GAUHATI UNIVERSITY
SYLLABUS FOR **B.Sc. BIOTECHNOLOGY**

RULES AND REGULATIONS

Name of the course:
This new course is named as **Bachelor of Science in Biotechnology** for Degree Colleges under Gauhati University.

Duration of the course:
The Course shall be of 3 years duration under semester system and shall be completed in 6 (six) semesters.

Eligibility for admission:
Minimum qualification of student essential for entry to the course shall be Higher Secondary School Leaving Certificate Examination, passed in 2nd division in Science stream with the following subjects -
Biology, Chemistry and Physics/ Mathematics.

Selection procedure for admission:
Selection criteria for admission shall be normally on merit basis. However, the college authority may adopt a suitable method for selection of the candidates for admission.

Maximum intake capacity :
This is fixed at 25 (Twenty five).

Course Structure:

Name of Papers	Marks		
	T/P	IA	Total
Semester-I			
BT-101: Communicative English (UGC syllabus)	100	-	100
BT-102: Microbiology-I	60	15	75
BT-103: Biochemistry-I	60	15	75
BT-104: Cell Biology	60	15	75
BT-105: Practical	100	-	100
Semester-II			
BT- 201: Genetics	60	15	75
BT- 202: Microbiology –II	60	15	75
BT- 203: Biochemistry-II	60	15	75
BT- 204: Practical	100	-	100
Semester-III			
BT- 301: Environmental Studies (UGC syllabus)	100	-	100
BT- 302: Biophysical Chemistry	60	15	75
BT- 303: Molecular Biology	60	15	75
BT- 304: Instrumentation	60	15	75

BT- 305: Practical	100	-	100
Semester-IV			
BT- 401: Genetic Engineering	60	15	75
BT- 402: Immunology	60	15	75
BT- 403: Developmental Biology	60	15	75
BT- 404: Practical	100	-	100
Semester-V			
BT- 501: Plant Biotechnology	60	15	75
BT- 502: Animal Biotechnology	60	15	75
BT- 503: Biostatistics	60	15	75
BT- 504: Computer Application and Bioinformatics	60	15	75
BT- 505:Practical-I: a)Plant and Animal Biotechnology b) Industrial / Advanced Laboratory Visit	90+10	-	100
BT- 506: Practical-II (Biostatistics and Computer Application and Bioinformatics)	100	-	100
Semester-VI			
BT- 601: Food and Industrial Biotechnology	60	15	75
BT-602: Environmental Biotechnology, Bioethics, Legal Issues, Patenting	60	15	75
BT- 603: Practical	100	-	100
BT- 604: Project	150	-	150
	Total Marks		**2400**

- Total marks for theory papers 1550
- Total marks for practical papers 700
- Total marks for project work 150
- Total marks for the whole course 2400

Assessment:

Twenty (20) percent of the marks allotted for each theory paper shall be assessed internally by the concerned teacher/s in the Department. Rest 80% marks shall be assessed by external examiners. Internal assessment marks shall be given on the basis of attendance (in theory and practical classes), regularity in submission of practical notebook and 1 (one) written test conducted for each paper.

Project work:

Each student shall do one project work, which carries 150 marks. The teacher in-charge/supervisor of the project will guide the student in selecting the topic of the project to be started from 5^{th} semester. Distribution of marks shall be as given below:

- Project report 100 marks
- Seminar & viva on the project work 50 marks

Project may be done in groups of students each comprising not more than 4 students.

Evaluation of project work:
The Department shall form a Project Evaluation Committee (**PEC)** with HOD as the Chairman. All the faculty members involved in supervision of students' projects shall be the members of the Committee.

1. Project report shall be evaluated separately by Internal and External examiners.
2. Seminar and viva shall be conducted jointly by the external examiner and the Project Evaluation Committee of the Department.

Visit to laboratories/Industry:
Visit to at least one advance research laboratory/industry by the students during 4^{th} / 5^{th} Semester and submission of a report on the visit is compulsory. The Project Evaluation Committee members shall evaluate the report for which 10 (ten) mark is allotted.

