M. Sc. BIOTECHNOLOGY

Program Outcomes:

MSc Biotechnology (2019 pattern) for the year 2019-20

Program Outcomes:

Knowledge Outcomes:

After successful completion of M.Sc. Biotechnology program, the students should be able:

PO 1: to get substantial knowledge in Biotechnology and allied fields

PO 2: to visualize the current and future trends in science, life sciences and inter-disciplinary fields.

PO 3: to apply the knowledge of biotechnological tools and principles for human and environment welfare

PO 4: to acquire knowledge and competence for clearing examinations such as UGC/CSIR-NET, ARS-NET, GATE, ICMR and DBT JRF for pursuing higher studies

Skill Outcomes:

After successful completion of M.Sc. Biotechnology program, the students should be able:

PO 5: to design, perform experiments, analyze and interpret data for investigating complex problems in subjects covered in the program

PO 6: to develop oral and written skills for effective communication

PO 7: to develop commercially viable processes and technologies in biotechnology related areas

Generic Competence:

The students will be:

PO 8: able to understand the need and impact of biotechnological tools, techniques and solutions to the problems and issues pertaining to environment and society in view and need for sustainable solution

PO 9: aware in social, ethical, and professional issues of contemporary practices in biotechnology and related fields

PO 10: able to undertake the responsibilities as an individual and as a team in a multidisciplinary environment

Program Specific Outcomes:

After successful completion of M.Sc. Biotechnology program, the students will be able to:

PSO 1: understand and demonstrate the principles of life science subjects such as biochemistry, cell and molecular biology, plant biotechnology, animal biotechnology and microbial biotechnology

PSO 2: utilize the biotechnological knowledge and tools for R&D and product development

PSO 3: apply the knowledge and competence developed during the program for initiating start-ups in biotechnology related areas

PSO 4: undertake higher studies and research (MPhil, PhD) in the fields of biotechnology

Course Outcomes:

Semester 1

MBT 101 Advanced Biological Chemistry

The students on successful completion of the course should be able to:

CO 1: To understand the basic principles of biological chemistry and advances therein

CO 2: To understand and explore protein chemistry, their structure folding, interactions and protein engineering

CO 3: To conceptualize the enzymes, their activities, active and binding sites and various factors affecting their specific activities

CO 4: To understand and illustrate enzyme kinetics, clinical and industrial applications of enzymes

CO 5: To explain the concepts of metabolome and metabolomics including integration of primary and secondary metabolisms

CO 6: To illustrate the processes involved in phytochemical investigations for isolating specific secondary metabolites

CO 7: To hypothesize how metabolic engineering can be used for directed production of desired secondary metabolites

CO 8: To design the process how plant secondary metabolites with therapeutic values can be isolated

MBT 102: Cell and Molecular Biology

After successfully completing this course, students will be able to:

CO1: Helps to differentiate between animal, plant and bacterial cell

CO2: Give an understanding of cell, its structure and its function.

CO3: Understand cell signalling and gives knowledge of membrane receptors/transporters.

CO4: Cell communications can be well understood.

CO5: Transport across plasma membrane and intra-cellular transport (vesicular and membrane transport) at molecular level can be explained

CO6: Cell cycle and cell death (Programmed cell death) can be understood.

CO7: Makes a basis for molecular biology, information flow in biological systems, Central Dogma

CO8: Analyse the genome structures and gene families.

CO9: Hormones and receptors signalling pathways that control gene activity can be explained.

CO10: Interpret C-Value paradox, Cot curves and Rot curves.

CO11: Understand the mobile genetic elements and their importance and functions

CO12: Illustrate Gene expression and its regulation and post-transcriptional modifications/silencing mechanisms

CO13: Understand the recombination, DNA damage and repair mechanisms, Post-translational modifications of proteins.

MBT103 Genetics and Immunology

After successfully completing this course, students will be able to:

CO1: Understand different types of Cytoplasmic inheritance.

CO2: Analyse different model systems in genetics with practical examples, emphasizing on Drosophila and Arabidopsis

CO3: Learn human genetics and the methodologies involved therein, and genetic disorders.

CO4: Learn and explore genetic mapping, molecular markers and their applications in genetics

CO5: Able to provide with a foundation in immunological processes

CO6: Gains knowledge on how the immune system works

CO7: Able to clearly state the role of the immune system

CO8: Able to compare and contrast the innate versus adaptive immune systems;

CO9: Able to distinguish various cell types involved in immune responses and associated functions

CO10: Understand the significance the Major Histocompatibility Complex in terms of immune response and transplantation

CO11: Able to provide an overview of the interaction between the immune system and pathogens.

