

SYLLABUS

M.Phil. BIOTECHNOLOGY

**Department of Biotechnology
University of North Bengal
Siliguri-734013 (WB)**

M.Phil in Biotechnology
Total Credits: 48, Total Marks: 1200

SEMESTER-I

Total marks: 300 Total Credits: 12

Sl. No.	Course	Name of Course	Full Marks	Credits
1.	BTMP-01	Research Methodology, Research Ethics, Scientific Writing and Presentation	75	3
2.	BTMP-02	Quantitative Methods and Computer Applications	75	3
3.	BTMP-03	Advanced Research Methods and New Trends in Biotechnology	75	3
4.	BTMP-04	Intellectual Property Rights and Biosafety	75	3

SEMESTER-II

Total marks: 300 Total Credits: 12

Sl. No.	Course	Name of Course	Full Marks	Credit
1.	BTMP-05	Critical Analysis of Classical Papers	75	3
2.	BTMP-06	Facets of Biotechnology	75	3
3.	BTMP-07	Nanobiotechnology	75	3
4.	BTMP-08	Animal and Plant Biotechnology	75	3

SEMESTER-III

Total marks: 300 Total Credits: 12

Sl. No.	Course	Name of Course	Full Marks	Credits
1.	BTMP-09	Project Work (Phase I)	200	8
2.		Synopsis of Project Work	50	2
3.		Continuous Evaluation	50	2

SEMESTER-IV

Total marks: 300 Total Credits: 12

Sl. No.	Course	Name of Course	Full Marks	Credits
1.	BTMP-09	Project Work (Final Report)	200	8
2.		Internal Evaluation	50	2
3.		Thesis Presentation	50	2

SEMESTER-I

BTMP-01, Research Methodology, Research Ethics, Scientific Writing and Presentation – 3 Credits

Unit - I

Research Design: Methods for defining an original research problem; accessing needed information; rigorous experimental design; usage of appropriate statistical analyses; scientific assumptions/approaches.

Unit - II

Research Ethics and Good Lab Practices: Fundamentals of Ethics and Bioethics; Ethical issues in conducting research; Conflict of interest and Publishing biases; Ethical Planning/Design and conduction of research; Scientific misconduct; Biosafety Principles, Laboratory Practices and Techniques, Risk analysis and control of biohazards, Dissimination of contaminants, Safety equipments-Biosafety cabinets; Biosafety Guidelines and regulations.

Unit - III

Scientific writing and Presentation: Writing a review paper on the proposed research proposal; drafting of a proposal for research funding; oral presentation and submission in written form.

BTMP-02, Quantitative Methods and Computer Applications – 3 Credits

Unit I

Biostatistics: Statistical concepts and Analytical methods as applied to data encountered in biotechnology, biomedical and agricultural sciences; Basic concepts of experimental design; Quantitative analysis of data; Statistical inferences; Usage of statistical data packages.

Unit II

Bioinformatics: Biological databank and sequence analysis; Biological databases including Genbank, EMBL, PDB; EXPASY, SWISS-PROT; Database searching and Dynamic programming methods for global and local alignments: PSI-BLAST algorithm, FASTA, MULTALIN, CLUSTALW; Nucleic acid sequence analysis: Reading frames, codon usage, transcriptional and translational signals, gene prediction methods; Computing evolution: Phylogenetic analysis; Sequence-Function relationship- Homology and conserved regions; Conserved DNA sequences: Promoters, Restriction sites, RNA folding patterns, Protein motifs, Domain pattern recognition softwares; Derived database of patterns, motifs and profiles: Prosites, Blocks, Prints-S etc; Primer design; Concept of Molecular modeling; Docking and drug design.

BTMP-03, Advanced Research Method and New Trends in Biotechnology – 3 Credits

Unit I

Advanced Research Methods-I: DNA protocols and applications; RNA protocols and applications; Protein protocols and applications; PCR protocols and applications; Epigenetic protocols and applications; Transfection protocols and applications; Animal cell culture protocols and applications; Organ regeneration: 3D stem cell culture and manipulations.

Unit II

Advanced Research Methods-II: Whole Genome Amplification (WGA) protocols and Applications; Whole Genome Transcriptome (WGT) protocols and Applications; Next Generation Sequencing (NGS) based metagenomic protocols and Applications; Microbial Environmental Genomics methods and revelations; High throughput cell population analysis; High-throughput RNAi screening; Biosensors and Biodetection; Methods and protocols.

