20
Unit – 2. Mechanisms of host defence: 1. Transmembrane signalling, antigen receptor signalling, hematopoiesis and B Lymphocyte development, B cell tolerance, central T cell tolerance, peripheral T cell tolerance, macrophage function, dendritic cell function, mucosal immunity, APC regulation of the immune response, immunological memory. 2. Immunity in health and disease: Introduction to infectious disease, innate immunity to infection, adaptive immunity to infection, evasion of the immune response by pathogens, inherited immunodeficiency diseases, acquired immune deficiency syndrome, IgE and allergic reactions; hypersensitivity diseases, transplant rejection: responses to alloantigens, autoimmunity: responses to self-antigens, tumor immunology, Graft rejection. 3. Molecular basis of antibody diversity	20
Unit – 2. Techniques of Immunology 1. Hybridoma technology and monoclonal antibody production 2. Vaccines & Vaccination – adjuvants, cytokines, Conventional vaccines: live, attenuated and inactivated or killed vaccines, DNA vaccines, recombinant vaccines, passive & active immunization. 3. Introduction to immunodiagnostics – agglutination & precipitation, haemagglutination & haemagglutinal inhibition, ELISA.	10

Practical (Credit – 1) **Marks - 20** **Immunology**	
Practical	**Marks**
Determination of Blood group	5
Separation of Blood Serum	10
Differential leucocytic count	10
Total leucocytes count	10
Total RBC count	5