CO12: Learn and explore vaccinology.

MBT 104: Laboratory Course I

On successful completion, the students should be able to:

CO1: Perform protein estimation using spectrophotometric methods and separation of proteins using chromatographic techniques

CO2: Demonstrate the NATIVE-PAGE non-denaturing gel electrophoresis of enzymes

CO3: Calculate specific activities of enzyme beta-galactosidase under variable parameters

CO4: Illustrate the solvent based crude extraction from plant material and qualitative detection of specific classes of secondary metabolites in the extract

CO5: Illustrate thin-layer chromatography for detection of specific secondary metabolite.

CO6: Understand the concept of antigen-antibody reaction.

CO7: Acquire knowledge about in-vitro diagnostic tests used in immunological diagnosis of various diseases.

CO8: Antibody titre by ELISA method.

CO9: Perform separation of mononuclear cells and leucocytes.

CO10: Explains the organisation of nuclei and chromatin in cells

CO11: Explains the organisation and functions of DNA and histone proteins.

CO12: Gives an understanding of RNA

CO13: Cell organelles can be well understood with their functions.

CO14: PCD can be well understood with an example of development of chick embryo.

CO15: Explains different types of cells.

CO16: Quantitative real time PCR for gene expression analysis

CO17: Illustration of Restriction digestion and Restriction Mapping.

MBT 105: Environmental Biotechnology (Theory)

Following successful completion of the subject students should be able to acquire a multifaceted knowledge in environmental issues and role of biotechnology including technical approach as:

CO1: Students will understand the concept of environmental pollution, types of pollutants and related hazards at national and international level.

CO2: They will understand the concept, various models used and importance of bio-monitoring in environment pollution.

CO3: Acquire in depth knowledge of various methods of bioremediation and its applications in environmental clean-up along with different waste management approaches.

CO4: Build awareness about concept of sustainable development in environment conservation and provision of environment protection acts at national and global level.

CO5: Study will be focused on importance of Environmental Impact Assessment (EIA), Environmental audits, remote sensing and Geographical Information System (GIS) in the management of various environment aspects.

CO6: The study emphasizes the significance of international and national quality standards and environment management systems to ensure better future.

MBT 105: Environmental Biotechnology (Practical)

After successfully completing this course, students will be able to:

CO1: Isolate microorganism from environmental sources and understand their potential use.

CO2: Perform genotoxicity assay and understand its importance in demonstration of toxic effects of pollutants.

CO3: Perform tests used in determination of quality of waste water.

CO4: Understand the use of remote sensing and GIS in human life.

CO5: Lear n the concept of bioremediation of xenobiotics.

CO6: Perform the qualitative and quantitative estimation of the known pollutant.

CO7: Understand the concept of Environmental Impact Assessment and retrospective evaluation of impacts due to environmental pollution on defined geographical region.

Semester 2

MBT 201: Genetic engineering

After successfully completing this course, students will be able to:

CO1: understand different types of PCRs.

CO2: understand various types of genome sequencing.

CO3: analyse different types of genetic and physical mapping techniques.

CO4: analyse applications of different vectors.

CO5: understand expression of industrially important products.

MBT 202: Principles of Bacteriology and Virology

On successful completion, the students

CO1. Learns, understands basic structure, function, metabolism, growth, physiology at molecular level

CO2. Can classify, characterize and identify bacteria based on the microscopic, biochemical and molecular basis

CO3. Can apply principles of bacteriology in health, agriculture, industry and biotechnology

CO4. Understands the economic importance of bacteria

CO5. Students will understand the concepts and importance of Virology studies at national and international level.

CO6. Study will be focused on understanding of basic structure, general properties and taxonomy of viruses.

CO7. Acquire in depth knowledge of various diseases caused by viruses and preventive measures for the same.

CO8. The study emphasizes upon the significance of national and international epidemiology studies of viral infections.

CO9. This study will impart an importance of good health and hygiene among students.

CO10. The study will help to build an awareness about economic importance of viruses.