BTMP-04, Intellectual Property Rights and Biosafety – 3 Credits

Unit I

Introduction to IPR: Introduction to intellectual property; types of IP: patents, trademarks, copyright & related rights, industrial design, traditional knowledge, geographical indications, protection of new GMOs; International framework for the protection of IP; IP as a factor in R&D; IPs of relevance to biotechnology and few case studies; introduction to history of GATT, WTO, WIPO and TRIPS; plant variety protection and farmers rights act; concept of ‘prior art’: invention in context of “prior art”; patent databases - country-wise patent searches (USPTO, EPO, India); analysis and report formation.

Unit II

Patenting: Basics of patents: types of patents; Indian Patent Act 1970; recent amendments; WIPO Treaties; Budapest Treaty; Patent Cooperation Treaty (PCT) and implications; procedure for filing a PCT application; role of a Country Patent Office; filing of a patent application; precautions before patenting-disclosure/non-disclosure - patent application- forms and guidelines including those of National Bio-diversity Authority (NBA) and other regulatory bodies, fee structure, time frames; types of patent applications: provisional and complete specifications; PCT and conventional patent applications; international patenting-requirement, procedures and costs; financial assistance for patenting introduction to existing schemes; publication of patents-gazette of India, status in Europe and US; patent infringement- meaning, scope, litigation, case studies and examples; commercialization of patented innovations; licensing – outright sale, licensing, royalty; patenting by research students and scientists-university/organizational rules in India and abroad, collaborative research - backward and forward IP; benefit/credit sharing among parties/community, commercial (financial) and non-commercial incentives.

Unit III

Biosafety: Biosafety and Biosecurity - introduction; historical background; introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; GRAS

organisms, biosafety levels of specific microorganisms; recommended biosafety levels for infectious agents and infected animals; definition of GMOs & LMOs; principles of safety assessment of transgenic plants – sequential steps in risk assessment; concepts of familiarity and substantial equivalence; risk – environmental risk assessment and food and feed safety assessment; problem formulation – protection goals, compilation of relevant information, risk characterization and development of analysis plan; risk assessment of transgenic crops vs cisgenic plants or products derived from RNAi, genome editing tools.

Unit IV

National and international regulations: International regulations – Cartagena protocol, OECD consensus documents and Codex Alimentarius; Indian regulations – EPA act and rules, guidance documents, regulatory framework – RCGM, GEAC, IBSC and other regulatory bodies; Draft bill of Biotechnology Regulatory authority of India - containments – biosafety levels and category of rDNA experiments; field trials – biosafety research trials – standard operating procedures - guidelines of state governments; GM labeling – Food Safety and Standards Authority of India (FSSAI).

SEMESTER - II

BTMP-05, Critical Analysis of Classical Papers – 3 Credits

Unit I

Molecular Biology:

1. Studies on the chemical nature of the substance inducing transformation of Pneumococcal types: Induction of transformation by a desoxyribonucleic acid fraction isolated from Pneumococcus type III. Avery OT, Macleod CM, McCarty M.; J Exp Med. 1944 Feb 1;79(2):137-58.
2. Independent functions of viral protein and nucleic acid in growth of bacteriophage Hershey AD and Chase M.; J Gen Physiol. 1952 May;36(1):39-56.
3. Molecular structure of nucleic acids; a structure for deoxyribose nucleic acid Watson JD and Crick FH; Nature. 1953 Apr 25;171(4356):737-8
4. Transposable mating type genes in *Saccharomyces cerevisiae* James Hicks, Jeffrey N. Strathern & Amar J.S. Klar; Nature 282, 478-483, 1979
5. Messelson & Stahl experiment demonstrating semi-conservative replication of DNA. Meselson M and Stahl FW.; Proc Natl Acad Sci U S A. 1958 Jul 15;44(7):671-82
6. In vivo alteration of telomere sequences and senescence caused by mutated Tetrahymena telomerase RNAs Guo-Liang Yu, John D. Bradley, Laura D. Attardi & Elizabeth H. Blackburn; Nature 344, 126-132, 1990

(**Note:-** Recent published papers related to above topic covering broad area and advancement in field)

Unit II

Cell Biology:

1. A protein-conducting channel in the endoplasmic reticulum Simon SM AND Blobel G.; Cell. 1991 May 3;65(3):371-80
2. Identification of 23 complementation groups required for post-translational events in the yeast secretory pathway Novick P, Field C, Schekman R.; Cell. 1980 Aug;21(1):205-15
3. A yeast mutant defective at an early stage in import of secretory protein precursors into the endoplasmic reticulum Deshaies RJ and Schekman R.; J Cell Biol. 1987 Aug;105(2):633-45
4. Reconstitution of the Transport of Protein between Successive Compartments of the Golgi Balch WE, Dunphy WG, Braell WA, Rothman JE.; Cell. 1984 Dec;39(2 Pt 1):405-16
5. A complete immunoglobulin gene is created by somatic recombination Brack C, Hiramama M, Lenhard-Schuller R, Tonegawa S.; Cell. 1978 Sep;15(1):1-14
6. A novel multigene family may encode odorant receptors: a molecular basis for odor recognition Buck L and Axel R; Cell. 1991 Apr 5;65(1):175-87
7. Kinesin walks hand-over-hand Yildiz A, Tomishige M, Vale RD, Selvin PR.; Science. 2004 Jan 30;303(5658):676-8

(Note:- Recent published papers related to above topic covering broad area and advancement in field)

Unit III

Developmental Biology/ Genetics:

1. Mutations affecting segment number and polarity in Drosophila Christiane Nüsslein-Volhard and Eric Weischaus; Nature 287, 795-801, 1980
 2. Information for the dorsal-ventral pattern of the Drosophila embryo is stored as maternal mRNA Anderson KV and Nüsslein-Volhard C; Nature. 1984 Sep 20-26;311(5983):223-7
 3. Hedgehog signalling in the mouse requires intraflagellar transport proteins Huangfu D, Liu A, Rakean AS, Murcia NS, Niswander L, Anderson KV.; Nature. 2003 Nov 6;426(6962):83-7
- Suggested Reference paper - Design and execution of a embryonic lethal mutation screen in mouse.

(Note:- Recent published papers related to above topic covering broad area and advancement in field)

BTMP-06, Facets of Biotechnology – 3 Credits

Unit I

Industrial Biotechnology: Microbial strain of industrial importance, microbial production of antibiotics (penicillin, streptomycin & tetracycline), Vitamins (Vit B12), amino acids (glutamic acid) & enzymes (amylase, protease, invertase & pectinase), microbial production of alcoholic beverages (whisky & brandy), vinegar, citric acid, acetic acid, glycerol, acetone, foods-SCP, Biotransformation of steroids and pesticides.

Unit II

Environmental Biotechnology: Environmental pollution and their management, concept of Global Warming and Ozone depletion (Ecofarming, Green house effect & acid rain), Waste water treatment, solid waste management, conventional & modern fuels & their environmental impact, Bioremediation, Biodegradation of xenobiotic compounds, Biomineralization,

Biotechnological approaches for preserving biodiversity (Gene banks ,Germ Plasm Banks & their management).

Unit III

Agricultural Biotechnology: Role of biofertilizers and biopesticides in sustainable development, petrocrops, aquaculture, Improvement of nutritional value of seed storage protein, starch, oil. Transgenic plants for increased shelf life molecular mapping of genes of agricultural importance, sericulture, transgenic fish, Plant Variety Protection Act, Plant breeders rights, International Convention on biological diversity.

Unit IV

Food Biotechnology: Prokaryotic & Eukaryotic based products (fermented meats, milk products, yoghurt, cheese, cereal, wine, beer), Impact of biotechnology on microbial testing of food, current/traditional methodology and new approaches (use of gene probes, RDT, Bioluminescence), Safety evaluation of genetically engineered enzyme/novel food products, Natural Control of Micro Organism and preservation, Biogums, Bio-colours Fumaric acid, sweetener, fat substitutes, natural & modified starch, fats & oils food.

BTMP-07, Nanobiotechnology – 3 Credits

Unit I

Introduction to nanobiotechnology: Introduction to Nanobiotechnology; Concepts, historical perspective; Different formats of nanomaterials and applications with example for specific cases; Cellular Nanostructures; Nanopores; Biomolecular motors; Bio-inspired Nanostructures, Synthesis and characterization of different nanomaterials.

Unit II

Nanofilms: Thin films; Colloidal nanostructures; Self Assembly, Nanovesicles; Nanospheres; Nanocapsules and their characterization.