Pass marks:
Students shall have to pass in each paper and minimum pass marks for each of the theory and practical paper will be 40%.

Attendance:
Minimum attendance to be eligible for appearing semester-end examination is 50%, However, student having attendance between 60 to 69% shall be declared as non-collegiate and can appear the exam paying non-collegiate fee as per University rule. Students with 70% or more attendance shall be declared as regular student. Due weightage will be given to attendance of students in computing internal assessment marks.

SEMESTER I

BT-101: **Communicative English** (UGC syllabus) **[Full marks 100]**

BT-102: **Microbiology I (Full Marks 75)**

1. History of microbiology, Scopes in microbiology, Concept of microbial diversity
2. Microscopy: Flourescence, Phase contrast, Electron Microscope
3. Introduction to eubacteria, archaea and eukaryotic microorganisms
4. Structural differences between Gram+ve, Gram-ve and archea cells
5. Microbial growth: batch, continuous and synchronized cultures
6. Microbial nutrition: phototrophs, chemotrophs, heterotrophs
7. Microbial Media : simple, differential and selective
8. Pure culture technique : Isolation, preservation and maintenance of culture

BT-103: **Biochemistry I (Full Marks 75)**

1. Basic chemistry of biomolecules: Carbohydrates, Lipids, Proteins and Nucleic acids
2. Amino acids: Classification and properties
3. Proteins: Classification based on structure and functions, structural organization of proteins (primary, secondary, tertiary and quaternary structures), biosynthesis of protein
4. Carbohydrates metabolism: Glycolysis, Kreb's Cycle and oxidative

phosphorylation, Gluconeogenesis, Pantose phosphate pathway, Glyoxylate cycle.

5. Photosynthesis: Structure of photosynthetic apparatus, Light and Dark reactions, C_3 and C_4 cycle
6. Lipids: Structure, properties, classification and functions

BT-103: **Cell Biology (Full Marks 75)**

1. Introduction: the Cell theory, structural organization of a prokaryotic and eukaryotic cell.
2. Plasma membrane: structural organization, function, transport across the membrane.
3. Cellular organelles: structure and functions of rough and smooth endoplasmic reticulum, Golgi complex, Lysosome, Peroxisome, Vacuoles, Mitochondria, Chloroplast.
4. Nucleus and nucleolus, chromatin structure and organization
5. Cytoskeleton and extra cellular matrix
6. Cell divisions: Cell cycle and control of cell cycle, cell death (apoptosis and necrosis), cancer.

BT- 104: **Practical (Full marks 100)**

1. Preparation of stock and working solution: PPM solution, Percent solution, Normal solution, Molar solution and Millimolar solution
2. Qualitative and quantitative tests of carbohydrates, proteins and amino acids.

3. Separation of amino acids and plant pigments by TLC/paper chromatography.
4. Determination of isoelectric point of protein
5. Preparation of culture media, sterilization, culturing techniques
6. Isolation of pure culture
7. Gram's staining, spore staining and motility test
8. Determination of air microflora, soil microflora
9. Use of Micrometer and calibaration, measurement of onion epidermal cells.
10. Cell division: Mitotic and Meiotic studies in onion root tips and flower buds.
11. Blood smear – differential staining

SEMESTER II

BT-201: **Genetics (Full Marks 75)**

1. Mendel's laws of inheritance
2. Extension of Mendelism: Incomplete dominance, codominance, pleiotropy, multiple allelism, complementation and epistasis,
3. Linkage and crossing over
4. Sex determination and sex linked inheritance
5. Numerical and structural changes in chromosomes
6. Mutation and mutagenesis
7. Extranuclear inheritance
8. Population genetics: Hardy-Weinberg equilibrium, maintenance and establishment of the equilibrium

BT-202: **Microbiology II (Full Marks 75)**

1. Bacterial genetics: conjugation, transformation and transduction
2. Microbial metabolism: photosynthesis, assimilation of inorganic nitrogen, phosphorous and sulphur
3. Viruses: Basic structure, classification, bacteriophages, lytic and lysogenic cycle, Viriods and prions.
4. Plant Microbe interactions
5. Mycoplasmas, Rickettsiae and Chlamydiae
6. Microbes and public health: Enterobacterioceae, Mycobacterium, Gonococci, Candida, Aspergillus, Variola, Varicella-Zoster, etc.
7. Microbes and pharmaceutical industry

