M. Sc. BIOTECHNOLOGY

Program Outcomes:

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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

MSc Biotechnology (Autonomous)

Course Outcomes:

Semester 1

22-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

22-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.

22-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.

22-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.

22-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.

22-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

22-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.

22-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.

22-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.

22-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

22-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

MSc II (2019 pattern) Semester 3

MBT 301 Animal and Stem Cell Technology

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

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.
CO6: Understand growth studies such as cell proliferation, cell cycle and mitosis.
CO7: Estimate the viability and cytotoxicity, cell transformation, microscopic examination and passage number

MBT 302: Bioprocess Engineering

On successful completion of the course, the students should be 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. Evaluate factors that contribute in enhancement of cell and product, process improvement through metabolic manipulations
CO5. Understand the rationale in medium optimization and formulation CO6. Understand the kinetics of death
CO7. Present knowledge about major metabolic pathways and those related to biofuels production from microbes
CO8. Analyse metabolic network and metabolic flux

CO9. Specify required technologies to effectively utilize genetically engineered microorganisms for bioprocessing
CO10. Estimate kinetic parameters from raw fermentation data

CO11. Understand and apply various techniques involved in the product isolation, purification and formulation

MBT 303: Bioinformatics and Biostatistics

On successful completion of the course, the students should be able to:

CO1: Understand and use publicly available Databases like PubMed, NCBI, DDBJ, EMBL, UniProt, PDB etc.
CO2: Retrieval of sequences and sequence analysis by: BLAST, FASTA CO3: Perform and understand Protein classification, domain identification, signature matching PFAM, Prodom, Prosite
CO4: Understand Phylogenetic analysis

CO5: Basic structure visualization using PDB/PMDB

CO6: Pharmacophore modelling and identification pharmacophore features

CO7: Understand basic principles of molecular docking besides its applications in drug designing.
CO8: Understand various biological variable and parameters pf statistical data display
CO9: Learn different curves and equations such as linear sigmoid, exponential, logistic, power and differential
CO10: Analyse power analysis and sample size calculation

CO11: Understand different data presentation models and hypothesis testing with type I and type II errors
CO12: Statistically design experiments and data analysis

CO13: Analyse variance table (ANOVA) and post hoc tests

CO14: Learn Tukey's test, Dunnet's test, Duncan's test and Mann-Whitney U test.

MBT 304: Laboratory Course IV (P)

On successful completion, the students should be able to learn and demonstrate:

CO1: Perform initiation of primary cell culture form chick embryo

CO2: Design and perform sub-culturing/establishment of cell line

CO3: Estimate the growth curve analysis of cell line
CO4: Demonstrate cryopreservation of animal cell

CO5: Perform and analyse chromosome spread preparation from animal cell line

CO6: Learn the importance and methods of screening and identification of a production strain from environmental samples.
CO7: Understand the need and methods of maintenance of the production strain
CO8: Learn the concept and methods of medium optimization for laboratory scale production
CO9: Learn Working of lab bench fermenter

CO10: Understand the method of recovery and assay of product formed

CO11: Learn the concept and process of solid state fermentation
CO12: Understand the working of fermentation process by visit to fermentation industry
CO13: Determine Karl-Pearson's coefficient of correlation from the given data.
CO14: Analyse variants on given data by ANOVA
CO15: Estimate measure of skewness and kurtosis of the given data
CO16: Perform t-test and Chi-square test
CO17: Students will be able to learn the access of various bioinformatics tools for their research purpose.
CO18: Students will learn to analyse the sequence alignment files using BLAST and CLUSTALW tools.
CO19: Students can perform phylogenetic analysis using Phylip or Mega 14 software.
CO20: Students can predict and visualize the protein structure and its various conformations using SWISS Model, MODELLER, CPH, EasyModeler and DeepView software.
CO21: Students will perform molecular docking and visualization using AutoDock and Pymol or Chimers tools.