MBT 203: Plant Biotechnology

After successfully completing this course, students will be able to:

CO1: Gives uses and importance of algal biotechnology

CO2: Discuss about used and significance of fulgal biotechnology

CO3: Advantages of micropropagation over conventional methods of plant breeding

CO4: Explains organogenesis and embryogenesis.

CO5: Importance of transgenic plants can be understood.

CO6: Explains biotic and abiotic stress tolerance mechanisms in plants.

CO7: Algal and fungal transgenics and their applications with respect to biofuels, single cell proteins, pigments, neutraceuticals, pharmaceuticals and biopesticides is understood.

CO8: Concepts like molecular farming and manipulations of different plant pathways can be well explained.

MBT 204: Lab Course II

After successfully completing this course, students will be able to:

CO1: Isolate plasmid DNA from various bacteria.

CO2: Perform transformation of *E. coli*

CO3: Isolate RNA and perform RT-PCR for analyzing gene expression.

CO4: Perform Southern blotting and hybridization.

CO5: analyse Restriction mapping of DNA molecules.

CO6. Demonstrate theory and practical skills in microscopy and their handling techniques and staining procedures

CO7. Understand various physical means of sterilization

CO8. Know General bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi and algae

CO9. Master aseptic techniques and be able to perform routine culture handling tasks safely and effectively. Comprehend the various methods for identification of unknown microorganisms

CO10. Know how viruses are classified

CO11. Understand the architecture of viruses

CO12. Know the methods used in study of viruses

CO13. Chlorella or Spirulina culture and biochemical analysis of products can be analysed

CO14. Initiation of somatic embryogenesis

CO15. Induction of androgenesis in vitro

CO16. Micropropagation studies

CO17. Cell suspension and growth analysis is studied.

CO18. Visiting a commercial level plant tissue culture facility

MBT 205: Clinical Research, Database Management and Intellectual Property Rights

On successful completion, the students will be able to:

CO1. Learn the basic concepts of clinical research, and data management along with the applications of database systems

CO2. Understand the basics of drug development process and clinical trials

CO3. Learn the good lab practices to be followed

CO4. Understand the drug-regulatory affairs

CO5. Get familiar with clinical safety measures and pharmacovigilance

CO6. Are aware of their rights for the protection of their invention done in their project work

CO7. Are able to understand the norms for getting registration in our country and foreign countries of invention, designs and thesis or theory written by the students during their project work.

CO8. Have knowledge of patents, copy right, trademarks, designs in biotechnology

Semester 3

BT 301: Animal Biotechnology

After successfully completing this course, students will be able to understand:

CO1: different vectors that are used for generating transgenic animals. CO2: all types of media used for culturing animal cells.

CO3: various cell lines used for production of therapeutic products. CO4: different culture systems such as 2-dimensional culture and 3-dimensional cultures.

CO5: several animal husbandry techniques such as artificial insemination, embryo transfer technology.

BT 302: Bioprocess Engineering and Fermentation Technology

On successful completion, the students are able to

CO1. Design bioreactors for the production of various products

CO2. Predict important yield coefficients using the principles of stoichiometry and energetics of microbial growth

CO3. Understand soluble and immobilized enzyme technologies for the production of industrial and medical products

CO4. Present knowledge about major metabolic pathways and those related to biofuels production from microbes

CO5. Analyse metabolic network and metabolic flux

CO6. Specify required technologies to effectively utilize genetically engineered microorganisms for bioprocessing

CO7. Estimate kinetic parameters from raw fermentation data

BT 303: Database Management and Intellectual Property Rights

On successful completion, the students

CO1. Learn the basic concepts and appreciate the applications of database systems CO2.

Learn and apply databases for knowledge building

CO3. Are aware of their rights for the protection of their invention done in their project work

CO4. Are able to understand the norms for getting registration in our country and foreign countries of invention, designs and thesis or theory written by the students during their project work.

CO5. Have knowledge of patents, copy right, trademarks, designs in biotechnology

BT 304: **Advanced Genetics**

After successfully completing this course, students will be able to:

CO1: understand different types of Cytoplasmic inheritance.

CO2: analyze all practical cases of human clinical genetics

CO3: learn many diagnostic tools and techniques for the detection of human genetic disorders.

CO4: analyse different model systems in genetics with practical examples. CO5:

understand basic concepts of genetics of plant breeding.

BT 305: Bioinformatics

After successfully completing this course, students will be able to:

CO1: Understand the concept of bioinformatics.