Unit III

Nanoparticles: Nanoparticles for drug delivery, concepts, optimization of nanoparticle properties for suitability of administration through various routes of delivery, advantages, strategies for cellular internalization and long circulation, strategies for enhanced permeation through various anatomical barriers.

Unit IV

Applications of nanoparticles: Nanoparticles for diagnostics and imaging (theranostics); concepts of smart stimuli responsive nanoparticles, implications in cancer therapy, nanodevices for biosensor development

Unit V

Nanomaterials: Nanomaterials for catalysis, development and characterization of nanobiocatalysts, application of nanoscaffolds in synthesis, applications of nanobiocatalysis in the production of drugs and drug intermediates.

Unit VI

Nanotoxicity: Introduction to Safety of nanomaterials, Basics of nanotoxicity, Models and assays for Nanotoxicity assessment; Fate of nanomaterials in different stratas of environment; Ecotoxicity models and assays; Life Cycle Assessment, containment..

BTMP-08, Animal and Plant Biotechnology – 3 Credits

Unit I

Animal reproductive biotechnology and vaccinology: Animal reproductive biotechnology: structure of sperms and ovum; cryopreservation of sperms and ova of livestock; artificial insemination; super ovulation, embryo recovery and in vitro fertilization; culture of embryos; cryopreservation of embryos; embryo transfer technology; transgenic manipulation of animal embryos; applications of transgenic animal technology; animal cloning - basic concept, cloning for conservation for conservation endangered species; Vaccinology: history of development of vaccines, introduction to the concept of vaccines, conventional methods of animal vaccine production, recombinant approaches to vaccine production, modern vaccines.

Unit II

Plant tissue culture and animal cell culture: Plant tissue culture: historical perspective; totipotency; organogenesis; Somatic embryogenesis; establishment of cultures – callus culture, cell suspension culture, media preparation – nutrients and plant hormones; sterilization techniques; applications of tissue culture - micropropagation; somaclonal variation; androgenesis and its applications in genetics and plant breeding; germplasm conservation and cryopreservation; synthetic seed production; protoplast culture and somatic hybridization - protoplast isolation; culture and usage; somatic hybridization - methods and applications; cybrids and somatic cell genetics; plant cell cultures for secondary metabolite production. Animal cell culture: brief history of animal cell culture; cell culture media and reagents; culture of mammalian cells, tissues and organs; primary culture, secondary culture, continuous cell lines, suspension cultures; application of animal cell culture for virus isolation and in vitro testing of drugs, testing of toxicity of environmental pollutants in cell culture, application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.

Unit III

Plant genetic manipulation: Genetic engineering: Agrobacterium-plant interaction; virulence; Ti and Ri plasmids; opines and their significance; T-DNA transfer; disarmed Ti plasmid; Genetic transformation - Agrobacterium-mediated gene delivery; cointegrate and binary vectors and their utility; direct gene transfer - PEG-mediated, electroporation, particle bombardment and

alternative methods; screenable and selectable markers; characterization of transgenics; chloroplast transformation; marker-free methodologies; advanced methodologies - cisgenesis, intragenesis and genome editing; molecular pharming - concept of plants as biofactories, production of industrial enzymes and pharmaceutically important compounds.

Unit IV

Plant and animal genomics: Overview of genomics – definition, complexity and classification; need for genomics level analysis; methods of analyzing genome at various levels – DNA, RNA, protein, metabolites and phenotype; genome projects and bioinformatics resources for genome research – databases; overview of forward and reverse genetics for assigning function for genes.

Unit V

Molecular mapping and marker assisted selection: Molecular markers - hybridization and PCR based markers RFLP, RAPD, STS, SSR, AFLP, SNP markers; DNA fingerprinting-principles and applications; introduction to mapping of genes/QTLs; marker-assisted selection - strategies for introducing genes of biotic and abiotic stress resistance in plants; genetic basis for disease resistance in animals; molecular diagnostics of pathogens in plants and animals; detection of meat adulteration using DNA based methods.

SEMESTER – III

BTMP-09, Project Work (Phase I) -

8 Credits

Project proposal Synopsis - 2 Credits

Students will draft a proposal on chosen research topic for research funding followed by oral presentation and submission in written form.

Continuous Evaluation - 2 Credits

SEMESTER- IV

BTMP-09, Project Works (Final Report)-

8 Credits

Internal Evaluation - 2 Credits

Thesis Presentation - 2 Credits

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