MBT 305: Nano-Biotechnology (T)

On successful completion of the course, the students should be able to:

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

MBT 305: Nano-biotechnology (P)

On successful completion, the students should be able to learn and demonstrate:

CO1. Practice chemical and biological methods of nanoparticle synthesis

CO2. Learn and understand the methods for analysis of synthesized nanoparticles

CO3. Assess the toxicity of the synthesized nanomaterial in animal and microbial systems

CO4. Correlate the above skills for actual application of nanomaterials in various fields

Semester 4

BT 401: Genomics and proteomics

On successful completion of the course, the students should be able to:

CO1. Understand the current methodologies and trends in the field of genomics and proteomics
CO2. Obtain an overview and awareness of typical genomics and proteomics applications.
CO3. Describe and discuss the possibilities and advantages, and the complexity and drawbacks of various genomics and proteomics technologies
CO4. Compare traditional methods with emerging technologies

CO5. Suggest suitable approaches for specified applications and motivate the choice

CO6. Speculate and argue about the future of genomics and proteomics technologies

CO7. Evaluate scientific results in the field of genomics and proteomics

CO8. Concept clearance of protein expression proteomics, structural proteomics, and functional proteomics
CO9. Learn MALDI-TOF, ESI tandem, Ion trap, Peptide mass fingerprinting, protein protein interaction and protein DNA interaction
CO10. Evaluate, perform and analyse proteomics and protein microarrays, databases and allied bioinformatics tools
CO11. Apply the learned knowledge in health care, disease diagnosis, and identification and characterisation of novel proteins

MBT 402: Advanced Bio-analytical Techniques

On successful completion of the course, the students should be able to:

CO1: Analyse staining and visualization of cells and subcellular components

CO2: Understand different Electron microscopy techniques such as SEM, TEM, Confocal microscopy and single cell imaging

CO3: Learn detection of antigens using ELISA, RIA, Western bot and stem cell markers CO4: Analyse Flow cytometry, FISH, GISH and FACS

CO5: Estimate molecular structure determination using X-ray diffraction and X-ray crystallography, and molecular analysis using light scattering, Mass spectroscopy and LC-MS and Surface plasmon resonance methods

CO6: Understand and analyse different advanced chromatographic techniques of HPTLC, HPLC, GLC, GC, and Affinity chromatography

CO7: Learn IF and 2D electrophoresis, capillary electrophoresis, DGGE CO8: Learn advances in PCR technology, NGS and different automated microbial identification systems

CO9: Apply learned advanced PCR, spectroscopy and microscopy knowledge in clinical research and environmental laboratories

MBT 405: Pharmaceutical Biotechnology & Drug Designing

On successful completion, the students should be able to:

CO1. Learn and understand the pathogenesis in diseases such as diabetes, cancer, inflammatory disease and infectious diseases

CO2. Learn to identify the targets used for designing drugs against the above diseases

CO3. Learn the mode of action of drugs used for treatment of diabetes, cancer, inflammatory disease and infectious diseases

CO4. Understand the mechanisms involved in developing drug resistance against antibiotic and anticancer drugs

CO5. Judge the gravity of drug resistance on the scale of MDR, XDR and PDR and the alternate treatment methods to combat drug resistance

CO6. Learn the upstream and downstream processes for production of therapeutics at industrial scale

CO7. Learn and practice the molecular docking methods and apply molecular docking for high throughput screening

CO8. Learn about various software used for docking

CO9. Understand the biotechnological approaches for drug discovery and design CO10. Learn different concepts such as Pharmacodynamics, pharmacokinetics, drug metabolism, Drug tolerance & intolerance, drug allergy, drug induced side effects CO11. Learn and understand the principles of the new biotechnology based assays CO12. Understand the therapeutic potential of plant products

CO13. Learn the process of drug development from target identification to the launch of new drug in the market

CO14. Understand the importance of pre-clinical and clinical studies in the process of drug development

CO15. Understand the regulatory aspects involved in progressing a new drug to market

CO16. Learn the essentials of Indian drug regulations and pharmacopeia CO17. Understand the role of regulatory authorities in the process of drug development

MBT 406: Research Methodology & Scientific Communication

On successful completion, the students should be able to:

CO1: Students will be introduced to the applications of different types of research philosophies and research methods in solving issues related to the mankind. CO2: Students will understand the critical components required for designing a research proposal and consecutive work flow.

CO3: Students will learn the techniques and applications of primary as well as secondary data collection to conduct literature survey for various research programmes

CO4: Students will appropriately apply statistical software's and other computer programmes to process collected data.

CO5: Students will learn to understand organization of research data using various routinely laboratory practices.

CO6: Students will understand the principles and laws of ethics in conducting an authentic research and consequences of failing to follow.

CO7: Students will get familiar with different types of research practices like accessing and reading journals, calculating citation index and impact factor and many other. CO8: Students will understand importance of different modes of scientific communications in research practices.

CO9: Students will learn to write and present a report writing for successful completion of this programme.

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