BT- 203: **Biochemistry –II (Full Marks 75)**

1. Human hormones: protein and steroid hormones, mechanism of hormone action.
2. Plant hormones: auxins, giberllins, cytokinins, ethylene, abscisic acid
3. Vitamins: water and fat soluble vitamins, dietary source and deficiency syndromes
4. Enzymes: Classification, catalysis, mechanism of enzyme action, factors influencing enzyme activity, immobilization of enzymes, co-enzymes and co-factors, Isozymes.
5. Nitrogen metabolism and fixation of nitrogen in leguminous plants
6. Contractile protein, neurotransmitter

BT- 204: **Practical** (**Full Marks 100)**

1. Determination of bacterial growth curve based on absorbance
2. Determination of water quality by MPN method
3. Isolation, identification and culture of Rhizobium
4. Isolation and identification of *E. coli* from given biological samples
5. Detection of extra cellular bacterial enzyme production
6. Estimation of Vitamin C from plant samples
7. Test of salivary amylase
8. Estimation of total Protein (Bradford method & Lowry's method)
9. Preparation of acetate and phosphate buffers with different pH
10. Extraction of casein from milk
11. Induction of variation in chromosome number using chemical mutagenes
12. Karyotype analysis – Man and Onion, Man – Normal and Abnormal – Down and Turner's syndromes (with the help of slides).

BOOKS

GENETICS

1. Principles of Genetics – E.J.Gardener, M.J.Simmons and D.P.Snustad, John Wiley and Sons Publications.
2. Genetics- M.W. Strickberger, Prentice Hall of India Pvt. Ltd., New- Delhi.
3. Fundamentals of Genetics- B.D. Singh
4. Principle of Genetics – Gardner

SEMESTER III

BT-301**: Environmental Studies (UGC syllabus) [Full Marks 100]**

BT-302: **Biophysical Chemistry (Full Marks 75)**

1. pH and Buffers
2. Chemical bonding: Ionic bond, covalent bond, hydrogen bond, peptide bond, Vander-Waals forces
3. Properties of water
4. Thermodynamics- the First law of thermodynamics, concept of internal energy, the Second law of thermodynamics, free energy, enthalpy, entropy, free energy in biochemical reactions, and in transport of non-ionic and ionic substances across the biological membranes.
5. Nucleic Acids: structure and aggregation of DNA and RNA, DNA double helix, different conformations of double helix, DNA supercoiling.
6. Concept of Protein folding: hydrophilic and hydrophobic amino acids

BT-303: **Molecular Biology (Full Marks 75)**

1. Nucleic Acids: Nucleic acid as the genetic material, structure and aggregation of DNA and RNA, DNA double helix, different conformations of double helix, DNA supercoiling, denaturation and renaturation of DNA, C-value paradox, Cot value and curve, chemical complexity
2. DNA replication, DNA damage and DNA repair (SOS and excision repair)

3. Homologous recombination, site specific recombination and transposons
4. Transcription in prokaryotes and eukaryotes
5. Regulation of gene expression in prokaryotes: *lac* and *trp* operons
6. Genetic code
7. Translation in prokaryotes and eukaryotes
8. Genomics, Transcriptomics and Proteomics- an overview

BT-304: **Instrumentation (Full Marks 75)**

1. Principles of pH meter, dialysis
2. Principles of different types of centrifugation, ultracentrifugation, application of analytical centrifugation and density gradient centrifugation.
3. General principles of chromatography, adsorption chromatography, column, affinity, TLC, partition, ion exchange, gel filtration and permeation chromatography.
4. Principles and application of gel electrophoresis
5. Spectroscopic techniques: principles and applications of spectroscopy,
6. Radioisotope technique: nature of radioactivity, principles of radioisotopes and radiations, units, radioactive decay, detection and measurement of radioactivity.