CO2: Understand the applications of bioinformatics in research and industry CO3:

Perform Data retrieval from various databases

CO4: Perform and understand sequence alignments

CO5: Understand gene annotations

CO6: Concept of Molecular Modelling

CO7: Understand Phylogenetic analysis

CO8: Acquisition and visualization of molecular structures
CO9: Importance of Energy optimization of molecules.

CO10: Sequence and Structure based predictions- Simulation of Molecular interactions CO11:

Understand Structural Bioinformatics

BT 306: Exercises in Animal Biotechnology

After successfully completing this course, students will be able to:

CO1: learn how to establish primary culture from chick embryos.

CO2: learn the art of sub-culturing of different cell lines.

CO3: Analyse cell counts in different cell lines.

CO4: perform chromosome preparation from animal cells.

CO5: set up MTT assay for analyzing cell proliferation or cell survival.

BT 307: Exercises in Bioprocess Engineering

On successful completion, the students are able to design experiments

CO1. To enrich, isolate and purify a microbe showing a metabolic ability (production of primary

or secondary metabolite)

Semester 4

CO2. Grow the organism to produce the metabolite and detect its presence CO3.
Optimize production, assay the product, predict yield

BT 308: Exercises in Bioinformatics

After successfully completing this course, students will be able to:

CO1: Understand and use publicly available Databases like PubMed, NCBI, DDBJ, EMBL, UniProt, PDB

CO2: Retrieval of sequences and Sequence analysis by: BLAST, FASTA CO3:
IMGT database search for IG, TR and MH

CO4: Perform and understand Protein classification, domain identification, signature matching PFAM, Prodom, Prosite

CO5: Understand gene annotations
CO6: Visualization and study of 3D molecular structures – RASMOL, Swiss PDB viewer

CO7: Understand Phylogenetic analysis

CO8: Acquisition and visualization of molecular structures

CO9: Calculate Mutation and energy minimization of proteins- Swiss PDB viewer 1 8 Homology Modeling- Swiss PDB viewer, ExPAsy

CO10: Phylogenetic tree construction: Phylip, FIGTREE

CO11: Multiple Sequence Analysis: ClustalW (JalView), MUSCLE, T- Coffee

BT 401: Genomics and proteomics

On successful completion, the students:

CO4. Are aware of the current methodologies and trends in the field of genomics and proteomics

CO5. Obtain an overview and awareness of typical genomics and proteomics applications.

CO6. Describe and discuss the possibilities and advantages, and the complexity and drawbacks of various genomics and proteomics technologies

CO7. Compare traditional methods with emerging technologies

CO8. Suggest suitable approaches for specified applications and motivate the choice CO9. Speculate and argue about the future of genomics and proteomics technologies CO10. Evaluate scientific results in the field of genomics and proteomics

BT 404 (T+P) - Nanobiotechnology

On successful completion, the students

CO1. Account for interaction of biomolecules with surfaces of different chemical and physical species.

CO2. Account for production and the applications of various types of nanostructured materials.

CO3. Suggest methods for the design of enzyme reactors and other bioconjugates on surfaces and second carriers, and explain the carrier's influence on the activity of the biomolecule.

CO4. Give examples of/analyse applications within the field of bioelectronics and account for the basic principles they are based on

CO5. Practice chemical and biological methods of nanoparticle synthesis CO6. Learn and understand the methods for analysis of synthesized nanoparticles

BT 405: Animal Development and Stem Cell Technology

After successfully completing this course, students will be able to understand:

CO1: gametogenesis and fertilization in different animals.
CO2: early embryonic development in invertebrates and vertebrates. CO3: mechanisms of neurulation and the role of neural crest cells. CO4: isolation, characterization and maintenance of different stem cells. CO5: different techniques used for genetic manipulation of stem cells.

BT 406: Agricultural Biotechnology

After successfully completing this course, students will be able to:

CO1: Give suggestions on Crop improvement.
CO2: Explain Advantages of biotechnological methods over conventional methods of crop

improvement

CO3: Understand Use of bioreactors in plant production & Scale-up, Marker assisted selection

CO4: Explain virus indexing

CO5: Understand somaclonal and gametoclonal variations and their applications in crop improvement

CO6: Concept of future crops

CO7: Understand Transgenics in crop improvement – stress tolerance, risk assessment w.r.t. high and low impact crops

CO8: Discuss chloroplast manipulations for production of therapeutic proteins, vaccines, antibodies and increased production.

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