BT-305: **Practical** (**Full Marks 100)**

1. DNA isolation and quantification using UV-VIS spectrophotometric analysis.
2. Study of optical activity of DNA (by UV-Vis Spectrophotometer).
3. Determination of molecular weight of DNA bands based on agarose gel electrophoresis
4. Curve fitting and interpretation of real data
5. TAMS (Teaching Aids for Molecular structures)- *in silico*
6. Calibration of pH meter
7. Spectrophotometric study of colour intensity of the given biological sample
8. XRD and XRF- demonstration (optional)

SEMESTER IV

BT- 401: **Genetic Engineering** (**Full Marks 75)**

1. Introduction to Genetic Engineering: definition, history and scope.
2. Restriction enzymes- definition, characteristics and uses.
3. Cloning and cloning vectors: Plasmid vectors, λ vectors.
4. Construction and screening of Genomic DNA library and c DNA library.
5. Molecular detection techniques - Southern, Northern and Western hybridization.
6. Polymerase chain reaction (PCR)
7. Restriction Fragment Length Polymorphism (RFLP), Random Amplified Polymorphic DNA (RAPD), DNA finger printing.
8. Nucleic acid sequencing: Di-deoxy and Chemical sequencing methods

BT-402: **Immunology (Full Marks 75)**

1. History and scope of Immunology
2. Types of Immunity: acquired and innate; cell mediated and humoral immunity
3. Cells, tissues and organs of the immune system
4. Antigen: antigenicity vs. immunogenicity
5. Immunoglobulin: structure, function and diversity; antigen-antibody reactions
6. T cell and B cell maturation and activation
7. Cytokines, Interleukins
8. Immunoassays, Concept of ELISA

BT- 403: **Developmental Biology (Full Marks 75)**

1.Introduction to Developmental Biology, Germ cells, Basic concepts in embryology, Genetics and Development.
2.Gametogenesis: Spermatogenesis and Oogenesis; Gametogenesis in angiosperms
3. Fertilization and embryogenesis: overviews in animals and higher plants.
4. Cellular basis of morphogenesis
5. Genetic regulation of development
6. Molecular biology of cell differentiation

BT-404: **Practical** (**Full Marks 100)**

1. Isolation of genomic DNA from bacteria, plant and animal tissue
2. Isolation of plasmid DNA (*E. coli*)
3. Restriction digestion of DNA
4. Separation of DNA by Gel Electrophoresis
5. SDS-PAGE for protein profiling
6. Blood coagulation test
7. Blood group determination
8. Blood film preparation
9. Radial immunoassay (Kit)
10. ELISA test (Kit)

IMMUNOLOGY

1. William, E. Paul (1989) Fundamental immunology, 2nd Edition Raven Press, New York.
2. William, R. Clark (1991) The Experimental Foundations of Modern Immunoogy (4th Edition) John Wiley and Sons, New York.
3. Ivan, M, roitt (1994) Clackwell Scientific Publications, London.

SEMESTER V

BT-501: **Plant Biotechnology (Full Marks 75)**

1. Introduction, history and scope of plant cell and tissue culture
2. Sterilization and Plant tissue culture media
3. Micro-propagation technique
4. Callus and suspension culture
5. Organogenesis and somatic embryogenesis – Techniques and applications
6. Protoplast Culture – Isolation, regeneration and viability test, somantic hybridization, methods of protoplast fusion – chemical methods, practical application of somantic hybridization
7. Somaclonal variation and their significance
8. Transgenic plants: Agrobacterium mediated transformation

BT-502: **Animal Biotechnology (Full marks 75)**

1. Introduction to animal cell culture and its scope
2. Basic principles of animal cell culture, Cell lines
3. Animal cell culture media
4. Animal cell culture applications and products: Cell products - antibodies and immuno-regulators, recombinant products, viral vaccines, cell and tissue therapy.
5. Stem cells: concept
6. Production of Vaccines in animal Cells.
7. Production and Applications of monoclonal antibodies.
8. Transgenic animals

BT-503: **Biostatistics (Full Marks 75)**

1. Introduction and principles of statistical sampling from a population.
2. Random sampling.
3. Frequency distributions and associated statistical measures.
4. Probability measures and probability distributions and Random variable.
5. Correlation, and regression analysis,
8. Hypothesis testing: T, F, Chi-square distribution and tests.
9. Analysis of variance and design of experiment CRD, RBD, LSD and Factorial experiment.

BT- 504: **Computer Application and Bioinformatics** (**Full Marks 75)**

1. Basics about computer (DOS, window operations)
2. Introduction to bioinformatics.
3. Application of different software in solving biological problems
4. Database management and data analysis – use of different databases e.g. Pubme, TIGR, PDB database, Gene bank.
5. Gene and protein sequence analysis
6. Genomics, transcriptomics and proteomics – computer applications

BT- 505: **Practical I** (**Full Marks 100)**

1. Preparation of Plant tissue culture media
2. *In vitro* propagation through shoot tip and nodal culture
3. Production of synthetic seeds
4. Production of callus and culture
5. Transformation by Agrobacterium based vector systems and regulation
6. Animal tissue culture (demonstration)

BT- 506: **Practical II (Full Marks 100)**

1. Introduction to Computer application and search of databases.
2. Practical work of simple Statistical programmes.
3. Introduction to softwares of enzymes, DNA and Proteins
4. Practical on Biostatistics: based on theory papers

SEMESTER VI

BT-601: **Food and Industrial Biotechnology (Full marks 75):**

1. Definition and scope for application of biotechnology in food industry.
2. Basic food chemistry and microbiology.
3. Food spoilage and preservation, preservation methods- physical, chemical, biological and irradiation.
4. Application of microorganisms in food fermentation; solid state fermentation (SSF); Types of fermented foods and beverages; traditional fermented foods of the Orient, Advantages of fermented foods. Technology for production of Sauerkraut, Soya, bamboo shoot, cheese, and grape wine. Concept of starter cultures.
5. Enzymes and their application in food industries.
6. SCP; SCP producing microorganism and substrates used; advantage of using SCP.
7. Fermenters and their types; structure of an ideal fermenters.
8. Microbes used in industrial fermentation; Industrial production process (fermentations) for ethanol, vinegar and penicillin. Media for industrial fermentation
9. Microbial enhanced oil recovery.

BT-602: **Environmental Biotechnology, Bioethics, Legal Issues and Patenting (Full Marks 75)**

1. Overview of the global environmental problems: Climate change, Energy crisis, use and abuse of plastics
2. Renewable and Non-Renewable resources of energy
3. Biofuels: Scope, source and production process
4. Bioremediation: Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents.
5. Treatment of municipal and Industrial waste water
6. Biofertilizers and Biopesticides- Scope, production and uses.
7. Environmental significance of Genetically Modified Microbes (GMOs), plants and animals

8. Biosafety regulations.
9. Intellectual property rights in biotechnology – patenting of life forms.
10. Moral and ethical issues in biotechnology.

BT-603: **Practical** (**Full Marks 100)**

PRACTICAL

1. Isolation of different types (bacteria, mould and yeast) for food
2. Sauerkraut and bamboo shoot fautations and study of microbial profile at different stage
3. Detection of amylase producing bacteria/ fungi from food sample
4. Detection of coli forms and E-coli in food
5. SCP production using pleurons
6. Estimation of BOD
7. Determination of dissolved oxygen concentration of water sample
8. Estimation of nitrate in drinking water
9. Vermiculture and solid waste treatment

ENVIRONMENTAL BIOTECHNOLOGY

1. Biosafety and Bioethics – Joshi, R.M.: Eastern Book House.
2. Biotechnology in Environmental Management- Pathade, G.R., Eastern Book House.
3. Biodiversity of Assam- Bhagavati, A.K., Kalita, M.C., and Baruah, S.
4. Biodiversity and Environmental Biotechnology- Dwivedi, P and Kalita, M.C.

BT-603: **Project** (**Full Marks 150)**

1. Project report Marks: 100
2. Seminar and viva –voce on Project work Marks: 50